EUROPEAN CENTRAL BANK

EUROSYSTEM

THE ROLE OF MONEY – MONEY AND MONETARY POLICY IN THE TWENTY-FIRST CENTURY

FOURTH
ECB CENTRAL BANKING
CONFERENCE
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INTRODUCTION

BY LUCREZIA REICHLIN, ECB

There is an apparent paradox in modern monetary policy theory. Although there is no doubt that monetarism gained an important intellectual victory after the great inflation of the 1970s and we can say that, citing a phrase used by Michael Woodford (Columbia University) at the conference whose proceedings are published in this volume, "we are all monetarists now", both in policy practice and in the academic mainstream, money has lost its central role. Most central banks in the world are now giving a prominent role to the price stability objective and most of them have adopted inflation targeting as a strategy (see the 2007 BIS Annual Report for a review of strategies at different central banks). Moreover, the new Keynesian model, the basis of quantitative analysis in the modern theory and practice of monetary economics, does not assign money a special role for the control of inflation. This model, although it implies the basic monetarist principle of the neutrality of money, determines the equilibrium price level without any reference to the money supply.

The fourth ECB central banking conference provided a floor for both academics and policy makers to explore this paradox. It is perhaps appropriate for the ECB to have chosen this subject for its fourth conference since, although it does not target monetary aggregates, the ECB is the only institution, amongst major central banks, to clearly attribute a special role to money under its "two pillar strategy".

The ECB has been much criticised, especially in academic quarters, for the monetary pillar aspect of its strategy, yet it is widely recognised that the ECB has been successful in maintaining price stability in the Euro area. Is practice ahead of theory, as the intervention of Otmar Issing (former ECB Board member) suggests? To find an answer to this broad question, the conference looks at the problem from different perspectives: analytical, empirical and historical, each of them discussed in a different session.

From the theoretical point of view, the question is whether the neglect of the special role of money in the basic neo-Keynesian model is due to its simplistic nature and, in particular, to the absence of credit frictions and the disregard of the role of financial markets.

From the empirical point of view, the question is what role the money pillar has actually played in the practical conduct of monetary policy in the Euro area. This is a difficult question to address given the short history of the institution, but it can, at least partly, be analysed on the basis of eight years of data.

If the history of the ECB is short however, there are other historical experiences that one can look at to shed light on the debate about the conduct of monetary policy. In the third session, Marc Flandreau (Institut d'Études Politiques de Paris) looks at two hundred years of European history to shed some light on why, over time institutions have adopted particular targets, while in the policy panel Chairman Bernanke (Federal Reserve), Deputy Governor Iwata (National Bank of Japan), Governor Zhou Xiaochuan (People's Bank of China) and President Trichet (ECB) examine the experience of their respective institutions.

Let me start from the analytical question of the role of money in the monetary transmission mechanism, the focus of the first session.

As mentioned, the macroeconomic model which represents the core consensus in modern macroeconomics and which is the basis of the models that are routinely calibrated or estimated at central banks to inform the policy process, does not give money a central role. In its most basic version it consists of three equations – an aggregate supply relation, an inter-temporal IS curve in which monetary policy affects aggregate expenditure via the expected short term real rate of return, and a third equation that closes the system by specifying monetary policy. Monetary policy is typically specified by means of a Taylor rule. In this model, inflation is determined by the inflation target of the central bank and by the gap between the natural rate of interest and the intercept adjustment in the Taylor rule. The model, although it has no explicit reference to the money supply, implies a determinate inflation rate and, given an initial price level, a determinate path for the price level. Although it implies that the equilibrium price level depends on monetary policy, and it is consistent with the principle of neutrality of money, the model carries no implication for how monetary policy should be conducted (see Woodford, 2008). From this, the paradox. We have a model that is fully in line with the basic principles of monetarism, but that does not imply that money should have a special role in the conduct of monetary policy.

From the monetarist side, several arguments have been put forward to advocate a special role for money in monetary policy implementation. Two of them are developed in the paper by Larry Christiano (Northwestern University), Roberto Motto (ECB) and Massimo Rostagno (ECB) (CMR from now on). Other monetarist arguments are empirical and based on two types of findings. First, the long-run correlation between money growth and inflation appears to be robust and remains clear across different policy regimes (e.g. Benati, 2005). Second, when the output gap and money growth are used as regressors in a forecasting model, money appears to be relevant for the long-run forecast while the output gap appears to be relevant for the short-run (Gerlach, 2004, Assenmacher-Wesche and Gerlach, 2006). The latter model is sometimes called the "two pillar" Phillips curve. The relevance of these findings for the role of money in monetary policy is addressed by Woodford's paper.

CMR's paper starts from the premise that inflation targeting is the best framework for the conduct of monetary policy, but it stresses that inflation stabilisation is not the exclusive focus of the inflation targeting framework. The authors argue that inflation targeting does not correspond to any particular strategy and that strategies differ according to how vigorously the central bank should respond to changing signals about aspects of the economy other than inflation, aspects that presumably matter for inflation expectations.

Starting from this premise, CMR provide two examples of why money and credit maybe useful for monetary policy even within the inflation targeting framework and on the basis of a model whose core structure is the same as that of the basic new-Keynesian model.

In the first example, the basic new-Keynesian model is modified so as to introduce a supply-side channel for monetary policy which creates the possibility of inflation expectations to lose their anchor even if monetary authorities react aggressively against inflation. When this happens, all variables in the model become unstable in a way that is not clearly linked to fundamental economic shocks. The central bank can avoid the danger of expectations becoming de-anchored by committing to directly control the variables that become unstable. Essentially this implies that monetary policy is run by following a standard Taylor rule, but with the "escape clause" that if in exceptional circumstances, inflation expectations become de-anchored, the central bank will control some key variables directly. According to the model, any variable would do. In practice, the authors argue that the only variable the central bank can control directly is the money supply and this therefore should be the variable that it commits to control under the escape clause. CMR's analysis leads to the empirical question of which monetary aggregate the central bank can control most effectively. For the Federal Reserve, this is understood to be non-borrowed reserves. It is debated whether M3, the much broader monetary aggregate that the ECB emphasizes under the monetary pillar, is the monetary aggregate which the central bank can more easily control. This is clearly an issue which requires further investigation.

CMR's second argument in favour of an important role for money in monetary policy starts from the observation that, when there is an expected future increase in productivity and the central bank follows a standard Taylor rule, the economy may experience "boom-bust episodes" where sharp movements in asset prices affect all nominal and real variables. The key point here is that nominal wage rigidity is transformed into real wage rigidity by an inflation targeting central bank. This point is developed analytically in Christiano, Ilut, Motto and Rostagno, 2007. When wages are rigid, inflation targeting reduces to real wage targeting and this interferes with the ability of real wages to allocate resources efficiently. Monetary authorities however, can avoid the booms and busts by responding to movements in credit variables since this makes the economy react to the shocks in a way that corresponds more closely to the efficient response.

Let me now turn to Woodford's paper. Woodford questions the relevance of the empirical findings on low frequency correlation and causality between money and inflation. He shows analytically that these findings are consistent with a model of inflation determination in which money is not a causal factor for inflation and does not help forecasting inflation. He shows that one can add a fourth equation, capturing money demand, to the basic three equations of the cashless neo-Keynesian model, but that the addition of this equation does not change the predicted equilibrium solution in the cashless case. However, given that solution, one can solve for the evolution of the money supply that should be associated with the equilibrium path of inflation derived in the cashless case.

When this model is used to make predictions about the co-movement of money and inflation, it can easily explain the long-run relations between money and inflation found in the literature and the findings of the "two pillar" Phillips curve.

More generally, Woodford's paper makes a point about optimal forecasting. Given the state space representation of a structural model, the best set of indicators to use to infer its state vector depends on which indicators are the most timely and which are the cleanest from measurement error. Money growth may be one of these indicators but whether it is or not, is an empirical question. In practice, central banks use a large set of indicators and there is no reason to exclude money from this set. The question of whether monetary aggregates are useful indicator variables was repeatedly discussed in various contributions and in the floor discussion.

The second session of the conference focused on the practice of monetary policy and on the empirical finding that can be drawn from it. The session was introduced by the paper by Björn Fisher, Michele Lenza, Huw Pill and Lucrezia Reichlin (FLPR from now on) all ECB, which analyses the empirical relevance of the monetary pillar in the experience of the ECB since its beginning. The paper presents both a narrative history of monetary analysis at the ECB and a quantitative evaluation of the models that had had a prominent role in the preparation of the ECB's inflation forecast that were based on money. The analysis is based on a rich data-set, containing both different vintages of data and vintages of models actually used by the staff in real time. This information allows the authors to describe the different challenges faced by monetary analysis over the years and the answers given by the ECB staff in terms of introducing some new tools and de-emphasizing some old ones. Beside the description of the evolution of the tools, the paper also assesses their value in evaluating the risks to price stability and their weight in the final policy decision.

The focus of the FLPR paper is on what the ECB has done and not on what the ECB should do. It shows that monetary analysis at the ECB is considerably broader than commonly thought by outside observers and that the reliance on mechanistic money demand equations was of less prominence than often expected by analysts outside the ECB. In particular, FLPR explain that money demand is not seen as the centrepiece of the framework for monetary analysis and that the latter does not rely on the stability of a particular specification of a money demand equation. In particular, it emerges that the overall assessment of risks for price stability produced for the Quarterly Monetary Assessment, the briefing note on monetary analysis produced for the Governing Council, is the result of analysis from a broad set of tools as well as judgement based on institutional and statistical analysis, and that the weight of these tools has changed over time. One of the contributions of the paper is the derivation of a qualitative index describing the staff's assessment of risks for price stability derived from this broad analysis and the comparison of this index with two indexes describing, respectively, the weight of monetary analysis and the weight of economic analysis in the Introductory Statement.

The findings of the FLPR paper clearly complement Governor Noyer's (Banque de France) comments on the papers in the first session. In discussing CMR and Woodford's papers, Noyer emphasizes that central banks should take into account well established empirical facts and not solely rely on specific models. One of the stylised facts from existing empirical experience is that money does matter in the preparation and determination of monetary policy in the euro area. Nevertheless, with reference to specific examples, he recognises that there are a number of challenging issues in the relevant signal extraction process, in particular in regimes that are not characterised by extreme developments in inflation and money growth.

Another perspective on the lessons that can be drawn from the practical experiences of different central banks is brought by the discussion of Philipp Hildebrand, Vice-Chairman of the Swiss National Bank (SNB), who describes the Swiss experience with regard to the role of money in monetary policy. His discussion relates to another theme discussed at the conference and touched on by Woodford's paper, FLPR's paper and Otmar Issing's contribution, namely whether monetary analysis (the second pillar) and economic analysis (the first pillar) should be kept as two separate exercises or combined in a unified framework. In the new framework introduced in January 2000, the SNB adopted a quantitative definition of price stability, regular inflation forecasts and 3 month LIBOR as the policy rate. The integration of monetary information and economic information in one inflation forecast was deliberately done to avoid the communication problems that, in Hildebrand's view, are associated with the two pillar approach of the ECB.

Hildebrand's discussion also opened another subject, addressed by the academic panel and discussed by both Issing's intervention and Lucas Papademos's key-note speech namely, the importance of monetary analysis for identifying imbalances in financial markets. With reference to the Swiss experience, Hildebrand stressed the importance of the role of money, beyond medium term inflation forecasts, in providing a link to asset prices and the identification of imbalances in financial markets that may influence inflation and output over horizons going beyond those generally analysed with standard models. He emphasizes that the importance of analysis of money and credit in monitoring financial market imbalances has grown over recent years, as a consequence of considerable increase in the importance of financial assets.

Reflecting on these themes, the academic panel broadened the discussion from money to financial variables in general, more specifically their importance in affecting macroeconomic performance. The discussion focused on equity prices (Jean-Pierre Danthine, Université de Lausanne), the role of leverage and balance sheet effects (Hyun Song Shin, Princeton University), asset price bubbles (Ricardo Caballero, MIT) and credit frictions and credit aggregates (Mark Gertler, New York University). Gertler listed a number of caveats in using credit aggregates to analyse boom-bust cycles in asset markets. For example, credit demand suffers from similar instability problems as does money demand. Due to the counter-cyclical demand for assets at the end of the cycles, credit aggregates are not good leading indicators to localise the business cycle.

Although the focus of Shin's paper is on the monetary transmission mechanism, and the possible role that banks' targets for their own leverage may play in this mechanism, his conclusions have a bearing on the usefulness of monitoring the money supply – as compared to other financial market aggregates – in the formation of monetary policy. Specifically, he shows that in a simple, bank credit dominated financial system, asset price booms and busts can be explained in terms of commercial banks' behaviour in targeting their own degree of leverage. Insofar as commercial banks' balance sheets are tied to the money supply, the monetary aggregates will be an important variable to monitor in such a system, in order to manage or avoid asset price booms and busts. However, in a more heterogeneous financial system, where a significant role is played by other types of leveraged institutions beside banks (e.g. hedge funds), monetary aggregates, may have less explanatory significance. Danthine underlines the importance of taking the housing market into account as real estate is more relevant than equities with regard to wealth. At the same time, given that in the euro area the correlation between markets in real estate is considerably less than that between stock market indices, the implications for monetary policy, when observing local housing bubbles, are less clear. Caballero suggests that we should not only look at house prices but that we should take a complete portfolio view. When analysing global imbalances, in his view, it is more important to look at the wealth side of the balance sheet.

Will the ECB integrate monetary analysis into a broader analysis of financial markets in the future? Both Issing and Papademos point in this direction. Should monetary analysis be integrated in a unified pillar as suggested by Woodford? This seems desirable in principle, say Issing and Papademos but difficult in practice, given the lack of a convincing model to integrate the real side and the financial side of the economy. The ECB is making efforts in this direction as is the academic community at large.

This volume presents several contributions focusing on the practical experience of central banks and on lessons from history.

The contribution by Issing explains the origin of the two pillar strategy at the ECB and the need not to break too abruptly with the monetary targeting approach of the Bundesbank in order to ensure the credibility of the new institution. In his paper, Marc Flandreau looks at the choice of the target in monetary policy from an historical perspective. The paper compares two "major eras of globalization": the period between 1797 and the World War II, when institutions had exchange rate targets, and the present, when institutions have, broadly, been pursuing inflation targets. The author argues that there are strong similarities between the issues discussed in the 19th century and those of today. Particularly relevant for the subject of this volume is the debate on the choice of the nominal anchor. Flandreau claims that true central banking emerged in 1797-1821 in England, at the time of the Bullionist debate over the quantity theory of money. He argues that the reason why the gold standard was chosen over the paper money regime was because it created problems of governance and monitoring. One interesting aspect of the paper is its focus on the interaction between the incentives and the constraints faced by the institutions. An important difference between the earlier historical period and today is the information set available to central banks. Nowadays, central banks have more resources and reliable measurements of prices are available. Therefore, the price level or the inflation rate can be used as a target whereas historically, when even reliable measures of inflation were unavailable, the only reliable target was the exchange rate. The significance of this point for the broader discussion on the relevance of money for monetary policy is that money might be useful as a good indicator variable, as stressed by Woodford's contribution.

The contributions from the policy makers, focusing on a variety of experiences, bring some interesting perspectives to the discussion. Chairman Bernanke takes an historical view and explains why the Federal Reserve has de-emphasized money in the conduct of monetary policy, describing how the financial innovations of the seventies and eighties induced instability in the relation between various monetary aggregates and other nominal variables. Bernanke however, makes the point that money growth may contain important information on future economic developments and that therefore monetary analysis is part of the eclectic modelling and forecasting framework used at the Federal Reserve. Deputy Governor Iwata explores the role of money in monetary policy implementation in three episodes in post-war Japan: the hyperinflation of the early seventies; the asset price bubbles of the eighties and the protracted deflation period which started in the mid-1990s. The third episode is particularly interesting for the theme of this volume. This is an occurrence of the "liquidity trap", where very low (zero) short-term interest rates are ineffective in stimulating output, and the traditional tools of monetary policy are thus seen not to work. Moreover, the linkage between monetary aggregates and income had largely disappeared since 1997, reflecting the increase in the precautionary demand for money. Still, Iwata argues, the ample provision of liquidity helped to prevent the economy from falling into a deflationary spiral and reinforced the duration effect of the zero interest policy. In describing the new framework adopted by the Bank of Japan in March 2006, the governor explains monetary aggregates are used to assess risk beyond the forecast period, a view very similar to that of the ECB. Governor Zhou Xiaochuan (People's Bank of China) describes the particular features of China's monetary policy, obviously different from those of mature market economies, and concludes that traditional monetary theory does not provide useful guidance to the challenges of monetary policy in the Chinese case. Finally, President Trichet (ECB) summarises the arguments that have led the ECB to give an important role to monetary analysis in the conduct of its monetary policy. Money, Trichet argues, is important for anchoring inflation expectations and monetary developments are useful indicators of imbalances in the financial system. The monetary pillar was crucial in stabilizing inflationary expectations in the Euro area at the time of the transition to the EMU. Now that the institution is mature monetary analysis is still useful in controlling for macroeconomic volatility, especially in a situation where uncertainty is higher than for other established central banks. Trichet also cites two episodes were the money pillar was actually crucial in driving the policy decision. The first is late 2002-end 2003, when the ECB did not follow the recommendation of loosening monetary policy to avoid risks of deflation on the basis of the signals coming from the sustained underlying monetary expansion.

The second is December 2005 when interest rates were increased in a situation where the economic recovery looked fragile, but where monetary analysis was indicating risks for price stability. In retrospect, Trichet explains, the recovery unfolding in the course of 2006 showed that the ECB was right.

Contributors to the conference and to this volume, expressed a range of views on the central question being discussed. Those views were sometimes in conflict but more often reflected contrasting nuances or points of emphasis. The ECB's two pillar strategy is inherently broad and, nothwistanding whether a single, unified pillar might or might not be desirable, the important central question will remain how to integrate diverse analytical perspectives – both in formulating and communicating monetary policy. The ECB was fortunate to have such an outstanding group of contributors to its fourth annual conference, and the contributions they made, reproduced in this volume, are helping today to consolidate and refine the models and tools used within the institution to analyse risks to price stability.

This volume certainly expresses different views from both academic and policy makers. Although it does not provide definite answers, it certainly brings food for thought to the discussion of monetary policy and more in general, to the classic topic of the role of money in the economy. The heterogeneity and quality of the contribution helped stir an exciting debate inside and outside the ECB that it is a clear sign of the transparency of our institution and our readiness to interact with different views.

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Jürgen Stark

OPENING ADDRESS

THE ROLE OF MONEY

BY JÜRGEN STARK, MEMBER OF THE EXECUTIVE BOARD OF THE ECB

Ladies and Gentlemen,

It is with great pleasure that I welcome you all to the fourth ECB central banking conference. We are all here to discuss the role of money and monetary analysis in the monetary policy process. This remains a crucial topic, of the utmost importance to all central banks, whatever strategy they pursue.

Bearing this in mind, I would like to thank all of you for coming to Frankfurt today to share with us your own experiences and views. The organisers have put together an impressive conference agenda and I trust that we will all benefit from the anticipated full and frank exchange on the issue.

The Swiss economist Jürg Niehans once characterised central banking as being "an art rather than a science". At least to me, this implies that we will never find definitive answers to the questions surrounding the design and implementation of monetary policy. Seeking an "absolute truth" is thus misguided. Rather, progress is made by identifying the key challenges and finding appropriate and practical responses that meet the circumstance of the time.

Let me come straight to the key substantive questions that I think we face at present. I see three main issues:

First, what is the information in monetary developments that is relevant for the conduct of a monetary policy aimed at the maintenance of price stability?

Second, how should the analysis of money be organised so that it is appropriately captured in the process leading to interest rate decisions?

Third, how should the monetary analysis and its implications for monetary policy be presented to the financial markets and public?

In the following remarks, I will try to address each of these issues in turn.

Let me start with the first question. Central banks throughout the world have been assigned responsibility for keeping inflation at low and stable rates. In the euro area, the Maastricht Treaty gave the ECB a clear mandate to maintain price stability. In my view, analysing monetary developments seems to be a necessary component of any monetary policy strategy aimed at preserving price stability. Since money serves to define the unit of account, monetary developments must be integral to the determination of the price level and thus the rate of inflation Or – as the Governor of the Bank of England recently usefully reminded us – without money there can be no inflation.[1]

1 King (2002).

One cannot deny that there are many practical problems in analysing and interpreting the relationship between money and prices. That has certainly been the ECB's experience in the euro area over the past eight years. Some of these practical challenges will be addressed in the discussions at this conference. But we should not let such practicalities obscure the fundamental principles of monetary economics and central banking that have prevailed, for good reason, over many decades and centuries.

To begin with, the long-run relationship between money and prices is perhaps one of the best documented results in all economics, in both the theoretical and empirical literature.[2] A multitude of empirical studies have confirmed the high correlation between monetary growth and inflation, both across time and across countries. Moreover, the evidence strongly supports the view that this correlation tends to increase when inflation and monetary dynamics are considered over longer horizons. Thus the theory implying that money and prices should move together at least over the longer run is strongly supported by the data.

Against this background, it would certainly be very unwise to ignore monetary developments and their connection to inflation dynamics in the conduct of monetary policy. This is widely recognised by central banks. The ECB organised a central bank workshop on monetary analysis in November 2000, the proceedings of which are available on the ECB's website.[3] This exercise confirmed that all leading central banks analyse monetary developments as part of the process underlying monetary policy decisions – and it seems to me for good reason.

Unfortunately, this has not been recognised in the public debate. At least in Europe, a lot of effort has been expended in addressing the rather trivial question of whether monetary analysis should play a role in monetary policy decisions. Such effort would have been better focused on the more meaningful issue of how to conduct a monetary analysis that will support monetary policy decisions aimed at the maintenance of price stability. In this context, I look forward to the presentations of Prof. Woodford and Prof. Christiano on this issue, which look set to stimulate a lively debate.[4]

The question of how to analyse money naturally brings me to the second issue I have identified. Before describing how we have organised the monetary analysis at the ECB, let me briefly recall the roles that such analysis can be expected to play in disciplining the monetary policy process.

First, assigning a prominent role to money is a useful tool to underpin the medium-term orientation of monetary policy. Taking policy decisions and evaluating their consequences only on the basis of the short-term indications stemming from the analysis of economic variables would be mis-guided. Assessing the trend evolution of monetary aggregates and liquidity allows a

2 Lucas (1996); McCandless and Weber (1995).
3 Klöckers and Willeke (2001).
4 Woodford (2008); Christiano, Motto and Rostagno (2008).

central bank to broaden its analysis. In particular, it often helps central banks to see beyond the transient impact of the various shocks hitting the economy. Therefore, it avoids setting monetary policy on an incompletely informed – and thus potentially destabilising – course.

Second, evaluating the money stock and liquidity situation helps to ensure that central banks look at developments in the level of key nominal variables, and not just their rate of change. As several recent academic papers have emphasised, maintaining such an orientation can help to stabilise private sector inflation expectations and thus serve the maintenance of price stability over the medium term. This literature is a restatement of the traditional view that money can serve as a "nominal anchor" for the economy.

Monetary policy "targets" – or, more broadly speaking, monetary policy strategies – should be understood in their specific context and in the light of the historical evolution of the institution that designs and announces them. Tomorrow's presentation by Prof. Flandreau will emphasise this point.[5] With this in mind, we should recall that the start of Monetary Union in 1999 was an entirely novel event and, partly as a consequence, had to address considerable uncertainties. The ECB, as a brand new central bank, lacked an established track record of success in maintaining price stability and therefore had to inspire confidence and build its own credibility. In this context, it was imperative that the ECB established a policy framework – a strategy – to govern and guide its actions, so as to reassure the general public in the euro area.

The ECB's monetary policy strategy announced in October 1998 explicitly recognised the importance of monetary analysis by assigning "a prominent role to money". More precisely, the analysis of risks to price stability is based on two complementary perspectives on the determination of the risks to price developments.[6]

The first perspective is aimed at identifying the economic shocks driving the business cycle and thus embodies a thorough assessment of the cyclical dynamics of inflation. This is the "economic analysis".

The second perspective the "monetary analysis" analyses the monetary trends associated with price developments over the medium to longer term. The monetary analysis mainly serves as a means of cross-checking, from a medium to long-term perspective, the short to medium-term indications for monetary policy coming from the economic analysis.

In sum, the so-called two pillar approach embodied in the ECB's strategy is a practical framework designed to ensure that no relevant information is lost in the assessment of risks to price stability. It ensures that appropriate attention is paid to different perspectives on the inflation process and the cross-checking of

5 Flandreau (2008); Issing (2005).
6 ECB (2003).

information provided by each of them. I am sure that Otmar will elaborate on this point further tomorrow morning.[7]

In 2003, the Governing Council of the ECB evaluated its monetary policy strategy, drawing on the experience of the first four years of Monetary Union to assess the performance of its various elements. Given the positive experience with the strategy, the prominent role for money was confirmed. At the same time, it was deemed useful to emphasise the medium to longer-term orientation of the monetary analysis.

Since the evaluation of the strategy, considerable progress has been made in various fields of monetary analysis which, overall, has tended to support the approach adopted by the ECB since 1999.

First, a number of studies have used statistical filters to decompose monetary growth into its low frequency – that is to say, its persistent or, more loosely, "longer-term" – component and higher frequency components. Such exercises confirm the relationship between monetary growth and inflation and demonstrate that it holds more strongly at low frequencies rather than high frequencies.[8] In other words, the relationship between money and prices is stronger between the trend-like developments than fluctuations over the business cycle or from one month to the next. These findings are, therefore, supportive of the conclusions of the evaluation of the strategy, in particular the clarification that monetary developments were more relevant for policy-making over medium to longer horizons.

In parallel, a second strand of the literature has attempted to augment the "standard" or "traditional" money demand equations for euro area M3 with various measures of financial and economic uncertainty in an attempt to model explicitly the portfolio shifts that threatened the stability of money demand between 2001 and 2003. As discussed in the paper prepared for this conference by ECB staff, such models have tended to support the conclusions drawn in real time by the ECB's analysis of the portfolio shifts phenomenon.[9]

A third body of research has focused on deepening the analysis of the out-of-sample indicator properties of money in the euro area. This work builds on ECB staff analysis published in 2001, which has proved influential in the presentation of the monetary analysis in recent years. In essence, these papers suggest that the indicator properties of money estimated on the basis of pre-Monetary Union data have been preserved since 1999. They also suggest that focusing exclusively on the official M3 series leads to a marked deterioration of information content of money with the onset of the portfolio shifts episode in 2001. However, when

7 Issing (2006).
8 Neumann and Greiber (2004); Bruggeman, Camba-Mendez, Fischer and Sousa (2005); Gerlach and Assenmacher-Wesche (2005); Pill and Rautanen (2005).
9 Carstensen (2004); Greiber and Lemke (2005); ECB (2005); Avouyi-Dovi, Brun, Dreyfus, Drumetz, Oung and Sahuc (2006).

the evaluation is based on the M3 series corrected in real time for the estimated impact of portfolio shifts, the information content of money is preserved.[10]

Fourth, a number of papers have attempted to incorporate money and credit variables into state-of-the-art dynamic stochastic general equilibrium (DSGE) models of the economy, by introducing a variety of so-called "financial frictions" into these models. These models are admittedly elegant from a theoretical point of view. They are based on fully developed micro-foundations and have the potential to offer a behavioural interpretation of developments in the monetary aggregates beyond that which is feasible with the conventional money demand frameworks. However, their practical use in the monetary policy process in general, and for monetary analysis in particular, is only starting and deserves further investigation.[11]

Finally, a number of papers have shown that an analysis of money and credit developments can provide advance information of the build-up of asset price misalignments. Historically, asset price "bubble" episodes which have been accompanied by strong money and credit dynamics have often been followed by "crashes" involving large downturns in output. Monitoring money and credit aggregates can, therefore, help to identify the build-up of financial imbalances.[12]

Without anticipating all the conclusions that, together, we will draw from the body of very stimulating work to be presented at this conference, let me share with you, albeit in synthetic form and yet still preliminary, my reading of this impressive body of literature written since the Governing Council's evaluation of the ECB's strategy.

Overall, this work supports the view that analysing money is important for monetary policy decisions. But it also suggests that integrating the monetary and economic analysis into a single analytical framework remains a difficult challenge. Attempts to do so – exemplified by the DSGE models mentioned above – although welcome and necessary, have yet to replicate the richness of the ECB's approach to monetary analysis and hence to monetary policy over the past eight years. The ECB's monetary policy strategy – with its two pillar structure – thus remains a practical and workable response to the challenge facing central banks in ensuring that the information in monetary developments is appropriately captured in the policy process.

Turning to the third issue that I mentioned at the outset, we should recognise that the complexity of conducting monetary analysis in real time runs the risk of making that analysis difficult for the public to understand and interpret. At the ECB, we have always striven to be transparent in the presentation of the monetary analysis and its role in monetary policy decisions. But such

10 Nicoletti Altimari (2001); Hofmann (2006); Lenza (2006).
11 Lopez Salido, Nelson and Andres (2004); Christiano, Motto and Rostagno (2004).
12 Borio and Lowe (2002); Detken and Smets (2004); Adalid and Detken (2006).

transparency has sometimes come at the expense of complexity, which may occasionally have obscured the key policy-relevant message. How to communicate the results of the monetary analysis in a simple – but not simplistic – way is a topic that deserves further research and will be central in maintaining the importance of monetary developments in the presentation of monetary policy decisions.

We have often been confronted with the question of how much "weight" is assigned to the monetary analysis in the Governing Council's interest rate decisions. Such a question is typically motivated by the observed negative relationship between policy interest rates and monetary growth in the euro area, especially in the period between 2001 and 2004. Addressing this critique provide an insight into the communication challenges faced by the monetary analysis.

As the paper by Fischer, Lenza, Pill and Reichlin demonstrates, assigning a "weight" to the monetary analysis is a simplistic and misleading way of characterising how such analysis has influenced monetary policy.[13] The role played by money in interest rate decisions has varied over time, as the clarity and reliability of the policy-relevant signal coming from monetary developments has fluctuated, both in its own terms and relative to the signal stemming from the economic analysis. What I can assure you is that the Governing Council has thoroughly engaged in the analysis of monetary issues and has not simply dropped money from its deliberations when the signals offered by the monetary analysis were puzzling or discomforting. Throughout, the Governing Council has fulfilled its commitment, as embodied in the ECB's monetary policy strategy, to analyse closely and assess their relevance for interest rate decisions, while eschewing any mechanical response to the evolution of a particular aggregate. This was made clear already, when the strategy was presented to the public in 1998.

This brings me to my final point. In economic and monetary research, it is necessarily the case that new and more sophisticated methods are continuously being developed and applied in various areas, both related and unrelated to monetary analysis. Indeed, scientific progress is possible because new research addresses the shortcomings of previous models or analysis. The academic journals most typically reward novelty and increased sophistication.

However, as central bankers, we often recognise that these new methods, techniques and models are not without their own problems and indeed, often share many of the problems of the "old" or more traditional methods. In this context, we ought to keep in mind that the new methods, techniques and models used should respect those fundamental principles of monetary economics and central banking that have survived the test of time.

13 Fischer, Lenza, Pill and Reichlin (2008).

The issue is not so much to discard "old" methods in favour of "new" ones, but rather to harness new methods to serve the role of monetary analysis in shaping monetary policy to maintain price stability. Monetary analysis is a field that has proven essential to central banks for a long time. We, therefore, need to invest further in it in the future, making the best use of the new tools without neglecting the trusted principles.

Against this background, we look forward to a stimulating two days of discussion and debate. I trust that you will also benefit and take new ideas and approaches back to academia, central banks and institutions. I wish us well in our endeavours, both over the next few days and beyond.

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Harald Uhlig, Lawrence J. Christiano, Roberto Motto,
Massimo Rostagno, Michael Woodford, Christian Noyer
and Gertrude Tumpel-Gugerell (from left to right)

SESSION 1

HOW IMPORTANT IS THE ROLE OF MONEY IN THE MONETARY TRANSMISSION MECHANISM?

TWO REASONS WHY MONEY AND CREDIT MAY BE USEFUL IN MONETARY POLICY[1]

BY LAWRENCE J. CHRISTIANO, NORTHWESTERN UNIVERSITY
ROBERTO MOTTO, ECB
MASSIMO ROSTAGNO, ECB

ABSTRACT

We describe two examples which illustrate in different ways how money and credit may be useful in the conduct of monetary policy. Our first example shows how monitoring money and credit can help anchor private sector expectations about inflation. Our second example shows that a monetary policy that focuses too narrowly on inflation may inadvertently contribute to welfare-reducing boom-bust cycles in real and financial variables. The example is of some interest because it is based on a monetary policy rule fit to aggregate data. We show that a policy of monetary tightening when credit growth is strong can mitigate the problems identified in our second example.

1 INTRODUCTION

The current consensus is that money and credit have essentially no constructive role to play in monetary policy. When Michael Woodford first suggested this possibility before a large gathering of prominent economists in Mexico city in 1996, the audience was mystified (Woodford, 1998). The consensus at the time was the one forged by Milton Friedman, according to which inflation is "always and everywhere a monetary phenomenon". The pendulum has now swung to the other extreme, in the form of a new consensus which de-emphasizes money completely. We briefly review the reasons for this shift, before presenting two examples which suggest the pendulum may have swung too far.

The experience of the 1970s shows that the inflation expectations of the public can lose their anchor and that when this happens the social costs are high. To stabilize inflation expectations, monetary authorities have evolved versions of the following policy: When the evidence suggests that inflation will rise above some numerical objective, the monetary authority responds proactively by tightening monetary policy. Monetary policy is loosened in response to signs

1 We would like to thank Claudio Borio, Dale Henderson, John Leahy, Andy Levin, Christian Noyer, Lars Svensson and Harald Uhlig for helpful discussions. The views expressed in this paper do not necessarily reflect the views of the European Central Bank.

that inflation will fall below the numerical objective.[2] A rough characterization of such a policy expresses the interest rate, R_t, as a function of expected inflation, π^e_{t+1}, and other variables, x_t:

$$R_t = \rho R_{t-1} + (1 - \rho) \left[\alpha_\pi \left(\pi^e_{t+1} - \pi^*_t\right) + \alpha_x x_t\right]. \tag{1.1}$$

Here, π^*_t denotes the monetary authority's inflation target. When $\rho > 0$, policy acts to minimize large movements in the interest rate from one period to the next.[3] Although we have included only the one-period-ahead forecast of inflation in this rule, what we have to say is also applicable in the more plausible case where central bank policy is driven by the longer-term outlook for inflation. We will refer to the rule as a Taylor rule though, strictly speaking, that is not accurate since the rule John Taylor discusses reacts only to current inflation and output. We chose to include expected inflation in (1.1) to account for the fact that, in practice, monetary authorities must anticipate economic developments in advance, since policy actions may have very little immediate impact and thus may take time to exert their influence on the economy.[4] We do not mean to suggest that any central bank‘s policy is governed by a rigid rule like (1.1). We think of (1.1) only as a rough characterization, one that allows us to make our points about the role of money and credit in monetary policy.

There are two reasons for the current consensus that money and credit have essentially no role to play in monetary policy. First, these variables are not included in (1.1). Second, monetary theory lends some support to the notion that money demand and supply are virtually irrelevant in determining the operating characteristics of (1.1). For intuition, recall the undergraduate textbook IS-LM model with an aggregate supply side. In this model, money balances do not enter the spending decisions underlying the IS curve, and they do not enter the considerations determining the supply curve. If monetary policy is characterized by an interest rate rule like (1.1), then the equilibrium of the model is determined independently of the LM curve.[5] That is, the operating characteristics of (1.1)

2 In practice, monetary policy strategies differ according to how vigorously the central bank responds to changing signals about future inflation, and how much weight it assigns to other factors, such as the state of the real economy. Strategies also differ according to how heavily they make use of formal econometric models of the economy. In recent years, there has been much progress towards integrating formal models into the design of monetary policy. For example, Giannoni and Woodford (2005), Svensson and Tetlow (2005), and Svensson and Woodford (2005) propose replacing (1.1) by the optimal policy relative to a specified objective function.

3 For a rationale, see Woodford (2003b).

4 This point was stressed by Svensson (1997).

5 The notion that money balances literally do not interact with consumption and investment decisions is implausible. Most theories of money demand rest on the premise that money balances play a role in facilitating transactions and that money balances therefore do interact with other decisions. However, experience has shown that those theories also imply that the role of money in consumption, investment and employment dedisions is quantitatively negligible (See, for example, McCallum, 2001.) That is, the insight based on the textbook macro model that one can ignore money demand and money supply when monetary policy is governed by (1.1) is a very good approximation in a broad class of models.

can be studied without taking a stand on the nature of money demand or money supply.[6]

In what follows we present two examples in which a strategy such as (1.1) is not successful at stabilizing the economy. In each example outcomes are improved if: (a) the central bank carefully monitors monetary indicators and (b) it reacts or threatens to react to such indicators in case inflation expectations or asset price formation get out of control. By "monetary indicators" we mean aggregates defined both on the liability (i.e. money proper) and the asset side (i.e. credit) of monetary institutions. After presenting the examples, we provide some concluding remarks. An appendix discusses our first example in greater detail.

2 FIRST EXAMPLE: ANCHORING INFLATION EXPECTATIONS

Our first example illustrates points emphasized by Benhabib, Schmitt-Grohe and Uribe (2001, 2002a,b), Carlstrom and Fuerst (2002, 2005) and Christiano and Rostagno (2001) (BSU-CF-CR). Although (1.1) may be effective at anchoring inflation expectations in some models, the finding is not robust to small, empirically plausible, changes in model specification. This is of concern because there is considerable uncertainty about the correct model specification.

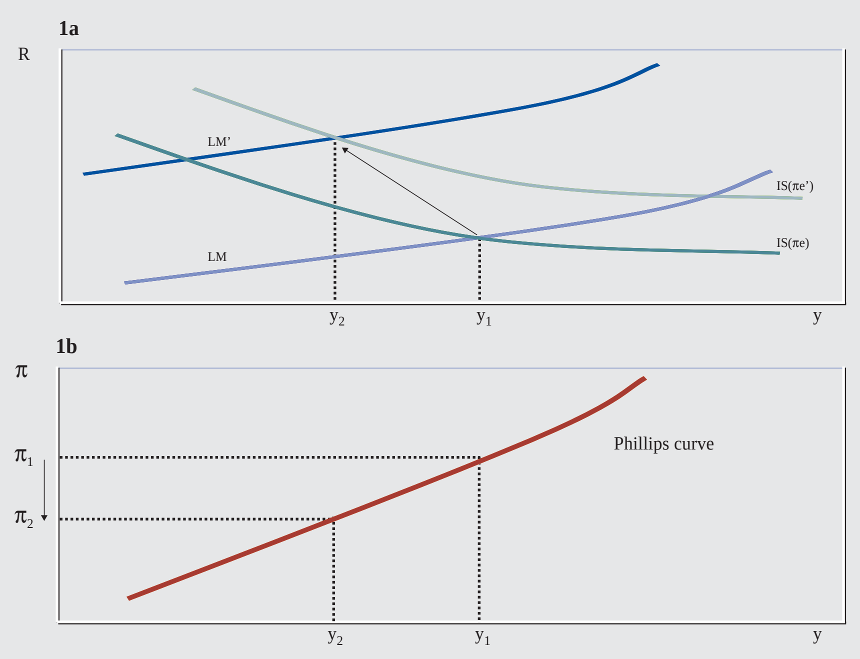
We begin by discussing why (1.1) is effective in anchoring inflation expectations in the simple New-Keynesian model.[7] We then introduce a slight modification to the environment which captures in spirit of many of the examples in BSU-CF-CR. The modification is motivated by the evidence that firms need to borrow substantial amounts of working capital to finance variable inputs like labor and intermediate goods.[8] This modification introduces a supply-side channel for

6 A third reason that is sometimes given for ignoring money demand is that money demand is unstable. This overstates the instability of money demand and understates the stability of non-financial variables. A simple graph of the money velocity based on the St. Louis Fed's measure of transactions balances, MZM, against the interest rate shows a reasonably stable relation. At the same time, the US consumption to output ratio suddenly began to trend up since the early 1980s, and is now about 6 percentage points higher than it used to be. This change in trend almost fully explains a similar change in trend in the US current account. No one would suggest not looking at the current account, consumption or GDP because of this evidence of instability.

7 As Benhabit, Schmitt-Grohe and Uribe (2001) note, even in this model there is a global problem of multiple equilibria. In addition to the "normal" equilibrium, there is another equilibrium in which the interest rate drops to zero. However, an escape clause strategy in which the monetary authority commits to deviating from (1.1) to a policy of controlling the money supply in the event that the interest rate drops to zero eliminates this equilibrium in many models. This observation reinforces our basic point that money may have a constructive role to play in monetary policy. For further discussion, see Christiano and Rostagno (2001).

8 See, for example, Christiano, Eichenbaum and Evans (1996) and Barth and Ramey (2002). The existence of a supply-side channel for monetary policy is potentially an explanation for the "price puzzle", the finding in structural vector autoregressions that inflation tends to rise for a while after a monetary tightening (see Christiano, Eichenbaum, and Evans, 1999). Additional evidence on the importance of the supply-side channel is provided in the appendix.

Chart 1 IS-LM model



monetary policy and creates the possibility for inflation expectations to lose their anchor. This is so, even if monetary policy acts aggressively against inflation by assigning a high value to α_π in (1.1). The resulting instability affects all the variables in the model, including money and credit. A commitment by the monetary authority to monitor these variables and to react when they exhibit instability that is not clearly linked to fundamental economic shocks (including money demand shocks) keeps inflation expectations anchored within a narrow range. In effect, the strategy corresponds to operating monetary policy according to (1.1) with a particular "escape clause": a commitment to control money and credit aggregates directly in case these variables misbehave. The strategy works like the textbook analysis of a bank run. The government's commitment to supply liquidity in the event of a bank run eliminates the occurrence of a bank run in the first place, so that government never has to act on its commitment. Similarly, the monetary authority's commitment to monitor money growth and reign it in if necessary implies that inflation expectations and thus money growth never get out of line in the first place.

Here, we provide an intuitive discussion. A formal, numerical analysis is presented in the appendix. Suppose that the economy is described by the IS-LM model augmented by a supply curve, as in Chart 1. On the vertical axis of Chart 1a, we display the nominal rate of interest and on the horizontal axis we display aggregate real output, *y*. Note that the IS curve is a function of expected inflation because the spending decisions summarized in that curve are a function of the real interest rate. The LM curve summarizes money market equilibrium in the usual way. Chart 1b displays the supply side of the economy, in which higher output is associated with higher inflation. The curve captures the idea that higher output raises pressure on scarce resources, driving up production costs and leading businesses to post higher prices.

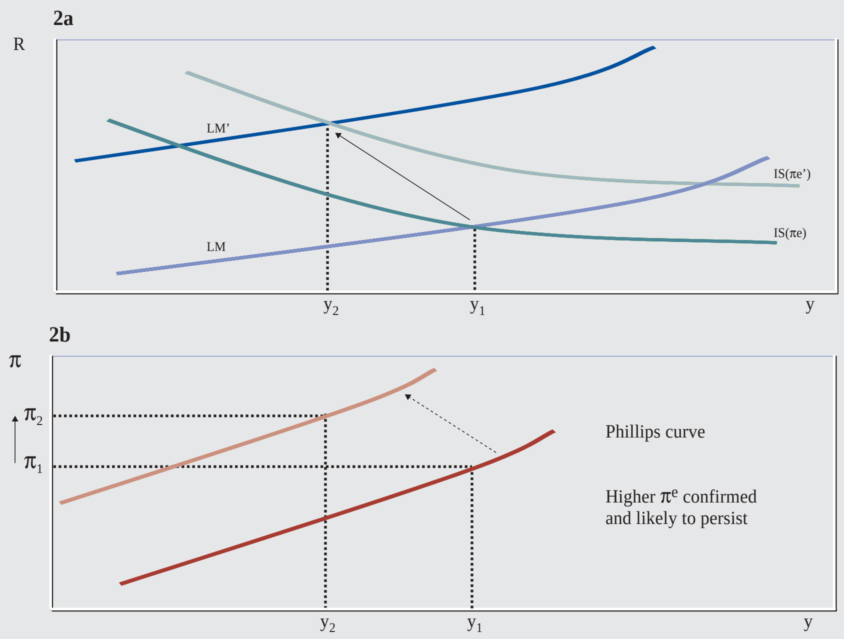
Suppose that monetary policy responds to a one percentage point rise in expected inflation, π^e, by raising the nominal rate of interest by more than one percentage point (the “Taylor principle”). It is easy to see that a monetary authority which follows the Taylor principle in the simple model of Chart 1 succeeds in anchoring the public‘s expectations about inflation. In particular, suppose a belief begins to circulate that inflation will rise, so that π^e jumps. The monetary authority reacts by reducing the money supply so that the nominal rate of interest rises by more than the rise in π^e (see Chart 1a). The resulting shift up in the LM curve causes output to fall from y_1 to y_2. The fall in output, by reducing costs, leads to a fall in inflation (Chart 1b). Thus, in the given model and under the given monetary policy, a spontaneous jump in expected inflation produces a chain of events that ultimately places downward pressure on actual inflation. Under these circumstances, a general fear that inflation will rise could not persist for long. Thus, inflation expectations are anchored under the Taylor principle in the given model.

To see how crucial the Taylor principle is for anchoring inflation expectations in the model of Chart 1, suppose the monetary authority did not apply the Taylor principle. That is, the monetary authority responds to a one percent rise in expected inflation by raising the nominal rate of interest by less than one percent. In terms of Chart 1, this means that the monetary authority shifts the LM curve up by less than the rise in π^e. The resulting fall in the real rate of interest implies an increase in spending. The rise in spending leads to a rise in output and, hence, costs. The rise in costs in turn places upward pressure on inflation. In this way a rise in expected inflation initiates a chain of events that ultimately produces a rise in actual inflation. The outcome is that inflation expectations are self-fulfilling and have no anchor.

Now consider the modification to the economy that we mentioned in the introduction. In particular, suppose that when the nominal interest rate is increased, the output-inflation trade-off shifts up (see Chart 2b). This could occur because an increase in the interest rate directly increases the cost of production by raising expenses associated with financing inventories, the wage bill and other variable costs.[9] Prices might also rise as a by-product of the tightening in balance sheets that occurs as higher interest rates drive asset values down. Suppose, as before, that inflation expectations rise and the monetary authority follows the Taylor principle. The monetary authority shifts the LM curve up by more than the amount of the increase in π^e, so that the real rate of interest rises. This leads to a fall in spending. If the supply curve did not shift, then our previous analysis indicates that actual inflation would fall and the higher π^e would not be confirmed. But, under the modified scenario tightening monetary conditions produce such a substantial rise in costs that actual inflation rises. In this scenario, a rise in inflation expectations produces a chain of events

9 We cite evidence in the appendix which indicates borrowing for variable inputs may be substantial in practice.

Chart 2 IS-LM model



that ultimately results in higher inflation. The outcome is that, despite the application of the Taylor principle, inflation expectations have no anchor.

It is asking too much of our simple diagrams to use them to think through what happens over time when inflation expectations have lost their anchor. For this, an explicit dynamic equilibrium model is required. The analyses reported in BSU-CF-CR do this, and there we see that when things go wrong all economic variables fluctuate over time in response to non-fundamental economic shocks. Among these variables is the money supply. It is shown that a monetary policy which commits to deviating from the Taylor rule as soon as money is observed to respond to non-fundamental shocks in effect anchors inflation expectations.[10] To implement this policy requires a public commitment to monitor the money supply carefully and to expend resources analyzing the reasons for its fluctuations. Paradoxically, in practice it will seem as if the monitoring policy is pointless.

A concluding remark about this example deserves emphasis. According to the theoretical analyses that support the idea of an escape clause strategy, *all* variables in the economy exhibit instability when inflation expectations lose their anchor. The models imply that an escape clause strategy which abandons (1.1) in favor of stabilizing any economic variable – not necessarily money per

10 It is possible to construct examples in which even this policy will not anchor expectations, though these examples seem unlikely. For further discussion, see Christiano and Rostagno (2001).

se – works equally well to anchor inflation expectations. When we conclude that the right variable to control in the event that the escape clause is activated is money, we introduce considerations that lie outside the models. Economic models assume that the monetary authority has perfect control over any one variable in the economy with its one policy instrument. It can control money as easily as the current account or Gross National Product. In reality, there is only one variable that the monetary authority controls directly and credibly, and that is money. All other variables that it may attempt to control – the interest rate, the current account, etc. – can only be controlled indirectly, by virtue of the monetary authority's control of the money supply.[11] What is crucial for the escape clause strategy to work is that the central bank be able to credibly control whatever variable it commits to control in the event that the escape clause is activated. In practice, there really is only one such variable: money.

3 SECOND EXAMPLE: ASSET MARKET VOLATILITY

Our second example summarizes the analysis of Christiano, Ilut, Motto and Rostagno (2007). This example builds on the analysis of Beaudry and Portier (2004, 2006), which suggests that a substantial fraction of economic fluctuations may be triggered by the arrival of signals about future improvements in productivity. We find that when such a signal shock is fed to a standard model used in the analysis of business cycles, it produces patterns that in many ways resemble the boom-bust cycles that economies experience periodically.[12] In the model, the response of investment, consumption, output and stock prices greatly exceed what is socially efficient. The excess volatility reflects two features of the model: (i) there are frictions in the setting of wages and (ii) monetary policy focuses too narrowly on inflation. The findings should be a cause for concern, because there is substantial evidence that wage frictions are important and because the monetary policy rule used in our analysis is a version of (1.1) in which the parameters have been estimated using aggregate data. Because the nominal wage rate is relatively sticky in the model, an overly narrow focus on inflation stabilization in effect reduces to real wage stabilization. Such a policy produces bad outcomes because it prevents the efficient allocation of resources. Although this is well known as a matter of principle (see, e.g., Erceg, Henderson and Levin, 2000), what is less well known is that a policy rule like (1.1) can make the monetary authorities unwitting participants in boom-bust episodes.[13] Although additional empirical research is necessary, there is indirect evidence consistent with the view that a narrow focus on inflation stabilization may produce instability. For example, Cecchetti and Ehrmann (2002) present evidence that suggests that adopting an inflation targeting monetary regime may increase output volatility.

11 The monetary aggregate directly controlled by the US Federal Reserve is the nonborrowed reserves of banks.

12 We use a variant of the model proposed in Christiano, Eichenbaum and Evans (2005) and further analyzed in Smets and Wouters (2003, 2007).

13 See also Borio and Low (2002).

There is a long tradition which locates the cause of boom-bust cycles in excessive credit creation. A recent review of this tradition, and some evidence to support it, is provided in Eichengreen and Mitchener (2004).[14] Motivated by this strand of literature, we introduce credit into our model. We do this by introducing frictions into the financing of capital, following the lead of Bernanke, Gertler and Gilchrist (1999). We find that when (1.1) is amended to include credit growth, then the response of the economy to the signal shock much more closely resembles the efficient response. We find that adding credit to (1.1) also brings the model response to other shocks more closely in line with the efficient response.[15]

We now summarize the analysis with a little more detail. We begin by briefly describing the baseline model used in the analysis. We then turn to the results.

3.1 MODEL

To accommodate frictions in price-setting, we adopt the usual Dixit-Stiglitz specification of final good production:

$$Y_t = \left[\int_0^1 Y_{jt}^{\frac{1}{\lambda_f}} dj \right]^{\lambda_f}, \ 1 \leq \lambda_f < \infty, \tag{3.1}$$

where Y_t denotes aggregate output and Y_{jt} denotes the j^{th} intermediate good. Intermediate good j is produced by a price-setting monopolist according to the following technology:

$$Y_{jt} = \begin{cases} \epsilon_t K_{jt}^{\alpha} \left(z_t l_{jt} \right)^{1-\alpha} - \Phi z_t & \text{if } \epsilon_t K_{jt}^{\alpha} \left(z_t l_{jt} \right)^{1-\alpha} > \Phi z_t \\ 0, & \text{otherwise} \end{cases}, \ 0 < \alpha < 1, \tag{3.2}$$

where Φz_t is a fixed cost and K_{jt} and l_{jt} denote the services of capital and homogeneous labor. Capital and labor services are hired in competitive markets at nominal prices, $P_t r_t^k$, and W_t, respectively. The object, z_t, is the deterministic source of

14 Several countries refocused their monetary policy more narrowly on inflation by formally adopting inflation targeting in the 1980s and 1990s. To isolate the impact of this policy change on output volatility, one has to disentangle the effects of the change from the effects of all the other factors that produced a moderation in volatility in this period (the 'Great Moderation'). Cecchetti and Ehrmann (2002) do this by computing the standard deviation of output growth in countries that adopted inflation targeting and in countries that are non-targeters. They report that the average volatility across non-targeters in the 1985-1989 period and the 1993-1997 period is 10.12 and 7.41, respectively. The analogous results for targeters is 7.47 and 6.92 (see their Table 1). Thus, targeters experienced a change of -.55 and non-targeters achieved a change of -2.71. Assuming the policy regime is the only difference between targeters and the targeters, one infers that inflation targeting per se increased volatility by 2.16 percentage points. Presumably, this is an over estimate. But, if the correct number was only half as large, it would still be cause for concern.

15 We considered shocks to the cost of investment goods, a cost-push shock, a shock to actual technology, a shock to the discount rate and a shock to the production function for converting investment goods into installed capital.

growth in the economy, with $z_t = \mu_z z_{t-1}$ and $\mu_z > 1$. The other technology factor, ε_t, is stochastic. The time series representation of ε_t is specified as follows:

$$\log \epsilon_t = \rho \log \epsilon_{t-1} + \varepsilon_{t-p} + \xi_t, \tag{3.3}$$

where ε_t and ξ_t are uncorrelated over time and with each other. Here, ε_t is a "news" shock, which signals a move in $\log \epsilon_{t+p}$. The other shock, ξ_t, reflects that although there is some advance information on ϵ_t, that information is not perfect. In the simulation experiment, we consider the following impulse. Up until period 1, the economy is in a steady state. In period $t = 1$, a signal occurs which suggests ϵ_{1+p} will be high. But, when period $1 + p$ occurs, the expected rise in technology in fact does not happen because of a contrary move in ξ_{1+p}. We refer to a disturbance in ε_t as a "signal shock".

The firm sets prices according to a variant of Calvo sticky prices.[16] In each period an intermediate good firm can reoptimize its price with probability, $1 - \xi_p$. With the complementary probability, a firm cannot reoptimize. The i^{th} firm that cannot reoptimize sets its price according to:

$$P_{it} = \tilde{\pi}_t P_{i,t-1},$$

where

$$\tilde{\pi}_t = \pi_{t-1}^{\iota} \bar{\pi}^{1-\iota}. \tag{3.4}$$

Here, π_t denotes the gross rate of inflation, $\pi_t = P_t / P_{t-1}$, and $\bar{\pi}$ denotes steady state inflation. If the i^{th} firm is able to optimize its price at time t, it chooses $P_{i,t} = \tilde{P}_t$ to optimize discounted profits:

$$E_t \sum_{j=0}^{\infty} \left(\beta \xi_p\right)^j \lambda_{t+j} \left[P_{i,t+j} Y_{i,t+j} - P_{t+j} s_{t+j} \left(Y_{i,t+j} + \Phi z_{t+j}\right)\right], \tag{3.5}$$

where λ_{t+j} is the multiplier on firm profits in the household's budget constraint. Also, $P_{i,t+j}$, $j > 0$ denotes the price of a firm that sets $P_{i,t} = \tilde{P}_t$ and does not reoptimize between $t + 1, \ldots, t+j$. The equilibrium conditions associated with firms are standard.

16 Price-setting frictions only play a small role in our analysis. Because prices are set in a forward-looking way, they do help the model produce a fall in inflation throughout the boom period. We conjecture that our basic results about the relationship between monetary policy and boom-bust episodes are robust to the use of any other form of price setting frictions that entail forward-looking behavior. The reason we specifically use Calvo-sticky prices is that they are computationally convenient to work with and they are consistent with some key features of the data: the fact that there are many small price changes (Midrigan (2005)) and the fact that the hazard rate of price changes for many individual goods is roughly constant (Nakamura and Steinsson (2006)).

We model the labor market as in Erceg, Henderson and Levin (2000).[17] The homogeneous labor employed by firms in (3.2) is "produced" from specialized labor inputs according to the following linear homogeneous technology:

$$l_t = \left[\int_0^1 (h_{t,i})^{\frac{1}{\lambda_w}} \, di \right]^{\lambda_w}, \; 1 \leq \lambda_w. \tag{3.6}$$

We suppose that this technology is operated by perfectly competitive labor contractors, who hire specialized labor from households at wage, W_{jt}, and sell homogeneous labor services to the intermediate good firms at wage, W_t. Optimization by labor contractors leads to the following demand for $h_{t,i}$:

$$h_{t,i} = \left(\frac{W_{t,i}}{W_t} \right)^{\frac{\lambda_w}{1-\lambda_w}} l_t, \; 1 \leq \lambda_w. \tag{3.7}$$

The j^{th} household maximizes utility

$$E_t^j \sum_{l=0}^{\infty} \beta^{l-t} \left\{ u(C_{t+l} - bC_{t+l-1}) - \psi_L \frac{h_{t,j}^{1+\sigma_L}}{1+\sigma_L} - \upsilon \frac{\left(\frac{P_{t+l} C_{t+l}}{M_{t+l}^d} \right)^{1-\sigma_q}}{1-\sigma_q} \right\} \tag{3.8}$$

subject to the constraint

$$P_t \left(C_t + I_t \right) + M_{t+1}^d - M_t^d + T_{t+1} \leq W_{t,j} l_{t,j} + P_t r_t^k K_t + \left(1 + R_{t-1} \right) T_t + A_{j,t}, \tag{3.9}$$

where M_t^d denotes the household's beginning-of-period stock of money and T_t denotes nominal bonds issued in period $t-1$, which earn interest, R_{t-1}, in period t. This nominal interest rate is known at $t-1$. The magnitude of υ controls how much money balances households hold on average. We found that when υ is set to reproduce the velocity of money in actual data, the properties of the model are virtually identical to what they are when υ is set essentially to zero. Thus, we simplify the analysis without losing anything if we work with the "cashless limit", the version of the model in which υ is zero.

The j^{th} household is the monopoly supplier of differentiated labor, $h_{j,t}$. With probability $1-\xi_w$ it has the opportunity to choose its wage rate. With probability ξ_w the household's wage rate evolves as follows:

$$W_{j,t} = \tilde{\pi}_{w,t} \mu_z W_{j,t-1},$$

where

$$\tilde{\pi}_{w,t} \equiv \left(\pi_{t-1} \right)^{\iota_w} \bar{\pi}^{1-\iota_w}. \tag{3.10}$$

17 This particular representation of wage frictions is thought to be vulnerable to the critique of Barro (1977). Christiano, Ilut, Motto and Rostagno (2007) report that when a variant of the labor market model suggested by Gertler, Sala and Trigari (2007) is used instead, the basic qualitative results described here go through. The latter model is not vulnerable to the Barro critique.

In (3.9), the variable, $A_{j,t}$ denotes the net payoff from insurance contracts on the risk that a household cannot reoptimize its wage rate, W_t^j. The existence of these insurance contracts have the consequence that in equilibrium all households have the same level of consumption, capital and money holdings. We have imposed this equilibrium outcome on the notation by dropping the j subscript.

The household chooses investment in order to achieve the desired level of its capital, according to the following technology:

$$K_{t+1} = (1-\delta)K_t + (1 - S\left(\frac{I_t}{I_{t-1}}\right))I_t, \tag{3.11}$$

where

$$S(x) = \frac{a}{2}\left(x - \exp\left(\mu_z\right)\right)^2,$$

with $a > 0$. For interesting economic environments in which (3.11) is the reduced form, see Lucca (2006) and Matsuyama (1984).[18]

The household's problem is to maximize (3.8) subject to the demand for labor, (3.7), the Calvo wage-setting frictions, the technology for building capital, (3.11), and its budget constraint, (3.9).

The monetary authority's policy rule is a version of (1.1). Let the target interest rate be denoted by R_t^*:

$$R_t^* = \alpha_\pi\left[E_t\left(\pi_{t+1}\right) - \bar{\pi}\right] + \alpha_y \log\left(\frac{Y_t}{Y_t^+}\right),$$

where Y_t^+ is aggregate output on a nonstochastic steady state growth path (we ignore a constant term here). The monetary authority manipulates the money supply to ensure that the equilibrium nominal rate of interest, R_t, satisfies:

$$R_t = \rho_i R_{t-1} + \left(1 - \rho_i\right) R_t^*. \tag{3.12}$$

3.2 RESULTS

We assign the following values to the model parameters:

$$\begin{aligned}
\beta &= 1.01358^{-0.25},\ \mu_z = 1.0136^{0.25},\ b = 0.63,\ a = 15.1, \\
\alpha &= 0.40,\ \delta = 0.025,\ \psi_L = 109.82,\ \sigma_L = 1,\ \rho = 0.83,\ p = 12, \\
\lambda_f &= 1.20,\ \lambda_w = 1.05,\ \xi_p = 0.63,\ \xi_w = 0.81,\ \iota = 0.84, \\
\iota_w &= 0.13,\ \rho_i = 0.81,\ \alpha_\pi = 1.95,\ \alpha_y = 0.18,\ \upsilon = 0.
\end{aligned}$$

For further discussion, see Christiano, Ilut, Motto and Rostagno (2007).

18 We also explored a specification in which capital adjustment costs are a function of the level of investment. This, however, led investment to fall in response to a positive signal about future technology.

The solid line in Chart 3 displays the response of the economy to a signal in period 1 that technology will improve 1 percent in period 13. The dotted lines represent the response of the efficient allocations. The efficient allocations are obtained by dropping the monetary policy rule, (3.12), and computing the best allocations that are consistent with the remaining model equations.[19] These are the allocations associated with the optimal monetary policy. Note first how the equilibrium responses overshoot the efficient responses to a signal shock. The percent responses in output, consumption, investment and hours worked are roughly three times greater in the equilibrium than they are under the optimal monetary policy. Also, the price of capital rises and then falls in the monetary

19 All calculations were done using the model-solution and simulation package, DYNARE. Although the computation of the Ramsey-efficient allocations is conceptually straightforward, the algebra required to derive the equations that characterize those allocations is laborious. In doing the calculations we benefited greatly from the code prepared for Levin, Lopez-Salido (2004) and Levin, Onatski, Williams, and Williams (2005), which automatically does the required algebra in a format that can be input into DYNARE. It is perhaps worth stressing that the monetary authority in the efficient allocations does not have any information advantage over private agents.

Chart 3 Benchmark monetary model and associated Ramsey-efficient allocations

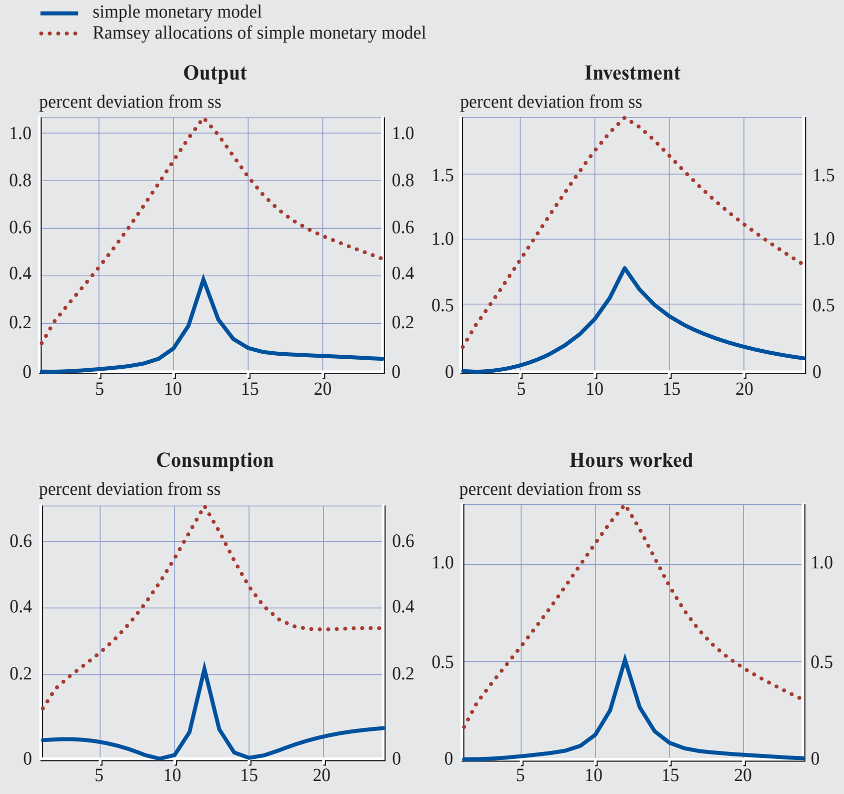
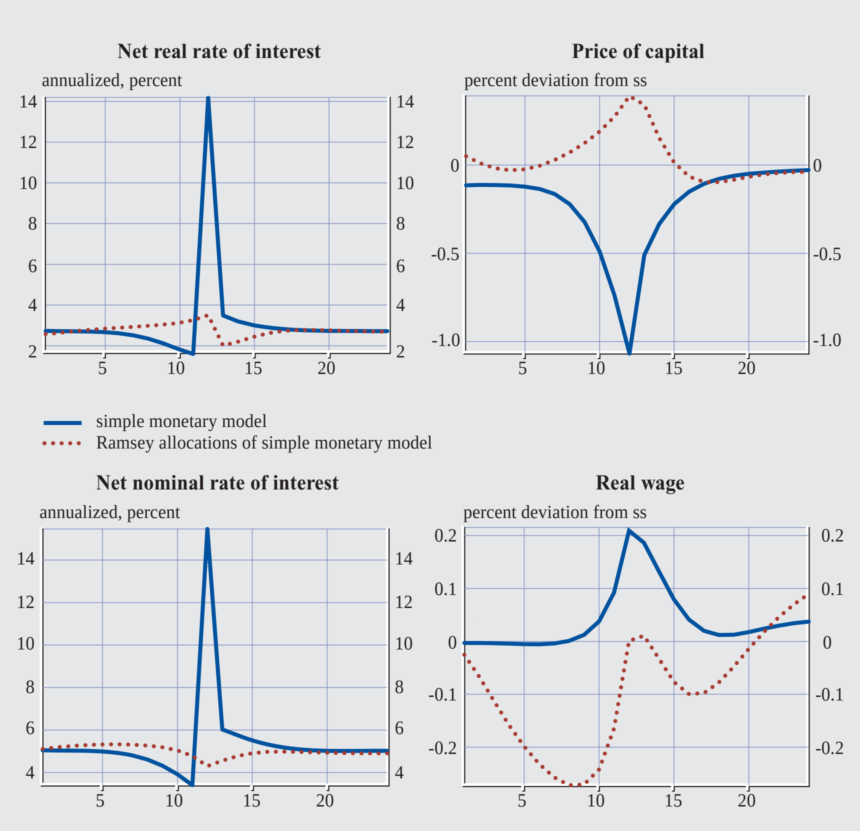


Chart 3 Benchmark monetary model and associated Ramsey-efficient allocations (cont'd)



equilibrium. The price of capital corresponds to the price of equity in our model.[20] The pattern of responses of the solid line correspond, qualitatively, to the pattern in a typical boom-bust episode.[21] Since the dotted line represents the best that is feasible with monetary policy, according to the analysis here most of the boom-bust episode reflects bad (in a welfare sense) monetary policy.

We verified that the problem with monetary policy is that it focuses too narrowly on inflation. If the coefficient on inflation in the monetary policy rule, (3.12), is reduced to nearly unity, then the solid line and the dotted lines essentially coincide. Also, if the frictions in wage setting are removed by setting $\xi_w = 0$, then the starred and solid lines also nearly coincide.

We found that if price frictions are eliminated, then the results are, for the most part, unchanged. One difference is that inflation falls less quickly in the early

20 Note how the price of capital falls in the efficient allocations. For an extensive discussion of this, see Christiano, Ilut, Motto and Rostagno (2007).

21 For what happens in boom-bust episodes, see, for example, Adalid and Detken (2007) and Bordo and Wheelock (2007).

phase of the boom-bust.[22] Regardless of sticky prices, however, everyone – the monetary authority included – expects prices to fall when the positive technology shock actually occurs. The anticipated monetary easing generated by this is enough to produce the boom in the immediate aftermath of the signal. We conclude that it is the interaction of sticky wages and a monetary policy too narrowly focused on inflation that accounts for the excessive volatility in allocations.

To understand the economics of the analysis, consider the dynamic behavior of the real wage. In the equilibrium with the Taylor rule, the real wage falls, while efficiency dictates that it rise. In effect, in the Taylor rule equilibrium the markets receive a signal that the cost of labor is low, and this is part of the reason that the economy expands so strongly. The "correct" signal would be sent by a high real wage, and this could be accomplished by allowing the price level to fall. However, in the monetary policy regime governed by our Taylor rule, (3.12), this fall in the price level is not permitted to occur: any threatened fall in the price level is met by a proactive expansion in monetary policy. Not surprisingly, when we redo our analysis with a Taylor rule in which longer-term inflation expectations appear, the problem is made even worse.

As noted above, when Christiano, Ilut, Motto and Rostagno (2007) introduce credit into the model they find that the solid line in the figure essentially drops to the dotted line. That is, allowing monetary policy to react to credit growth causes the model response to a signal shock to virtually coincide with the efficient response.

4 CONCLUSION

We described two examples that illustrate in different ways how money and credit may be useful in monetary policy. The first example shows how a commitment to monitor money and control it directly in the event that it behaves erratically can help anchor inflation expectations. The second example shows how a policy that focuses too narrowly on inflation may inadvertently contribute to welfare-reducing boom-bust cycles. According to the example, a policy of monetary tightening when credit growth is strong can attenuate this unintended effect of too-narrow inflation stabilization.

We emphasize that in our examples, the problem is not the stabilization of inflation expectations or inflation per se. The examples show that there can be trade-offs between overly rigid inflation stabilization and the stabilization of asset prices and output. The design of an efficient inflation stabilization program

22 Presumably, in a more complete boom-bust scenario an actual rise in technology would accompany the signal shock, and this would help place downward pressure on the price level in the wake of the signal shock. In our analysis we do not allow for a rise in actual technology during the boom in order to isolate the very large role played by expectations.

must balance trade-offs, and to get these right one must get the structure of the economy right. Fortunately, there has been great progress in recent years as increasingly sophisticated macroeconomic models are developed and fit to data. In addition, there have been substantial strides in the conceptual aspects of designing policies to stabilize inflation.[23] Each of our two examples perturbs the standard sticky price model in directions that appear to be empirically plausible. The first example integrates financial frictions in the supply side of the economy. The second example introduces frictions in the setting of wages. These examples suggest to us that as the models used for monetary policy analysis become more realistic, money and credit will come to play a direct role in monetary policy.

5 APPENDIX

In this appendix, we describe a perfect foresight version of the standard New Keynesian model.[24] We show that when a working capital channel is added, then the model displays the kind of multiplicity of equilibria discussed in the text. Although the analysis is similar in spirit to the ones in BSU-CF-CR, the detailed example is new. For this reason, we develop the example carefully.

We need only consider the perfect foresight version of the model because the argument is based only on the properties of the model in a neighborhood of the perfect foresight steady state. The first section below describes the agents in the economy. Because the Taylor rule assumed in the equilibrium of our model involves deviations from the optimal equilibrium, the second subsection presents a careful discussion of optimality. We describe the best equilibrium that is supportable by some feasible monetary and fiscal policy (i.e., the "Ramsey" equilibrium). We also describe a different concept, the best allocations that are feasible given only the preferences and technology in the economy and ignoring the price-setting frictions. Although the two concepts are different along a transition path, they coincide in steady state. The third subsection below describes our Taylor rule, and presents our basic result.

23 The recent work in "flexible inflation targeting" (see Bernanke, 2003, for an informal discussion) focuses on replacing (1.1) by the optimal policy. This requires taking a stand on the model of the economy. When the economy is our benchmark economy, the monetary authority observes the shocks striking the economy as they occur and the monetary authority's objective is social welfare, then optimal policy corresponds to the policy captured by the Ramsey policies exhibited in Chart 1. Discussions of this approach appear in, among other places, Benigno and Woodford (2007), Gianonni and Woodford (2005) and Svensson and Woodford (2005). This approach obviously requires that the model economy be correctly specified and that the appropriate commitment technology exist to resist the time inconsistency associated with optimal plans.

24 See, for example, Woodford (2003a) and the references he cites.

5.1 THE AGENTS IN THE ECONOMY

Households are assumed to have the following preferences:

$$\sum_{t=0}^{\infty} \beta^t \left(\log C_t - \frac{N_t^{1+\varphi}}{1+\varphi} \right),$$

where N_t denotes employment and C_t denotes consumption. We suppose that households participate in a labor market and in a bond market, leading to the following efficiency conditions:

$$\begin{aligned} -c_t &= -rr + r_t - c_{t+1} - \pi_{t+1}, \\ \varphi n_t + c_t &= w_t - p_t, \end{aligned}$$

where

$$rr \equiv -\log \beta,\ c_t \equiv \log C_t,\ r_t \equiv \log R_t,\ w_t = \log W_t,\ p_t = \log P_t,\ \pi_t \equiv p_t - p_{t-1}.$$

Here, P_t denotes the price of consumption goods, W_t denotes the nominal wage rate, and R_t denotes the gross nominal rate of interest from t to $t+1$.

Final output is produced by a representative competitive producer with technology:

$$Y_t = \left(\int_0^1 Y_t(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}},\ \infty > \varepsilon \geq 1, \tag{5.1}$$

where $Y_t(i)$, is an intermediate good purchased at price $P_t(i)$, $i \in [0,1]$. Final output, Y_t, is sold at price P_t and the representative final good firm takes $P_t(i)$ and P_t as given. Optimization by the representative final good producer implies:

$$Y_t(i) = Y_t \left(\frac{P_t(i)}{P_t} \right)^{-\varepsilon} \tag{5.2}$$

Substituting (5.2) into (5.1) and rearranging, we obtain:

$$P_t = \left(\int_0^1 P_t(i)^{(1-\varepsilon)} di \right)^{\frac{1}{1-\varepsilon}}. \tag{5.3}$$

The i^{th} intermediate good producer is a monopolist in the market for $Y_t(i)$, but interacts competitively in the labor market. The i^{th} intermediate good producer's technology is given by:

$$Y_t(i) = N_t(i),$$

and the producer's marginal cost is:

$$(1-\nu_t) \frac{W_t}{P_t} (1 + \psi r_t),$$

where v_t is a potential subsidy received by the intermediate good firm from the government. Any subsidy is assumed to be financed by a lump-sum tax to households.

The intermediate good producer faces Calvo-style frictions in the setting of prices. A fraction, θ, of intermediate good firms cannot change their price:

$$P_t(i) = P_{t-1}(i)$$

and the complementary fraction, $1-\theta$, sets prices optimally:

$$P_t(i) = \tilde{P}_t.$$

5.2 RAMSEY ("NATURAL") EQUILIBRIUM

Given the nature of technology, the ideal allocation of labor occurs when it is spread equally across the different intermediate good producers:

$$N_t(i) = N_t \text{ all } i,$$

so that

$$Y_t = N_t, \;\; y_t = n_t, \tag{5.4}$$

where $y_t = \log Y_t$. Efficiency in the total level of employment requires equating the marginal cost of work in consumption units (the marginal rate of substitution between work and leisure – MRS_t) to the marginal benefit (the marginal product of labor, $MP_{L,t}$). In logs:

$$\overbrace{c_t + \varphi n_t}^{\log \; MRS_t} = \overbrace{0}^{\log \; MP_{L,t}} \tag{5.5}$$

Combine (5.4) and (5.5) and $c_t = y_t$ to obtain:

$$y_t(1+\varphi) = 0$$

so that natural level of output and employment are:

$$y_t^* = n_t^* = 0. \tag{5.6}$$

Under the ideal allocations, employment, consumption and output are all equal to unity in each period.

What we call the ideal allocations do not in general coincide with the Ramsey allocations. The latter are the ones attainable by some feasible choice of monetary and fiscal policy. However, the Ramsey allocations do converge to the ideal allocations in steady state.

We express the Ramsey equilibrium as the solution to a particular constrained optimization problem. The pricing frictions and the technology imply, as shown in Yun (1996, 2005):

$$C_t = Y_t = p_t^* N_t, \tag{5.7}$$

where p_t^* is the following measure of price dispersion:

$$p_t^* = \left[\int_0^1 \left(\frac{P_t(i)}{P_t} \right)^{-\varepsilon} di \right]^{-1},$$

where P_t is defined in (5.3). Note that $p_t^* = 1$ when all intermediate goods prices are the same. The law of motion for p_t^* is obtained by combining the last equation with the first order condition for firms that optimize their price. The resulting expression is:

$$p_t^* = \left[(1-\theta) \left(\frac{1-\theta(\pi_t)^{\varepsilon-1}}{1-\theta} \right)^{\frac{\varepsilon}{\varepsilon-1}} + \frac{\theta \pi_t^{\varepsilon}}{p_{t-1}^*} \right]^{-1}. \tag{5.8}$$

Note that $p_{t-1}^* = \pi_t = 1$ implies $p_t^* = 1$. That is, if there was no price dispersion in the previous period (i.e., $p_{t-1}^* = 1$) and there is no aggregate inflation in the current period (i.e., $\pi_t = 1$), then there is also no price dispersion in the current period. To understand the intuition behind this result, recall that non-optimizers leave their price unchanged. If in addition there is no aggregate inflation, then it must be that optimizers also leave their price unchanged. If everyone leaves their price unchanged and all intermediate firm prices were identical in the previous period, then it follows that all intermediate good firm prices must be the same in the current period.

The first order necessary conditions associated with firms that optimize their prices can be shown to be:[25]

$$1 + \left(\frac{1}{\pi_{t+1}} \right)^{1-\varepsilon} \beta \theta F_{t+1} = F_t \tag{5.9}$$

$$\frac{\varepsilon}{\varepsilon - 1} \frac{(1-\nu_t) W_t (1+\psi r_t)}{P_t} + \beta\theta \left(\frac{1}{\pi_{t+1}} \right)^{-\varepsilon} K_{t+1} = K_t \tag{5.10}$$

$$F_t \left[\frac{1-\theta \left(\frac{1}{\pi_t} \right)^{1-\varepsilon}}{1-\theta} \right]^{\frac{1}{1-\varepsilon}} = K_t, \tag{5.11}$$

25 See, for example, Benigno and Woodford, (2004).

where F_t and K_t represent auxiliary variables. Finally, we restate the household's inter- and intra-temporal Euler equations for convenience:

$$\frac{1}{C_t} = \frac{\beta}{C_{t+1}} \left(1 + r_t\right) / \pi_{t+1}, \quad \frac{W_t}{P_t} = N_t^{\varphi} C_t \tag{5.12}$$

The allocations in a Ramsey equilibrium solve the Ramsey problem:

$$\max_{N_t, K_t, \nu_t, C_t, p_t^* F_t, \pi_t, r_t} \sum_{t=0}^{\infty} \beta^t \left(\log C_t - \frac{N_t^{1+\varphi}}{1+\varphi} \right), \tag{5.13}$$

subject to (5.7)-(5.12) and the given value of p^*_{-1}. We now establish the following proposition:

Proposition 5.1 *The allocations in a Ramsey equilibrium are uniquely defined by the following expressions:*

$$\pi_t = \arg\max_{\pi_t} p_t^* = \left[\frac{\left(p_{t-1}^*\right)^{(\varepsilon-1)}}{1 - \theta + \theta \left(p_{t-1}^*\right)^{(\varepsilon-1)}} \right]^{\frac{1}{\varepsilon-1}}, \tag{5.14}$$

$$N_t = 1 \tag{5.15}$$

$$p_t^* = \left[1 - \theta + \theta \left(p_{t-1}^*\right)^{\varepsilon-1}\right]^{\frac{1}{\varepsilon-1}}, \tag{5.16}$$

$$\lim_{T\to\infty} P_T = p_{-1}^* P_{-1}, \tag{5.17}$$

$$1 - \nu_t = \frac{\varepsilon - 1}{\varepsilon \left(1 + \psi r_t\right)} \tag{5.18}$$

$$1 + r_t = \frac{1}{\beta} \tag{5.19}$$

for $t = 0, 1, 2, \ldots$

According to (5.14) and (5.15), the only restrictions that bind on the solution are the resource constraint, (5.7), and the law of motion for p_t^*, (5.8). In particular, π_t, N_t and C_t may be chosen to solve (5.13) subject to (5.7) and (5.8), ignoring the other restrictions on the Ramsey problem. The other restrictions may then be solved for the remaining choice variables in the optimization problem, (5.13). The details are reviewed in what follows.

Substitute out for C_t in (5.13) using (5.7) and then maximize the result with respect to N_t and π_t. The solution to this problem is characterized by (5.14) and (5.15). Then, substitute out for π_t from (5.14) into (5.8) to obtain (5.16). The latter is a stable linear difference equation in $(p_t^*)^{\varepsilon-1}$, with slope equal to θ.

Because $0<\theta<1$, the difference equation is globally stable and has a unique fixed point at $p_t^*=1$. Combining (5.16) and (5.14), we obtain:

$$\pi_t = \frac{p_{t-1}^*}{p_t^*}. \tag{5.20}$$

Note that although the resource allocation distortion, p_t^*, is minimized according to (5.14), it is not necessarily eliminated in each period. If $p_{-1}^* \neq 1$ the resource allocation distortion is eliminated gradually over time. Combining (5.20) with the global stability of (5.16) we obtain (see Yun, 2005):

$$\lim_{T\to\infty} \frac{P_T}{P_{-1}} = \lim_{T\to\infty} \frac{p_{-1}^*}{p_T^*} = p_{-1}^*.$$

This establishes (5.17).

Impose (5.7), (5.12) and (5.18) on (5.10) and divide by p_t^*, to obtain:

$$1+\beta\theta\left(\frac{1}{\pi_{t+1}}\right)^{1-\varepsilon}\frac{K_{t+1}}{p_{t+1}^*} = \frac{K_t}{p_t^*}, \tag{5.21}$$

where (5.20) has been used. We use (5.21) to define K_t, so that (5.10) is satisfied. Define

$$F_t = \frac{K_t}{p_t^*}$$

Note

$$\left[\frac{1-\theta\left(\pi_t\right)^{\varepsilon-1}}{1-\theta}\right]^{\frac{1}{1-\varepsilon}} = \left[\frac{1-\theta\left(\frac{p_{t-1}^*}{p_t^*}\right)^{\varepsilon-1}}{1-\theta}\right]^{\frac{1}{1-\varepsilon}}$$

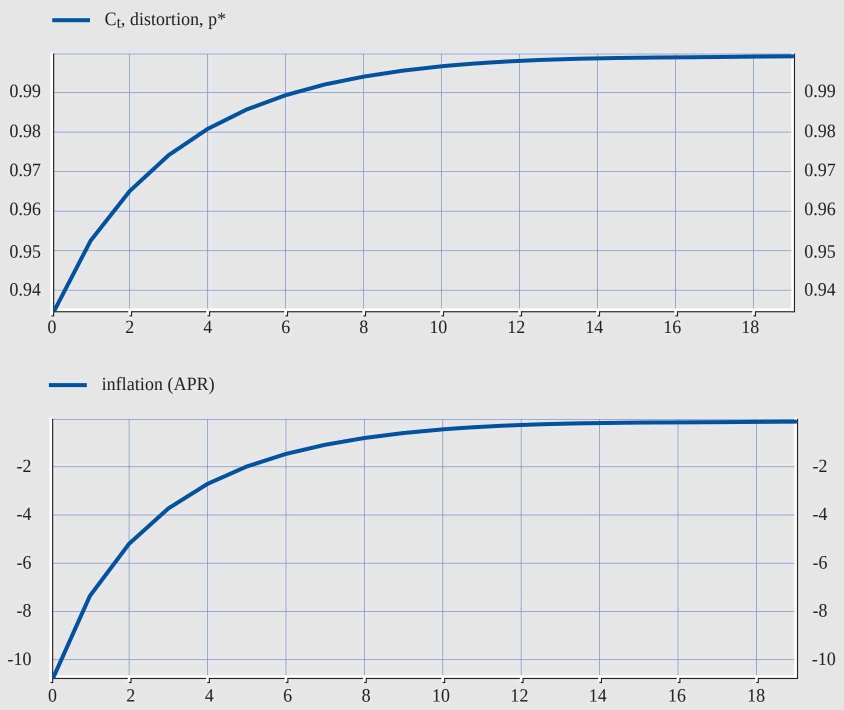
$$= \left[\frac{1-\theta\frac{\left(p_{t-1}^*\right)^{\varepsilon-1}}{1-\theta+\theta\left(p_{t-1}^*\right)^{\varepsilon-1}}}{1-\theta}\right]^{\frac{1}{1-\varepsilon}} = \frac{1}{\left[1-\theta+\theta\left(p_{t-1}^*\right)^{\varepsilon-1}\right]^{\frac{1}{1-\varepsilon}}}$$

$$= \frac{1}{p_t^*},$$

so that (5.11) is satisfied. Note that given (5.21) and our definition of F_t, it follows that (5.9) is satisfied. Finally, (5.19) is obtained by substituting (5.15), (5.20) and (5.7) into (5.12). Since all the constraints on the problem, (5.13), are satisfied, the proposition is established.

Three observations on the proposition are worth emphasizing. First, if $p_{-1}^* \neq 1$ then $\pi_t = 1$ for $t = 0,1,..$ is not optimal. However, π_t does optimally converge to unity so that the allocations converge to what we call the "ideal" allocations asymptotically. To get a sense of how long the transition path is, consider the

Chart 4 Ramsey equilibrium starting with 9 percent distortion



case $p^*_{-1} = 0.91$. With this initial condition, output is 9 percent below potential, for any given aggregate level of employment. The transition of inflation and the distortion (or, equivalently, consumption) to the steady state is indicated in Chart 4 (we use the following quarterly parameter values, $\theta = 0.75$, $\varepsilon = 5$, $\varphi = 1$, $\beta = 0.99$). Note how very far the inflation rate is from its steady state. The Ramsey level of consumption also remains substantially below its steady state value. The example assumes that the average duration of prices is one year (i.e., $1/(1-\theta) = 4$). With our parameterization, it takes about one year for the inflation rate and consumption to converge to the Ramsey steady state.

A second observation worth emphasizing is that equation (5.18) implies the labor subsidy on firms is chosen to completely eliminate the monopoly power distortion and the distortion due to the financial friction. It is interesting that this distortion is eliminated entirely, because the cross-sectoral distortion is not eliminated during the transition (note that p^*_t takes about three years to converge). The theory of the second best might have led us to expect that if one distortion could not be eliminated, then the other would not either.

Third, the fact that (5.7) and (5.8) are the only restrictions that bind on the Ramsey problem indicates that the Ramsey policy is time consistent. This is because neither (5.7) or (5.8) incorporates expectations about the future. Thus, the Ramsey policy would be implemented by a policymaker that has no ability to commit to future inflation.

The benchmark economy that we use is the steady state of the Ramsey equilibrium. This corresponds to the ideal allocations defined at the beginning of this section.

5.3 EQUILIBRIUM WITH TAYLOR RULE MONETARY POLICY

In our economy with a Taylor rule, we suppose that fiscal policy, v_t, is set to ensure that the steady state corresponds to the steady state of the Ramsey equilibrium:

$$1 - v_t = \frac{\varepsilon - 1}{\varepsilon\left(1 + \psi rr\right)}. \tag{5.22}$$

Under the Taylor rule, the interest rate deviates from the Ramsey or natural rate according to whether expected inflation is higher or lower than steady state inflation:

$$\hat{r}_t = \tau \pi_{t+1},\ \hat{r}_t \equiv r_t - rr.$$

We repeat here the household intertemporal equilibrium condition in the Taylor rule equilibrium:

$$y_t = -\left[\hat{r}_t - \pi_{t+1}\right] + y_{t+1}.$$

The intertemporal equilibrium condition in steady state (either Ramsey or in the economy with the Taylor rule) is:

$$y_t^* = -\left[rr_t^* - rr\right] + y_{t+1}^*,$$

where y_t^* is defined in (5.6) and rr_t^* is the Ramsey (or, “natural”) rate of interest. We deduce that $rr_t^* = rr$. Subtracting the steady state intertemporal condition from the one in the economy with the Taylor rule, we obtain the “New Keynesian IS equation”:

$$x_t = -\left[\hat{r}_t - \pi_{t+1}\right] + x_{t+1}.$$

The log of (5.7) implies:

$$y_t = \log p_t^* + n_t.$$

In a sufficiently small neighborhood of steady state, $\log p_t^* \approx 0$ (see Yun, 1996, 2005) and we impose this from here on. This is appropriate because we are concerned with the properties of equilibrium in a small neighborhood of steady state. The Calvo reduced form inflation equation implies

$$\pi_t = \beta\pi_{t+1} + \kappa \times \widehat{mc}_t,\ \kappa = \frac{(1-\theta)(1-\beta\theta)}{\theta},$$

where $\widehat{mc}_t$ denotes the log deviation of real marginal cost in the Taylor rule equilibrium from its log steady state value, mc^*:

$$\begin{aligned} mc^* &= \log(1-\nu) + \log \frac{W_t}{P_t} + \log(1+\psi rr) \\ &= \log \frac{\varepsilon - 1}{\varepsilon}, \end{aligned}$$

using (5.16), the household's static Euler equation and the fact that output and employment are unity in steady state. Then,

$$\begin{aligned} \widehat{mc}_t &= \log(1-\nu_t) + \log \frac{W_t}{P_t} + \log(1+\psi r_t) - mc_t^* \\ &= \log(1-\nu) + \varphi n_t + c_t + \psi r_t - \log(1-\nu) - \psi rr \\ &= (\varphi + 1) x_t + \psi \hat{r}_t, \end{aligned}$$

using the household's static Euler equation and (5.7). Also, we have used the approximation,

$$\log(1+\psi r_t) \simeq \psi r_t.$$

Substituting this into the Phillips curve, we obtain:

$$\pi_t = \beta \pi_{t+1} + \kappa(\varphi + 1) x_t + \kappa \psi \hat{r}_t.$$

Collecting the equilibrium conditions, we obtain:

$$\begin{aligned} \pi_t &= \beta \pi_{t+1} + \kappa(\varphi+1) x_t + \kappa \psi \hat{r}_t \text{ `Phillips curve'} \\ x_t &= -[\hat{r}_t - \pi_{t+1}] + x_{t+1} \text{ `IS curve'} \\ \hat{r}_t &= \tau \pi_{t+1} \text{ `Taylor rule'}. \end{aligned}$$

5.4 DETERMINACY PROPERTIES OF THE NONSTOCHASTIC STEADY STATE

Using the monetary policy rule to substitute out for $\hat{r}_t$:

$$\begin{aligned} x_t + \sigma(\tau - 1) \pi_{t+1} - x_{t+1} &= 0 \\ \pi_t - \lambda x_t - (\beta + \gamma \tau) \pi_{t+1} &= 0, \end{aligned}$$

where σ is the intertemporal elasticity of substitution (assumed unity in the previous derivation). Also,

$$\begin{aligned} \lambda &= \kappa(\varphi + 1) \\ \gamma &= \kappa \psi. \end{aligned}$$

Expressed in matrix form, the system is:

$$\begin{bmatrix} \sigma(\tau - 1) & -1 \\ -(\beta + \gamma\tau) & 0 \end{bmatrix} \begin{pmatrix} \pi_{t+1} \\ x_{t+1} \end{pmatrix} + \begin{bmatrix} 0 & 1 \\ 1 & -\lambda \end{bmatrix} \begin{pmatrix} \pi_t \\ x_t \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix},$$

for t = 0, 1, 2, ..., or, after inverting:

$$\begin{pmatrix} \pi_{t+1} \\ x_{t+1} \end{pmatrix} = A \begin{pmatrix} \pi_t \\ x_t \end{pmatrix}, \tag{5.23}$$

where

$$A = \frac{1}{\beta + \tau\gamma} \begin{bmatrix} 1 & -\lambda \\ a & b \end{bmatrix}, \; a = \sigma(\tau - 1), \; b = \beta + \tau\gamma - \lambda a.$$

Note that the eigenvalues of A solve:

$$\mu = \frac{1}{2}(b+1) \pm \frac{1}{2}\sqrt{b^2 - 4a\lambda - 2b + 1}.$$

Local uniqueness of the steady state equilibrium, $x_t = 0 = \pi_t$, requires that both eigenvalues of A exceed unity in absolute value. To see why, note first that both x_t and π_t are endogenous variables whose values are determined at time t (they are period t "jump" variables). If one or both eigenvalues of A were less than unity in absolute value, one could set some combination of x_0 and π_0 different from zero, and the solution to (5.23) describes a path that eventually takes the system back to steady state (i.e., $(x_t, \pi_t) \rightarrow 0$, as $t \rightarrow \infty$). Because there is an uncountable number of such combinations, (x_0, π_0), each of which follows a path back to steady state and each such path satisfies the equilibrium conditions, it follows that there is a multiplicity of equilibria. Consider, for example, the parameter values:

$$\theta = 0.75, \; \kappa = 0.085, \; \tau = 1.5, \; \sigma = 1, \; \varphi = 1, \; \psi = 1, \; \beta = 0.99, \; \gamma = \kappa.$$

These parameter values are standard. They imply that the average time between price changes is one year (see θ); the coefficient on expected inflation, τ, represents an aggressive reaction to inflation; households have log utility (see σ); the (Frisch) labor supply elasticity is unity (see φ); and the discount rate is 4 percent per year (see β). We set ψ = 1, so that intermediate good firms are assumed to have to finance 100% of their variable input costs (i.e., labor) in advance. We found that in this example, the smallest (in absolute value) root of A is 0.94. So, we have a multiplicity of equilibria, as in the discussion of the text. We found that the smallest root of A is less than unity for all $\psi \geq 0.08$. For ψ smaller than this, we reproduce the standard result that both eigenvalues of A are greater than unity. This is consistent with the intuition described in the body of the paper.

To assess the empirical plausibility of the range of values of ψ that produce multiplicity of equilibrium, we examined the Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations: 2006, Quarter 1, issued June

2006 (US Bureau of the Census, available online at http://www.census.gov/prod/2006pubs/qfr06q1.pdf). According to Table 1.0, page 2, sales in 2006 Q1 were S = \$1.4 trillion. According to Table 1.1, page 4, short term liabilities (bank loans and commercial paper with maturity less than one year, plus trade credit, plus other current liabilities) totaled L = \$1.3 trillion. If we take S/L as a (very) crude estimate of ψ, we conclude that the range of values of ψ that generate multiple equilibria is empirically reasonable.

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DOES A "TWO-PILLAR PHILLIPS CURVE" JUSTIFY A TWO-PILLAR MONETARY POLICY STRATEGY?[1]

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ABSTRACT

Arguments for a prominent role for attention to the growth rate of monetary aggregates in the conduct of monetary policy are often based on references to low-frequency reduced-form relationships between money growth and inflation. The "two-pillar Phillips curve" proposed by Gerlach (2004) has recently attracted a great deal of interest in the euro area, where it is sometimes supposed to provide empirical support for the wisdom of a "two-pillar strategy" that uses distinct analytical frameworks to assess shorter-run and longer-run risks to price stability. I show, however, that regression coefficients of the kind reported by Assenmacher-Wesche and Gerlach (2006a) among others are quite consistent with a "new Keynesian" model of inflation determination, in which the quantity of money plays no role in inflation determination, at either high or low frequencies. I also show that empirical results of this kind do not in themselves establish that money growth must be useful in forecasting inflation, either in the short run or over a longer run. Hence they provide little support for the ECB's monetary "pillar".

1 INTRODUCTION

A distinctive feature of the monetary policy strategy of the European Central Bank is the prominent role assigned to the monitoring of measures of the money supply. In what the ECB calls its "two-pillar strategy", one pillar is "economic analysis", which "assesses the short-to-medium-term determinants of price developments". According to the ECB, this analysis "takes account of the fact that price developments over those horizons are influenced largely by the interplay of supply and demand in the goods, services and factor markets." But in addition, a second pillar, "monetary analysis", assesses the medium-to-long-term outlook for inflation, "exploiting the long-run link between money and prices". The two alternative frameworks for assessing risks to price stability are intended to provide "cross-checks" for one another (ECB, 2004, p. 55).

1 I would like to thank Stefan Gerlach, Christian Noyer, Athanasios Orphanides, Lucrezia Reichlin, Harald Uhlig, and Volker Wieland for helpful discussions of an earlier draft, while absolving them of any responsibility for the opinions expressed. I would also like to thank Mehmet Passaogullari for research assistance and the (U.S.) National Science Foundation for research support through a grant to the National Bureau of Economic Research.

The most important justification for using two quite distinct analytical frameworks in parallel – rather than a single, integrated conceptual framework (within which one might, of course, obtain information from a large number of different indicators) – seems to be the view that different factors determine longer-run trends in inflation than those responsible for shorter-run fluctuations, and that distinct models are accordingly necessary in order to monitor and respond to developments of the two types. In effect, it is supposed that inflation should be viewed as a superposition of two distinct phenomena that each deserve to be separately modeled.

The case for separate treatment of short-run and long-run determinants of inflation is sometimes argued on theoretical grounds. For example, it is sometimes asserted that models of wage and price adjustment in response to the balance of supply and demand in product and factor markets – that provide the basis for the ECB's "economic analysis" of the inflation outlook – are by their nature unable to determine the long-run trend rate of inflation, even if they correctly describe short-run departures from the inflation trend.[2]

I have shown elsewhere that this is a misunderstanding of the structure of conventional "new Keynesian" models (Woodford, 2007, sec. 2.2).[3] While the long-run inflation trend in such models most assuredly depends on *monetary policy* – it cannot be explained by factors relating to factor markets and product markets *alone*, and indeed, the central bank can ensure any long-run average inflation rate that it wishes (within certain limits) through an appropriate choice of policy, independently of those structural factors – this does not mean that one and the same model cannot simultaneously explain the determination of the inflation trend and of short-run departures from it.[4] In fact, the specification of the monetary policy of the central bank is essential to the explanation of *both* aspects of inflation – without an equation specifying monetary policy,[5] the model would also fail to determine the short-run departures of inflation from trend. At the same time, all changes in the general level of prices, both in the short run and in the long run, are explained as resulting from the optimizing decisions of price-setters, who respond at all times to the same sorts of perceived changes in production costs and demand conditions. Hence there is no fundamental difference in the framework required to understand inflation determination over different time scales.

But probably the most commonly cited arguments for the need for a separate monetary "pillar" are purely empirical ones. The association of money growth with inflation is argued, as an empirical matter, to be highly robust, confirmed by data from different centuries, from different countries, and from economies

2 Comments of this kind can be found, for example, in Nelson (2003, sec. 2.2), Lucas (2006, p. 137), and Reynard (2006, pp. 2-3).
3 McCallum (2001) also provides an insightful discussion of the nature of inflation determination in models of the same general kind.
4 A simple example of the kind of model that simultaneously explains both is given in section 3.
5 As discussed in the paper just cited, such a specification of monetary policy need make no reference to the quantity of money.

with different financial institutions and different monetary and fiscal policies. Empirical work in the monetarist tradition often emphasizes simple correlations (and sometimes leadlag relationships) rather than structural estimation; but it may be argued that the relations thus uncovered represent more certain knowledge, because they are independent of any maintained assumption of the correctness of a particular structural model. Monetarists argue that the causal relation between money growth and inflation is as a consequence one that can more safely be relied upon in designing a policy aimed at controlling inflation than the relations (such as the Phillips curve) that make up a structural macroeconometric model.[6]

The empirical evidence that is relied upon in such arguments relates to primarily to long-run or low-frequency correlations between money growth and inflation. While early advocacy of money-growth targets was often based on analyses of the correlation between money growth and real activity at business-cycle frequencies, these correlations have broken down in many countries since the 1980s,[7] and the more recent monetarist literature has instead emphasized the wide range of evidence that exists for a long-run relationship between money growth and inflation. This relationship is argued to be more robust, and to suffice as a justification for controlling money growth given a central bank's proper concern with the character of long-run inflation trends. But to the extent that the relationship is asserted only to hold at low frequencies, the possibility is left open that higher-frequency (or shorter-run) inflation developments must be understood in other terms. This is what is asserted in explanations of the ECB's "two-pillar" strategy.

A branch of the empirical literature on the relation between money growth and inflation at low frequencies that has been especially influential among defenders of the ECB's strategy is the one that estimates "two-pillar Phillips curves" of the kind proposed by Gerlach (2004). Because studies of this kind purport to show that different factors explain inflation movements at different frequencies, they may appear to provide an especially straightforward justification for the strategy of the ECB. It is therefore desirable to give particular attention to what exactly can be concluded about the nature of inflation from such studies, and what they imply about the role of measures of money growth in the assessment of risks to price stability.

6 See Woodford (2007, sec. 3.1) for further discussion both of the kind of evidence that is cited and of its implications for the design of a robust approach to the control of inflation.

7 See, for example, Friedman and Kuttner (1992) and Walsh (2003, Fig. 1.3) for changes over time in the relation between money and national income in the U.S. data. For a recent discussion of the stability of M3 demand in the euro area, and its implications for the usefulness of "excess liquidity" measures based on cumulative M3 growth, see Bordes et al. (2007). Fischer et al. (2008) document the reduced reliance on estimated money-demand relations in recent years in the monetary analysis of the ECB.

2 "TWO-PILLAR" PHILLIPS CURVES

A recently popular approach to using money growth to forecast longer-run inflation trends has been the estimation of "money-augmented" or "two-pillar Phillips curves," pioneered by Stefan Gerlach (2004).[8] These are forecasting models in which both an output gap measure and a measure of money growth are used to forecast inflation, with the two sources of information argued to each be relevant to forecasting a different frequency component of inflation. The argument about the differing determinants of inflation at different frequencies is made most clearly in the work of Assenmacher-Wesche and Gerlach (2006a). In their work, inflation π_t is decomposed into low-frequency and high-frequency components,

$$\pi_t = \pi_t^{LF} + \pi_t^{HF},$$

using linear band-pass filters. The high-frequency component is modeled as forecastable using a relation of the form

$$\pi_t^{HF} = \alpha_g g_{t-1} + \epsilon_t^{HF}, \tag{2.1}$$

where g_t is the output gap (defined as the log of output, minus its low-frequency component). The low-frequency component is instead modeled by a relation motivated by the quantity theory of money,

$$\pi_t^{LF} = \alpha_\mu \mu_t^{LF} + \alpha_y \gamma_t^{LF} + \alpha_\rho \rho_t^{LF} + \epsilon_t^{LF}. \tag{2.2}$$

Here μ_t is the rate of money growth, γ_t the rate of output growth, and ρ_t the change in a long-term real interest rate (included as a determinant of changes of velocity), and in the case of each of these variables the superscript *LF* indicates the low-frequency component of the series in question.

A relation of the form (2.2) is expected to hold at sufficiently low frequencies because of the existence of a relatively stable money-demand relation of the form

$$\log(M_t/P_t) = \eta_y \log Y_t - \eta_i i_t + \epsilon_t^m, \tag{2.3}$$

in which M_t is the (nominal) money supply in period t, Y_t is an index of aggregate real output, it is a short-term nominal interest rate, the positive coeffcients η_y and η_i are the income elasticity and interest-rate semielasticity of money demand respectively, and ε_t^m is an exogenous disturbance to money demand. First-differencing (2.3) then yields a relation of the form

$$\mu_t - \pi_t = \eta_y \gamma_t - \eta_i \Delta i_t + \Delta \epsilon_t^m. \tag{2.4}$$

8 Other examples of work of this kind include Neumann (2003), Neumann and Greiber (2004), Assenmacher-Wesche and Gerlach (2006a, 2006b), and Hofmann (2006). Assenmacher-Wesche and Gerlach (2006b) provide a useful review of related literature.

Table 1 Inflation equations of Assenmacher-Wesche and Gerlach (2006a) for alternative frequency bands.

Frequency range **Period (years)**	**HF** **0.5-8**	**LF** **8-∞**
Money growth	-0.02 (0.30)	0.96** (0.19)
Output growth	-0.03 (0.07)	-0.98 (0.97)
RR change	1.10 (0.46)	3.01 (6.92)
Output gap	0.12** (0.05)	-

Note: Dependent variable is euro-area inflation; standard errors are given in parentheses below each regression coeffcient.
** indicates significance at the 1 percent level.

Relation (2.2) is expected to hold because of (2.4); thus on theoretical grounds, α_μ should equal 1. In the case that the income elasticity of money demand η_y is equal to 1, as long-run estimates often find, one would also predict that α_y should equal -1 in (2.2).

Combining the two models of the separate components of inflation, one obtains a complete forecasting model for inflation of the form

$$\pi_t = \alpha_\mu \mu_t^{LF} + \alpha_y \gamma_t^{LF} + \alpha_\rho \rho_t^{LF} + \alpha_g g_{t-1} + \epsilon_t, \qquad (2.5)$$

where the different "causal" variables are expected to have explanatory power at different frequencies. Assenmacher-Wesche and Gerlach argue that this is the case, by using band-spectral regression to estimate an inflation equation of the form

$$\pi_t = \alpha_\mu \mu_t + \alpha_y \gamma_t + \alpha_\rho \rho_t + \alpha_g g_{t-1} + \epsilon_t, \qquad (2.6)$$

allowing the coefficients to vary across frequency ranges of the data. Their results (a representative sample of which are reported in Table 1) support the hypothesis sketched above about the difference between high-and low-frequency inflation dynamics. In their regression for the lowest-frequency band (fluctuations with periods of 8 years or longer), the only strongly significant variable is money growth, with a coefficient α_μ not significantly different from 1; the point estimates for the coefficients associated with the other "quantity-theoretic" variables, while not significant, have the signs predicted by the quantity equation,[9] while α_g is zero at these frequencies (by construction). In their regression for the high-frequency band (periods 0.5 to 8 years), instead, the coefficient α_μ is found to be near zero, while α_g is significantly positive (at the

9 The coeffcient α_y is very close to the theoretical prediction of -1, and α_ρ is estimated to be positive, as predicted if higher interest rates lower money demand, as in the specification (2.3).

1% level), and is the only forecasting variable that enters so significantly at this frequency.[10]

Assenmacher-Wesche and Gerlach call equation (2.5) a "two-pillar Phillips curve," arguing that it provides support for the view (offered as a primary rationale for the ECB's "two-pillar" strategy) that separate sources of information must be consulted in order to judge the nearer-term and longer-term outlooks for inflation respectively. They argue furthermore that since inflation is the sum of *both* components (technically, a sum of components corresponding to all frequencies), the predictors that are relevant for either component are relevant for forecasting inflation. In particular, "the fact that money growth is important only at low frequencies does not mean that it can be disregarded when analyzing current price pressures" (Assenmacher-Wesche and Gerlach, 2006b, p. 25).

The argument that money should not be disregarded does not, of course, imply that there is a need for a separate "monetary pillar." In fact, Gerlach (2004) explicitly argues against a separate pillar, concluding instead that forecasting equations like (2.6) show how the information contained in monetary aggregates can be used along with real indicators such as the output gap in a single, integrated framework for assessing risks to price stability. But I shall argue that, not only do such regressions provide no evidence for a need for separate, incompatible approaches to modeling inflation dynamics at different frequencies, but they do not in themselves provide any reason to believe that money growth provides any useful information at all in assessing risks to price stability.

3 DO SUCH RELATIONS IMPLY A CAUSAL ROLE FOR MONEY IN INFLATION DETERMINATION?

Findings such as those reported by Assenmacher-Wesche and Gerlach do not imply a need for two separate models of inflation determination, depending on the time horizon (or frequency range) with which one is concerned. A single model of inflation determination is capable of explaining why inflation would be more closely related to different sets of variables at high and low frequencies. Perhaps more surprisingly, the importance of money growth in their low-frequency inflation equation is perfectly consistent with a model of inflation determination in which money is not among the causal factors that account for inflation variations, and in which observations of the growth rate of money are not of value in forecasting inflation, either at longer horizons or at shorter ones.

10 In a subsequent extension of this work, Assenmacher-Wesche and Gerlach (2006b) find that certain "cost-push variables" (notably, import prices) are also significant predictors of inflation, especially at frequencies even higher than those at which the output gap is most important.

Table 2 Numerical parameter values

β	0.99
κ	0.0238
σ	6.25
ϕ_π	1.5
ϕ_y	0.125
η_y	1.0
η_i	12.0

3.1 A SIMPLE "NEW KEYNESIAN" MODEL

To illustrate this, it is useful to recall the structure of a fairly basic "new Keynesian" model.[11] The model presented here is a simplified version of the account of inflation determination given by empirical models such as the euro-zone model of Smets and Wouters (2003), stripped down to a structure that can be solved explicitly.

The log-linearized model consists of three equations. The first is an aggregate supply relation,

$$\pi_t - \bar{\pi}_t = \kappa \log(Y_t/Y_t^n) + \beta E_t[\pi_{t+1} - \bar{\pi}_{t+1}] + u_t, \tag{3.1}$$

where π_t again represents the rate of inflation between periods t and $t+1$, $\bar{\pi}_t$ is the perceived rate of "trend inflation" at date t, Y_t is aggregate output, Y_n^t is the "natural rate of output" (a function of exogenous real factors, including both technology and household preferences), u_t is a possible additional exogenous "cost-push" disturbance, and the coefficients satisfy $\kappa > 0, 0 < \beta < 1$. This equation represents a log-linear approximation to the dynamics of aggregate inflation in a model of staggered pricesetting; in the variant of the model presented here, in periods when firms do not reoptimize their prices, they automatically increase their prices at the trend inflation rate $\bar{\pi}_t$. This assumption of automatic indexation was first used in the empirical model of Smets and Wouters (2003), who assume indexation to the current inflation target of the central bank, part of the specification of monetary policy below.

The second equation is a log-linear approximation to an Euler equation for the timing of aggregate expenditure,

$$\log(Y_t/Y_t^n) = E_t[\log(Y_{t+1}/Y_{t+1}^n] - \sigma[i_t - E_t\pi_{t+1} - r_t^n], \tag{3.2}$$

sometimes called an "intertemporal IS relation," by analogy to the role of the IS curve in Hicks' exposition of the basic Keynesian model. Here i_t is a short-term nominal interest rate (a riskless "one-period rate" in the theoretical model,

11 The foundations of models of the type presented here are treated in greater detail in Woodford (2003).

earned on money-market instruments held between periods t and t+1) and r_t^n is the Wicksellian "natural rate of interest" (a function of exogenous real factors, like the natural rate of output). Euler equations of this sort for the optimal timing of expenditure are at the heart of the monetary transmission mechanism in models like that of Smets and Wouters (2003), though they separately model the timing of consumer expenditure and investment spending.

The remaining equation required to close the system is a specification of monetary policy. For purposes of illustration, I shall specify policy by a rule of the kind proposed by Taylor (1993) for the central bank's operating target for the short-term nominal interest rate,

$$i_t = r_t^* + \bar{\pi}_t + \phi_\pi(\pi_t - \bar{\pi}_t) + \phi_y \log(Y_t/Y_t^n). \tag{3.3}$$

Here $\bar{\pi}_t$ is the central bank's inflation target at any point in time, and r_t^* represents the central bank's view of the economy's equilibrium (or natural) real rate of interest, and hence its estimate of where the intercept needs to be in order for this policy rule to be consistent with the inflation target; ϕ_π and ϕ_y are positive coefficients indicating the degree to which the central bank responds to observed departures of inflation from the target rate or of output from the natural rate respectively. I shall assume that both $\bar{\pi}_t$ and r_t^* are exogenous processes, the evolution of which represent shifts in attitudes within the central taken to be independent of what is happening to the evolution of inflation or real activity.

This is a simplified version (because the relation is purely contemporaneous) of the empirical central-bank reaction function used to specify monetary policy in the empirical model of Smets and Wouters (2003). Like Smets and Wouters, I shall assume that the inflation target follows a random walk,

$$\bar{\pi}_t = \bar{\pi}_{t-1} + \nu_t^\pi, \tag{3.4}$$

where ν_t^π is an i.i.d. shock with mean zero, while r_t^* is stationary (or, if the natural rate of interest has a unit root, $r_t^* - r_t^n$ is stationary). This completes a system of three equations per period to determine the evolution of the three endogenous variables $\{\pi_t, Y_t, i_t\}$.

Using (3.3) to substitute for i_t in (3.2), the pair of equations (3.1) – (3.2) can be written in the form

$$z_t = A\, E_t z_{t+1} + a\, (r_t^n - r_t^*), \tag{3.5}$$

where

$$z_t \equiv \begin{bmatrix} \pi_t - \bar{\pi}_t \\ \log(Y_t/Y_t^n) \end{bmatrix}$$

A is a 2 × 2 matrix of coefficients and a is a 2-vector of coefficients. One can show that the system (3.5) has a unique non-explosive solution (a solution in

Table 3 Parameterization of the disturbance processes

ρ^{yn}	0.95
$\rho^{rn}; \rho^{rd}$	0.8
ρ^{u}	0.6
$\gamma_{11}; \gamma_{22}; \gamma_{33}$	1
$\gamma_{12}; \gamma_{13}; \gamma_{23}$	0.5
$\sigma(\nu^{\pi}); \sigma(\varepsilon^{u})$	0.0001
$\sigma(\varepsilon^{yn})$	0.0003
$\sigma(\varepsilon^{rn})$	0.001
$\sigma(\varepsilon^{m})$	0.003
$\sigma(\varepsilon^{rd})$	0.004

which both elements of z_t are stationary processes, under the maintained assumption that the exogenous process $r_t^n - r_t^*$ is stationary) as long as

$$\phi_\pi + \frac{1-\beta}{\kappa}\phi_y > 1. \tag{3.6}$$

If this condition holds (as it does for many empirical Taylor rules), the unique nonexplosive solution is given by

$$z_t = \sum_{j=0}^{\infty} A^j a\ E_t[r_{t+j}^n - r_{t+j}^*]. \tag{3.7}$$

This implies, in particular, a solution for equilibrium inflation of the form

$$\pi_t = \bar{\pi}_t + \sum_{j=0}^{\infty} \psi_j E_t[r_{t+j}^n - r_{t+j}^*], \tag{3.8}$$

where

$$\psi_j \equiv [1\ 0]\ A^j\ a$$

for each j.[12] This shows how inflation is determined by the inflation target of the central bank, and by current and expected future discrepancies between the natural rate of interest and the intercept adjustment made to central bank's reaction function. Note that one can solve for the equilibrium path of the inflation rate without any reference at all to the evolution of money.

One can, however, easily enough solve for the evolution of the money supply that should be associated with an equilibrium of the kind just described. Let us suppose that money demand is given by a relation of the form (2.3).[13] The addition of this equation to the system does not change the predicted solution for the equilibrium evolution of inflation, output, and interest rates; but given

12 For plots of these coefficients in some numerical examples, see Woodford (2003, Figs. 4.5, 4.6). The coefficients are denoted ψ_j^{π} in the figures.

13 Such a relation is perfectly consistent with the microeconomic foundations underlying the structural relations expounded earlier in this section; see Woodford (2003, chap. 4, sec. 3).

that solution, equation (2.3) can be solved for the equilibrium evolution of the money supply as well. The model can then be used to make predictions about the co-movement of money and inflation.

It can easily explain the kind of long-run or low-frequency relations between money growth and inflation emphasized in the monetarist literature. One popular approach has been to compare the low-frequency movements in money growth and in inflation through bandpass filtering of the respective time series; essentially, this means taking long moving averages of the data, so as to average out high-frequency fluctuations. For example, Benati (2005) compares the low-frequency variations in money growth and inflation in both the U.K. and the U.S., using various measures of money and prices, and data from the 1870s to the present, and finds that the timing and magnitude of the shifts in the low-frequency trend are similar for both money growth and inflation.[14] Another popular approach to studying the long-run relationship between money growth and inflation in a single country is cointegration analysis. Assenmacher-Wesche and Gerlach (2006a), for example, find that in the euro area, broad money growth and inflation are each non-stationary series (stationary only in their first differences), but that the two series are cointegrated, so that they have a common (Beveridge-Nelson) "stochastic trend": changes in the predicted long-run path of one series are perfectly correlated with changes in the predicted long-run path of the other series. Moreover, one cannot reject the hypothesis that the linear combination of the two series that is stationary is their difference (*i.e.*, real money growth), so that a one percent upward shift in the predicted long-run growth rate of broad money is associated with precisely a one percent upward shift in the predicted long-run rate of inflation, in accordance with the quantity theory of money.[15]

Results of these kinds are perfectly consistent with the kind of model described above – in which there is assumed to exist a stable money-demand relation, but money does not play any causal role in inflation determination. As a simple example, let us suppose that in the above model, $\eta_y = 1$, that the fluctuations in log Y_t^n, r_t^n, and ϵ_t^m are at least difference-stationary (so that the growth rate $\gamma_t^n \equiv \log(Y_t^n/Y_{t-1}^n)$ of the natural rate of output is stationary), and that the Taylor-rule intercept r_t^* tracks the natural rate of interest well enough (at least in the long run) so that the discrepancy $r_t^n - r_t^*$ is stationary, and moreover has a long-run average value of zero.[16] Then in the case of Taylor-rule coefficients satisfying the inequality (3.6), the result (3.7) implies that the unique non-explosive solution will be one in which both elements of z_t are stationary mean-zero processes. This in turn implies that inflation will be equal to the stochastic trend

14 Similar results are obtained (albeit with shorter time series requiring averaging over a somewhat shorter window) for euro-area data on money growth and inflation by Jaeger (2003) and Assenmacher-Wesche and Gerlach (2006a).

15 Cointegration analysis is similarly used to establish a long-run relationship between euro-area money growth and inflation by Bruggeman *et al.* (2003) and Kugler and Kaufmann (2005).

16 This assumption about the central bank's reaction function is necessary in order for the policy rule to imply that on average inflation will be neither higher nor lower than the target $\bar{\pi}_t$.

$\bar{\pi}_t$ plus a stationary process, so that $E_t\pi_{t+1}$ will also equal the stochastic trend $\bar{\pi}_t$ plus a stationary process. Moreover, log Y_t will equal the difference-stationary variable log Y_t^n plus a stationary process, so that the growth rate γ_t will be stationary. Equation (3.2) then implies that the nominal interest rate it will equal the difference-stationary variable r_t^n plus the difference-stationary variable $E_t\pi_{t+1}$ plus a stationary process, and thus will be difference stationary.

It follows that all terms in (2.4) will be stationary except μ_t and π_t. Hence μ_t and π_t will both be integrated series of order 1, with the common stochastic trend $\bar{\pi}_t$. Thus these two non-stationary series will be cointegrated, with cointegrating vector [1 −1]. Hence the cointegration results of Assenmacher-Wesche and Gerlach for the euro zone are in no way inconsistent with such a model. Moreover, since both inflation and money growth are equal to the integrated series $\bar{\pi}_t$ plus a stationary series, a bandpass filter that retains only sufficiently low-frequency components of the two series will average out the stationary components, yielding filtered series that are nearly the same in each case. Hence comparisons of the low-frequency movements in money growth and inflation, of the kind presented by Benati (2005) as well as by Assenmacher-Wesche and Gerlach, are consistent with this kind of model as well.

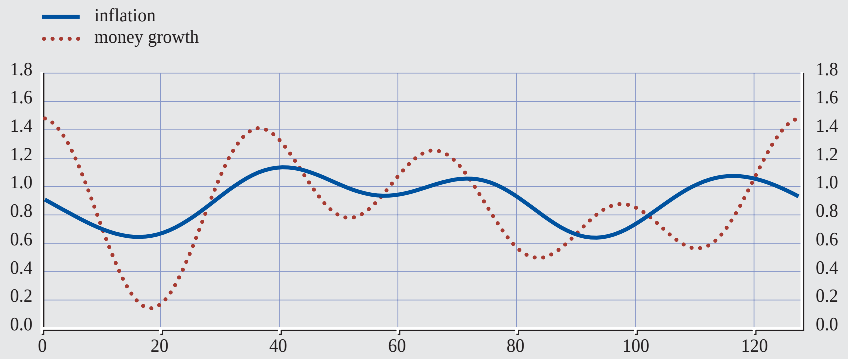
3.2 AN EXPLANATION FOR A "TWO-PILLAR PHILLIPS CURVE"

The kind of model just presented is equally consistent with estimates of "two-pillar Phillips curves." The appearance of money growth in the low-frequency bandpass regression, with a coefficient near 1, simply indicates that inflation and money growth are cointegrated, with a cointegrating vector close to the vector [1 −1] predicted by a money demand relation of the form (2.3). The other variables that appear in the low-frequency regression are similarly consistent with a model in which one of the structural equations is (2.3), and in which the disturbance term ϵ_t^m exhibits little low-frequency variation. The non-appearance of the "output gap" measure g_{t-1} in the low-frequency regression tells nothing about inflation determination, as this variable exhibits no low-frequency variation *by construction*.

At the same time, the appearance of the output gap as a significant predictor of high-frequency inflation variations is consistent with the existence of another structural relation which relates short-run variations in inflation and output to one another (*i.e.*, an aggregate-supply or Phillips-curve relation), in conjunction with substantial high-frequency variation in ϵ_t^m (or in inflation expectations), so that there need not be a substantial correlation between inflation and the quantity-equation variables at high frequencies. Under this interpretation of the findings, different *equations* of the structural model play a greater role in determining the coefficients of the (reduced-form) inflation equation in the case of different frequency ranges, but a single (internally coherent) *model* is consistent with both sets of findings.

Here I illustrate this through simulation of a numerical version of the simple model presented above. The model structural equations consist of (2.3), (3.1), (3.2), and (3.3), with numerical parameter values given in Table 1. Here the

Chart 1 Low-frequency components of inflation and money growth, in a simulation of the new Keynesian model



numerical values of β, κ, and σ are those estimated by Rotemberg and Woodford (1997) for the U.S. economy,[17] the assumed values of φ_π and φ_y are the coefficients of the celebrated "Taylor rule" (Taylor, 1993),[18] and the coefficients η_y and η_i are those indicated by the "low-frequency" regression of Assenmacher-Wesche and Gerlach (shown in Table 1), if this regression is interpreted as estimating the relation (2.4).[19]

To complete the model, we must specify stochastic processes for the six exogenous disturbances $\{\bar{\pi}_t, r_t^*, r_t^n, Y_t^n, u_t, \epsilon_t^m\}$. As above (and in Smets and Wouters, 2003), $\{\bar{\pi}_t\}$ is assumed to be a random walk (3.4), with white-noise innovation process $\{v_t^\pi\}$. I assume a VAR(1) specification for the natural rate of interest, the central bank's estimate of the natural rate (*i.e.*, the intercept of the central-bank reaction function), and the growth rate of the natural rate of output,

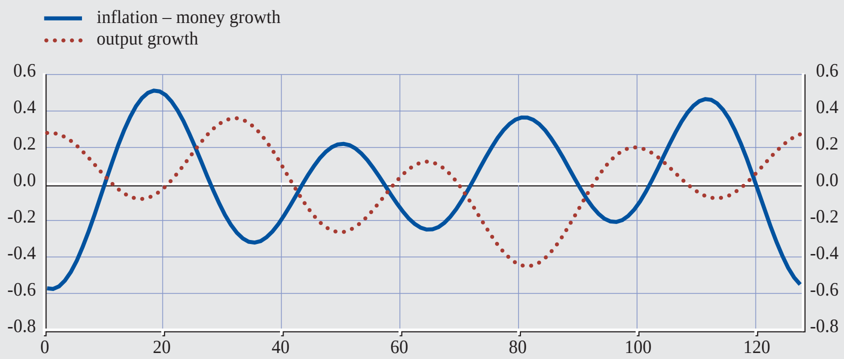
$$\begin{bmatrix} r_t^* - r_t^n \\ r_t^n - \bar{r}^n \\ \Delta\log(Y_t^n) \end{bmatrix} = \begin{bmatrix} \rho_{r^d} & 0 & 0 \\ 0 & \rho_{r^n} & 0 \\ 0 & 0 & \rho_{y^n} \end{bmatrix} \begin{bmatrix} r_{t-1}^* - r_{t-1}^n \\ r_{t-1}^n - \bar{r}^n \\ \Delta\log(Y_{t-1}^n) \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ 0 & \gamma_{22} & \gamma_{23} \\ 0 & 0 & \gamma_{33} \end{bmatrix} \begin{bmatrix} \epsilon_t^{r^d} \\ \epsilon_t^{r^n} \\ \epsilon_t^{y^n} \end{bmatrix} \quad (3.9)$$

17 The empirical model of Rotemberg and Woodford is not identical to the simple model assumed here, but has a similar basic structure.

18 The coefficient ϕ_y here is only ¼ the size of Taylor's value (0.5), because I measure the nominal interest rate i_t in terms of a quarterly rate rather than the annualized rate used in Taylor's paper.

19 Here the value η_i = 12 refers to the semi-elasticity with respect to the quarterly interest rate i_t; this corresponds to a semi-elasticity of 3 with respect to an annualized interest rate (the units in which this parameter is often reported in empirical money-demand studies).

Chart 2 Low-frequency components of inflation minus money growth compared with the low-frequency component of output growth



where the steady-state natural rate of interest $\bar{r}^n$ is equal to $\beta^{-1}-1$ and the $\{\epsilon_t^{rd}, \epsilon_t^{rn}, \epsilon_t^{yn}\}$ are each mean-zero white noise processes.[20] The cost-push shock is assumed to follow an independent AR(1) process

$$u_t = \rho_u u_{t-1} + \epsilon_t^u, \tag{3.10}$$

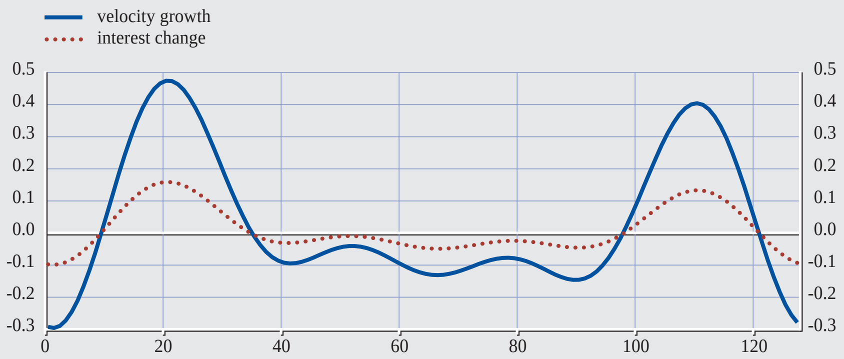
while the money-demand shock $\{\epsilon_t^m\}$ is assumed to be a white-noise process. The six white-noise processes $\{v_t^\pi, \epsilon_t^{rd}, \epsilon_t^{rn}, \epsilon_t^{yn}, \epsilon_t^u, \epsilon_t^m\}$ are all assumed to be distributed independently of one another (as well as i.i.d. over time), and each is assumed to be normally distributed with mean zero. The numerical parameter values for these processes assumed in the illustrative simulations here are given in Table 3.[21]

Following Assenmacher-Wesche and Gerlach (2006a), the inflation rate, the various interest rates, and the output growth rate are quoted as quarterly rates of change; thus, for example, the value $\bar{r}^n = .01$ means one percent per quarter, or a 4 percent annual rate. The initial value assumed for the inflation target in the simulations is .01 (one percent per quarter, or a 4 percent annual rate); this has a permanent effect on the inflation rate in the simulations, since the target

20 The off-diagonal elements in the γ_{ij} matrix allow changes in the growth rate of natural output to affect the natural rate of interest, and allow changes in either the natural growth rate or the natural rate of interest to have transitory effects on the discrepancy between the current natural rate of interest and the central bank's estimate. However, the natural growth rate is assumed to evolve independently of the other factors that affect the natural rate of interest, and other sources of shifts in the intercept of the central bank's reaction function are assumed to have no effect on the evolution of either natural output or the natural rate of interest.

21 No attempt is made here to estimate parameter values that can be said to be empirically realistic for the euro area, as the model is in any event overly simplistic. The point of the exercise is simply to show that regression coefficients of the kind obtained by Assenmacher-Wesche and Gerlach, among others, are perfectly consistent with a model in which money growth plays no causal role in inflation determination.

Chart 3 Low-frequency components of velocity growth and of quarterly changes in the nominal interest rate.



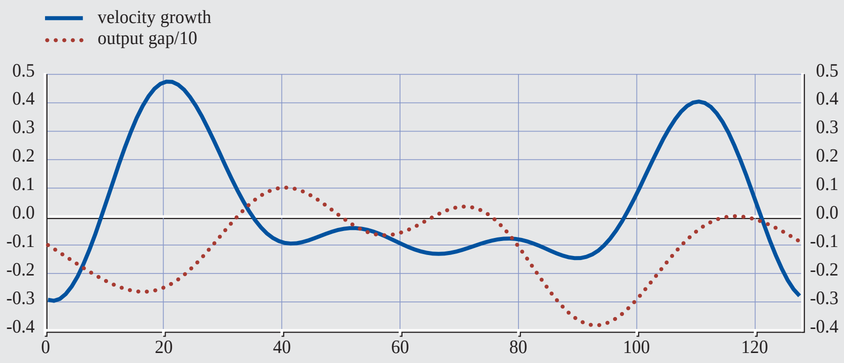
is assumed to follow a random walk.[22] Similarly, the value $\sigma(\nu^\pi) = .0001$ means that a one-standard-deviation shock to the inflation target increases the quarterly target inflation rate by one basis point, or the annualized target inflation rate by 4 basis points.

Given these disturbance processes, the model is solved in the manner indicated above, and then simulated using a random number generator to generate shocks with the indicated standard deviations. To study the kind of regression results that one would expect to obtain in a study like that of Assenmacher-Wesche and Gerlach, if the data generating process were the one specified here, I generate 1001 simulated time series,[23] each 128 quarters (32 years) in length,[24] starting from the same initial conditions (in particular, the same initial inflation target) in each case, but drawing a different series of shocks in each case.

Charts 1-7 illustrate some of the frequency-domain properties of a typical simulation. The simulation chosen for presentation is the one in which the standard deviation of inflation happens to have exactly the median value across all 1001 simulations. Chart 1 compares the low-frequency components of money growth and inflation in the simulated data, after the same bandpass filter is applied to each series. (Here, as in Table 1, the "low-frequency" components are taken to be those with periods longer than 8 years.) One observes, as in the corresponding figure presented by Assenmacher-Wesche and Gerlach for euro

22 Note, however, that the absolute level of the inflation rate has no consequences for any of the issues of interest to us here (since we ignore the zero lower bound on interest rates). As it happens, the nominal interest rate is always positive in the simulations reported below.
23 An odd number of series is generated so that I can report the median values of the statistics in Table 4.
24 Simulations of this length are chosen as this is approximately the length of the time series studied by Assenmacher-Wesche and Gerlach. It is convenient, when computing the Fourier transforms of the series, to have a number of observations that is a power of 2; this accounts for the choice of exactly 128 quarters as the length of each simulation.

Chart 4 Low-frequency components of velocity growth and of the output gap



area data, that the low-frequency components of the two series are quite similar.[25]

Next we may consider what accounts for the modest discrepancy between the two series that remains even at low frequencies. Chart 2 compares the low frequency components of inflation minus money growth (the solid line) and of output growth (the dashed line). These are nearly inverses of one another, as one would expect on the basis of a simple quantity-theoretic model of inflation in which money demand is proportional to national income. Finally, Chart 3 compares the low-frequency component of velocity growth (inflation minus money growth plus output growth) to the low-frequency component of the quarterly change in the nominal interest rate.[26] There is clearly a positive correlation in the low-frequency fluctuations in the two series, though the amplitude of the fluctuations in velocity is larger, consistent with a money-demand equation in which in the interest-rate semi-elasticity is well above one. In Chart 4, low-frequency velocity growth is instead compared with the lowfrequency component of the output gap, $\log(Y_t/Y_t^n)$.[27] While there is substantial low-frequency variation in the output gap in this simulation, given the definition that I am using of the "low frequency" component of the series,[28]

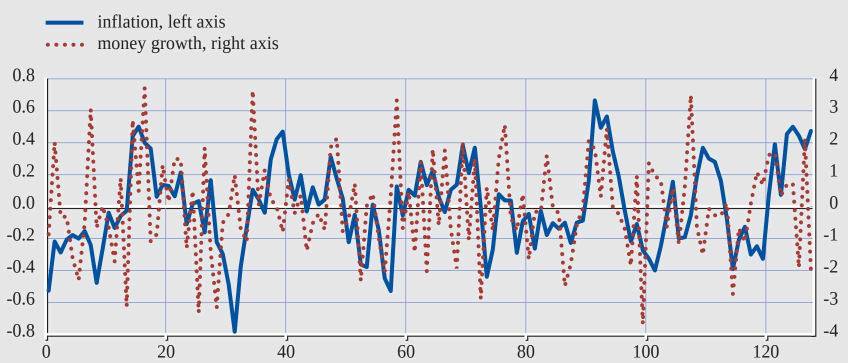
25 Not only are the two series highly correlated, as in the actual euro-area data, but the turning points of the filtered money growth series appear to "lead" the corresponding turning points of the filtered inflation series. But in our simulation model, it is clear that this does not imply causality from money growth to inflation!

26 For comparability with the results of Assenmacher-Wesche and Gerlach, my interest-rate change variable is the change from one quarter to the next in an *annualized* interest rate. However, for simplicity, I plot the (filtered) changes in the short-term (three-month) interest rate, rather than changes in a long-term interest rate. This is also the interest-rate change variable used in the regressions reported in Table 4.

27 In the chart, the low-frequency component of the output gap is divided by 10, so that the range of variation in the two series plotted in the chart is similar.

28 Because of the relatively short time series, it is necessary to retain medium-frequency components in the "low-frequency" filtered series, just as in the work of Assemacher-Wesche and Gerlach. It should also be noted that in this model, with the degree of persistence assumed for the disturbance processes, fluctuations in the output gap are fairly persistent, though stationary (and hence of negligible variance at very low frequencies).

Chart 5 High-frequency components of inflation and money growth, in the same simulation as in Chart 1



the low-frequency variation in the output gap is not nearly as closely related as the other variables to low-frequency variations in inflation.

The correlations that are observed at high frequencies are quite different, as can again be illustrated using plots of bandpass-filtered data from the same simulation. Chart 5 compares the high-frequency components of money growth and inflation (defined as the complements of the low-frequency components plotted in Chart 1). Here a much less close relation between the two series is visible, and a scatter plot of the two series (Chart 6) shows that indeed they are very weakly correlated. Chart 7 instead compares the high-frequency component of inflation with the high-frequency component of the output gap. At high frequencies (here corresponding to periodicities between 0.5 and 8 years), inflation and the output gap are very highly correlated. This makes it hardly surprising that the output gap should be the main variable of any significance in a reduced-form inflation equation that is estimated using only high-frequency data.

Chart 6 Scatter plot of the high-frequency components of inflation and money growth shown in Chart 5

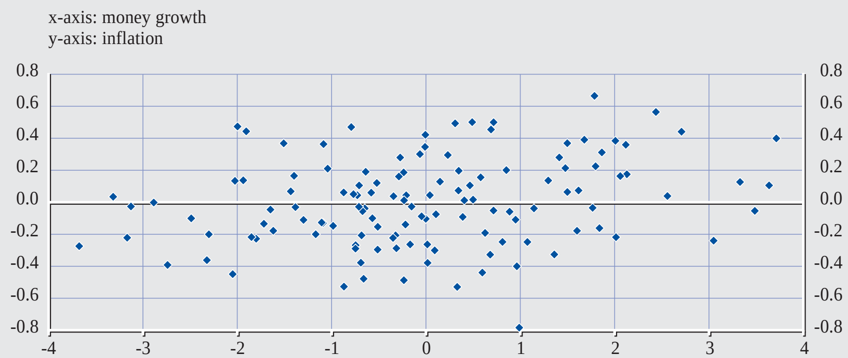
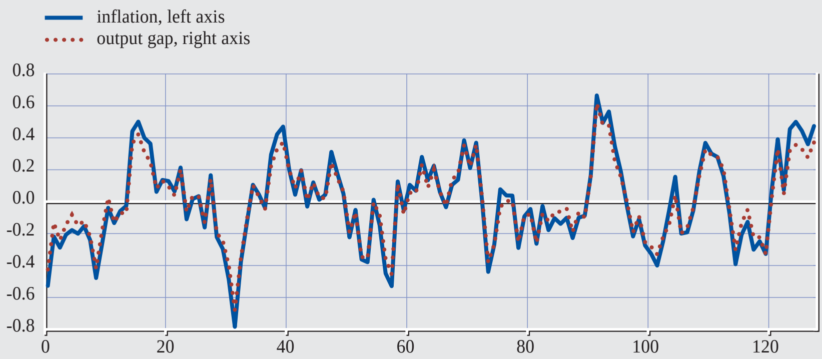


Chart 7 High-frequency components of inflation and of the output gap



In fact, if one estimates a "two-pillar Phillips curve" using simulated data from the simple new Keynesian model, one obtains results very similar to those reported by Assenmacher-Wesche and Gerlach (2006a), and reproduced in Table 1. Table 4 presents the results of the Monte Carlo simulation described above. Three regressions are estimated for each of the 1001 simulated time series. The first is a bandpass regression of inflation on a constant,[29] money growth, output growth, and the interest-rate change,[30] using the method of Engle (1974), where the frequency components of the series that are used are those with periodicities longer than 8 years.[31] The second is an alternative low-frequency regression, in which it is assumed to be known that inflation and money growth are cointegrated, with a cointegration vector [1 −1]. Here I regress the stationary variable, inflation minus money growth, on the other (stationary) regressors, again using low-frequency bandpass regression.[32] The third is a high-frequency bandpass regression of inflation on money growth, output growth, the interest-rate change, and the output gap (lagged one quarter).[33]

29 The estimated coefficients on the constant in the low-frequency regressions are omitted in Table 4, as Assenmacher-Wesche and Gerlach do not report the values that they obtain, though they report that constants were included among their regressors. In each of the low-frequency regressions in Table 4, the estimated coefficient on the constant has a median absolute value less than 0.01 and a median standard error less than 0.01 as well. This is not surprising, given that our theoretical model allows for no velocity trend; but of course a velocity trend could be added to the model without changing any of the conclusions reached here.

30 The interest-rate change variable used in these regressions is the quarterly change in the shortterm nominal interest rate, because this is the variable that appears in the theoretical relation (2.4), even though the variable used by Assenmacher-Wesche and Gerlach (2006a) is the change in a real interest rate.

31 This is not really a correct procedure, because inflation and money growth are non-stationary series; but the results are reported to show that this naive procedure would recover a coefficient close to one for money growth.

32 This is the kind of low-frequency regression reported by Assenmacher-Wesche and Gerlach, though they estimate the cointegrating relation in a first stage, whereas I treat it as known.

33 The constant is omitted in the high-frequency regression, as there is no high-frequency variation in a constant. The output gap regressor is lagged one quarter for comparison with the results of Assenmacher-Wesche and Gerlach.

Table 4 Inflation equations for alternative frequency bands, estimated using the data

Frequency range **Period (years)**	**HF** **0.5-8**	**LF** **8-∞**	**LF** **8-∞**
Money growth	0.02 (0.46) [-0.54, 0.70]	1.00** (0.02) [0.95, 1.04]	1 - -
Output growth	0.10 (0.41) [-0.50,0 .56]	-1.00** (0.03) [-1.07, -.92]	-1.00** (0.02) [-1.05, -.94]
Interest rate change	0.05 (1.08) [-1.21, 1.70]	3.00** (0.11) [2.75, 3.24]	3.01** (0.08) [2.82, 3.20]
Output gap	0.11* (0.05) [0.03,0.17]	- - -	- - -

Following Assenmacher-Wesche and Gerlach (2006a), the high-frequency regression uses a frequency-domain instrumental-variables approach proposed by Corbae et al. (1994) to deal with possible simultaneity bias that might be created by the cointegration relation between inflation and money growth.[34]

In the case of each regressor, Table 4 reports the median value of the regression coefficient over the 1001 simulations, the median standard error for this coefficient (in parentheses under the coefficient), and the range of values for the regression coefficient (in brackets) corresponding to the 5th through 95th percentiles of the distribution of coefficients obtained. Double asterisks again identify the regression coefficients that would be judged to be significant at the 1 percent level (when the t-statistic takes its median value), while a single asterisk indicates significance at the 5 percent level.

The results are quite similar to those obtained by Assenmacher-Wesche and Gerlach (2006a) for euro-area data, reported in Table 1. In the case of the low frequency inflation regressions (the last two columns of Table 4), the coefficient on money growth is highly significant and very close to the value of 1 implied by a quantity-theoretic model of inflation determination. The coefficient on output growth is also highly significant and very close to the value of -1 implied by the quantity theory (if one assumes a conventional unit-elastic money demand function), while the coefficient on the interest-rate change is significantly positive, as would also be implied by an interpretation of the low-frequency regression as estimation of the relation (2.4). The values obtained for all three coefficients in the long-run regressions are essentially the same as those obtained by Assenmacher-Wesche and Gerlach; the only notable difference is that in the case of the simulated data, it is possible to estimate the coefficients on output growth and the interest-rate change much more precisely.

The results of the high-frequency inflation regression (the first column of Table 4) are also very similar to those obtained by Assenmacher-Wesche and

34 Lagged money growth is used as an instrument for money growth. No instruments are used for the other regressors, as they are not cointegrated with inflation.

Gerlach. None of the three "quantity-theoretic" variables appear with coefficients significantly different from zero, and the (median) point estimates of these coefficients are also quite small. Instead, the lagged output gap appears with a significantly positive coefficient,[35] and the (median) numerical value of this coefficient is very close to the value reported by Assenmacher-Wesche and Gerlach. The reported range for the coefficient estimates indicates that a positive coefficient on the output gap is obtained more than 95 percent of the time.[36]

3.3 IMPLICATIONS FOR THE ROLE OF MONEY IN INFLATION CONTROL

The results presented above show that a finding of different numerical coefficients in a reduced-form inflation equation when it is estimated using different frequency ranges of the data is perfectly consistent with a *single* model of the causal factors responsible for variations in the rate of inflation. The fact that different coefficients values are obtained at different frequencies is simply a sign that the regression equation is *misspecified*, and so cannot be viewed as estimation of a structural relationship. But a coherent structural model may well exist that can simultaneously account for the lowfrequency and high-frequency regression coefficients; the model presented above is one simple example. For purposes of predicting the path of inflation under contemplated policy interventions, one should seek to determine an empirically realistic *structural* model, rather than expecting to be able to conduct policy on the basis of equations that are assuredly *not* invariant across alternative monetary policies. But once a structural model is available that simultaneously accounts for both low-frequency and high-frequency relationships, there will be no need for *separate* modeling efforts, intended to capture shorter-run and longer-run inflation dynamics respectively.

Moreover, the type of model needed to account for estimates of "two-pillar Phillips curves" need not be one that assigns any intrinsic role to money, either in the specification of monetary policy or in the monetary transmission mechanism. It could well be a model like the one sketched here (or like the Smets-Wouters model), in which monetary policy is specified by an interest-rate equation like (3.3) that makes no reference to monetary aggregates, and in which the effect of monetary policy on aggregate demand depends solely on the path of interest rates. A system of equations that make no reference to money might suffice to completely determine the evolution of inflation, as in the model presented above, and yet – as long as the central bank's inflation target $\bar{\pi}_t$ is non-stationary, and the associated evolution of the money supply is determined

35 The median t-statistic, across the 1001 simulations, is 3.14. This is somewhat smaller than the one obtained by Assenmacher-Wesche and Gerlach (2006a) for their (10 percent longer) historical sample, though the median standard error of the coefficient estimate that I obtain is, to the number of decimal places that they report, the same as theirs.

36 In fact, the coefficient is negative in only 3.6% of the simulations. The theoretical explanation for a positive high-frequency regression coefficient given at the beginning of this section suggests that the high-frequency relation between inflation and the output gap should be *contemporaneous* rather than with a one-quarter lag. Indeed, if the high-frequency regression is run with the current-quarter output gap as the regressor rather than the lagged output gap, the results are the same as those given in Table 4, to the degree of precision reported in the table.

by an equation like (2.3) – it will nonetheless be the case that at sufficiently low frequencies inflation will satisfy an equation like (2.2). Thus the findings of Assenmacher-Wesche and Gerlach do not imply any empirical inadequacy of "cashless" models, in either their low-frequency or their high-frequency implications.

Nor do their findings necessarily imply that money growth contains any useful information for forecasting inflation.[37] As a simple example, consider the new Keynesian model presented above, in the special case in which the interest-rate gap $r_t^g \equiv r_t^n - r_t^*$ is a white-noise process. (This could be true either because both r_t^n and r_t^* are white-noise processes, or because the central bank adjusts r_t^* to track the changes in the natural rate of interest that are forecastable a period in advance, setting $r_t^* = E_{t-1} r_t^n$.) In this case, the solution (3.7) is of the form

$$\begin{aligned} \pi_t &= \bar{\pi}_t + a r_t^g, \\ \log Y_t &= \log Y_t^n + b r_t^g, \end{aligned}$$

for certain coefficients a, b. If inflation evolves in this way, the optimal forecast of future inflation at any horizon $j \geq 1$ is given by

$$E_t \pi_{t+j} = \bar{\pi}_t = \pi_t + (a/b) \log(Y_t / Y_t^n). \tag{3.11}$$

Thus if one uses the current inflation rate and the current output gap to forecast future inflation, one cannot improve upon the forecast using information from any other variables observed at time t.

Forecasting future inflation using the output gap *alone* would not be accurate, since inflation has a stochastic trend while the output gap is stationary; one needs to include among the regressors some variable with a similar stochastic trend to that of inflation. In the specification (2.6), the only regressor with that property is money growth. But *inflation itself* is also a variable with the right stochastic trend, and using current inflation to forecast future inflation means that one need not include any other regressors that track the stochastic trend. What one needs as additional regressors are *stationary* variables that are highly correlated with the current *departure* of inflation from its stochastic trend, *i.e.*, the Beveridge-Nelson "cyclical component" of inflation. In the simple example presented above, the output gap is one example of a stationary variable with that property. More generally, the thing that matters is which variables are most useful for tracking relatively highfrequency (or cyclical) variations in inflation, and *not* which variables best track longrun inflation. Hence results like those of Assenmacher-Wesche and Gerlach provide no basis for assuming that money

37 Here I refer specifically to the finding that money growth is the most important explanatory variable in a regression such as (2.6) at low frequencies, as shown in Table 1. Other results, beyond the scope of the present discussion, do suggest that money contains information useful for forecasting inflation; for example, Gerlach (2004) shows that forecasts using money growth are superior to ones based on past inflation alone. But just how useful money growth is as an indicator variable depends on what other variables are also available as regressors.

growth should be valuable for forecasting inflation, regardless of the horizon with which one is concerned.

The conditions that lead to an optimal forecast as simple as (3.11) are rather special, but the conclusion reached about the kind of variables that should be most useful for forecasting inflation is a good deal more general. Consider, for example, the somewhat more general specification of the disturbance processes in (3.9). In this case, (3.7) implies an equilibrium of the form

$$\begin{aligned} \pi_t &= \bar{\pi}_t + a' v_t, \\ \log Y_t &= \log Y_t^n + b' v_t, \\ i_t &= \bar{r}^n + \bar{\pi}_t + c' v_t, \end{aligned}$$

where

$$v_t \equiv \begin{bmatrix} r_t^g \\ \hat{\imath}_t^n \\ \gamma_t^n \end{bmatrix}$$

is the vector of variables relevant to forecasting the evolution of the interest-rate gap, and *a*, *b*, *c* are now vectors of coefficients. The existence of a solution of this kind implies that the optimal inflation forecast will be of the form

$$E_t \pi_{t+j} = \bar{\pi}_t + d_j' v_t \qquad (3.12)$$

for any horizon $j \geq 1$, where d_j is another vector of coefficients.

It furthermore implies that

$$q_t = F\, v_t, \qquad (3.13)$$

where

$$q_t \equiv \begin{bmatrix} x_t \\ i_t - \pi_t \\ \gamma_t - \Delta x_t \end{bmatrix}, \qquad F \equiv \begin{bmatrix} b' \\ c' - a' \\ e' \end{bmatrix}$$

using the notation e´ ≡ [0 0 1]. The relation (3.13) implies that one should be able to infer the state vector v_t by observing the elements of q_t. The optimal inflation forecast can then alternatively be written

$$E_t \pi_{t+j} = \pi_t + (d_j' - a')\, F^{-1}\, q_t) \qquad (3.14)$$

in terms of observables. It is a linear function of the current inflation rate, the current nominal interest rate, and the current and lagged values of the output gap.

Once again, there is no need for information that is uniquely associated with money growth; and if one were to add money growth to the vector of indicators q_t, the weight on this indicator in the optimal inflation forecast would be zero, given that some of the variation in money growth would be due to disturbances (the money demand shocks) that are independent of the fluctuations in the state vector v_t.

Of course, the best set of indicators to use in inferring the state vector v_t in practice might not correspond to the vector q_t above; it will depend which indicators are available to the central bank with relative precision and in a timely way. But there is no obvious reason to suppose that money growth would be especially useful for this purpose, whatever the defects of other economic statistics may be. One needs to find indicators useful for estimating the current value and forecasting the future evolution of the interest-rate gap, and *not* additional indicators of the inflation trend. Thus the relation that may be found to exist between money growth (or smoothed money growth) and the inflation trend is no reason to expect money growth to be useful for this purpose. Moreover, the state vector v_t consists entirely of real variables, so it should not be surprising if the most useful indicators are real variables as well – not variables that depend on either the inflation trend or the absolute level of prices.

Nor do reduced-form inflation equations of the kind presented by Assenmacher-Wesche and Gerlach (2006a) provide any basis for supposing that an optimal inflationstabilization policy should make the central bank's interest-rate operating target a function of the observed rate of money growth. Beck and Wieland (2006) derive an optimal policy rule in which the interest rate depends on money growth, if an estimated "two-pillar Phillips curve" is treated as one of the structural relations of a model of the monetary transmission mechanism replacing the aggregate-supply relation (3.1). But in the case discussed here, that would be an incorrect inference. In the correct structural model, the evolution of inflation is fully described by equations (3.1) – (3.4), which do not involve money growth at all. Hence an optimal rule for choosing the central bank's interest-rate operating target – assuming a policy objective that can also be expressed purely in terms of the variables appearing in those equations, and assuming observability of the variables appearing in the equations – can also be formulated with no reference to money growth.

Of course, it remains possible that monetary statistics may have some use as indicator variables. In general, central banks use measures of a wide range of indicators in assessing the state of the economy and the likely effects of alternative policy decisions, and it is right for them to do so. There is no *a priori* reason to exclude monetary variables from the set of indicators that are taken into account. But the mere fact that a long literature has established a fairly robust long-run relationship between money growth and inflation does not, in itself, imply that monetary statistics must be important sources of information when assessing the risks to price stability. Nor does that relationship provide the basis for an analysis of the soundness of policy that can be formulated without reference to any structural model of inflation determination, and that can consequently be used as a "cross-check" against more model-dependent analyses. To the extent that money growth is useful as an indicator variable (as Beck and Wieland also propose), its interpretation will surely be dependent on a particular modeling framework, that identifies the structural significance of the state variables that the rate of money growth helps to identify (the natural rate of output and the natural rate of interest, in their example). Thus a fruitful use of information revealed by monetary statistics is more likely to occur in the context of a model-based "economic analysis" of the inflationary consequences of contemplated policies than in some wholly distinct form of "monetary analysis."

4 REFLECTIONS ON THE MONETARY POLICY STRATEGY OF THE ECB

The European Central Bank has already achieved a considerable degree of credibility for its commitment to price stability, and succeeded in stabilizing inflation expectations to a remarkable extent. The achievement is all the more impressive when one considers what a novel kind of institution it was, and how little basis the public had, as a result, for judging what kind of policy to expect from it. It is hardly surprising, then, that the ECB would be proud of the credibility that it has won, and concerned to maintain it. To what extent has its "two-pillar strategy" for monetary policy – and more especially, the prominent role for monetary analysis within that strategy – been a key element in that success?

One obvious advantage of the two-pillar strategy was that the emphasis placed on monetary analysis served as a sign of the new institution's fidelity to principles stressed earlier by the Bundesbank, which had in turn played a critical role as the anchor of the previous European Monetary System. This was doubtless an important source of reassurance as to the new institution's degree of commitment to price stability. But however prudent such a choice may have been when the new institution's strategy was first announced, in 1998, it hardly follows that it should never be possible to dispense with pious references to monetary aggregates. At some point, the institution should have earned its own credibility and no longer need to borrow this from an association with past policies of another institution. Of course, it will remain important that the ECB not appear to change its strategy abruptly or capriciously, if its own past successes are to count as a basis for confidence in the institution in the future. But evolution of the details of its strategy should be possible without risking the credibility of the Bank's core commitment to price stability, especially when this evolution can be explained as a result of improved understanding of the means that best serve that unchanging end.

Are there advantages of the two-pillar strategy besides the continuity that it maintains with the past? Two other merits of the strategy are worthy of mention. One is that the existence of the two pillars, acting as cross-checks on one another, underlines the fact that the Bank's preeminent goal is price stability, rather than any particular "intermediate target" or recipe for *reaching* that goal. Rather than drawing attention to any particular quantitative guideline for policy

– whether a monetary target like that of the Bundesbank in the past, or the kind of mechanical rules for setting interest rates on the basis of an inflation projection for a specific horizon sometimes offered as an account of inflation-forecast targeting at other central banks – the ECB has instead emphasized its goal of price stability, and shown a willingness to be pragmatic in determining the policy needed to achieve it. There are important advantages to such a "high-level" policy commitment (in the terminology of Svensson and Woodford, 2005). On the one hand, the commitment that is made is closer to what the Bank actually cares about, avoiding the problem of sometimes being forced to take actions that are known *not* to serve the ultimate goal simply because they are prescribed by a guideline that is often but not always congruent with that goal. And on the other, the public's attention is focused on the variable about which it is most useful for them to have well-anchored expectations; for it is inflation expectations (rather than expectations about either money growth or overnight interest rates) that most directly affect the degree to which the Bank can achieve its stabilization objectives.

Yet there are other ways in which a central bank can emphasize the outcome that it is promising to deliver rather than the particular means that it uses to judge the required policy action. Inflation-targeting central banks all give much more prominence, in their communication with the public, to their quantitative inflation targets (that play essentially the same role for these banks as the ECB's definition of price stability) than to the nature of the decision framework that the use to set interest rates. At the same time, they provide a great deal of information about their decision framework as well – more, in fact, than the ECB does – but in a part of their communication that is addressed to a more specialized audience of financial professionals. The Inflation Reports of banks like the Bank of England, the Riksbank, or the Norges Bank provide detailed information about the justification of individual policy decisions – providing a considerable basis for the prediction of future policy, in the case of those in their audience capable of making use of such information – without the banks being tied to a rigid decision framework by their commitment to providing such explanations. And this approach has the important advantage – relative to the strategic ambiguity that is inherent in a "multiple pillar" approach – of requiring a greater degree of coherence in the bank's explanations of its policy. Such discipline should ultimately better serve the bank's interest in allowing verification of its commitment to its putative target and in improving public understanding of how policy is likely to be conducted in the future.

Another notable advantage of the ECB's strategy – over some of the common interpretations of inflation targeting at the time that the Governing Council first had to announce that strategy – is that it is not purely forward-looking. As I have discussed elsewhere[38] the computation of a measure of "excess liquidity" on the basis of a "reference value" for money growth introduces an element of errorcorrection into the decision process that is not present if a central bank is solely concerned with whether projections of inflation some years in the future conform to its (time-invariant) target. But as I have also explained, the desirable

38 See the discussion in Woodford (2007, section 4).

consequences of a commitment to error-correction can be obtained more directly and more reliably through an explicit commitment to adjust policy in response to past target misses; and this only requires monitoring of inflation outcomes, not of monetary aggregates. A commitment instead to correct past excesses or insufficiencies of money growth can only create undesirable uncertainty about the extent to which this may or may not imply stability of the general level of prices at the horizons that are most relevant for economic decisions.

In short, while the general goals of the ECB's strategy are highly praiseworthy – as is the institution's willingness to openly discuss the means that it uses to determine the specific policy actions that serve those goals – there would appear to be room for further refinement of the intellectual framework used as a basis for policy deliberations. And I believe that a serious examination of the reasons given thus far for assigning a prominent role to monetary aggregates in those deliberations provides little support for a continued emphasis on those aggregates.

This is not because a simple formula for sound monetary policy has been discovered and can be shown not to involve money. The quest for a robust decision-making framework for policy is an important one, and there is no reason to regard the procedures currently used by any of the inflation-targeting central banks as the final word on the matter. It makes sense to seek to refine those methods, and to try to find ways to reduce the chance of especially bad outcomes owing to errors in one's model of the monetary transmission mechanism. But there is at present little reason for the quest for such a robust framework to devote much attention to questions such as the construction of improved measures of the money supply or improved econometric models of money demand. For there is little intelligible connection between those questions and the kinds of uncertainty about the effects of monetary policy that are the actual obstacles to the development of more effiective, more reliable, and more transparent ways of conducting policy.

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COMMENT

BY CHRISTIAN NOYER, GOVERNOR OF THE BANQUE DE FRANCE

It is a great pleasure and honour for me to take part in this Central Banking Conference.

My communication will be organised as follows: I will first review some stylized facts about money and inflation that show that money still matters; second, I will relate these stylised facts to the two-pillar monetary policy strategy of the Eurosystem. I will conclude my presentation by addressing some interesting challenges we face in implementing our monetary analysis.

SOME STYLIZED FACTS ABOUT MONEY AND INFLATION

Let me start with a well known paradox which can be articulated in three propositions: first, price stability is the objective of all Central Banks; second, as Milton Friedman put it "inflation is always and everywhere a monetary phenomenon"; and third, nevertheless, in most countries, money has little or no part in the design or implementation of monetary policy.

There is, of course, one noticeable exception: the euro area. Before getting into more details about our approach, I would like to mention two reasons why I think money, as such, remains an essential component for the design and implementation of monetary policy.

- First, money is still of direct relevance to monetary policy in exceptional circumstances: either strong (or hyper) inflation or deflation. When Paul Volcker brought down US inflation from 13% to 3% in three years, he did it by setting a cap on Central Bank money growth. And symmetrically, when the Japanese authorities had to fight deflation, they resorted to a "quantitative easing" policy, which basically meant they were targeting a specific amount of Central Bank money. There has been considerable debate over the theoretical underpinnings of those policies: namely whether a specific channel of transmission of monetary policy, independent of interest rates, could be identified. In any case, those experiments show, in my view, that setting a path for money growth (or its level) can prove very effective in controlling expectations – or pin down the price level – in an extreme environment.

- In more normal circumstances, however, the relationship between money and prices is more subtle and uncertain. In modern market economies, the demand for money exhibits – at least in the short and medium run – some chronic instability, if not unpredictability, a point to which I shall come back later. This has led to the demise of monetary aggregates as targets of monetary policy, and, in some countries, they have been abandoned as indicators as well.

But we still think, in the euro area, that Friedman is right in the very long run. Our research has established that low frequency movements in money growth and inflation are closely correlated, retaining fluctuations with a period of 8 to 10 years. This is because, in our view, money can directly influence output and inflation in particular due to monetary and financial frictions existing in the economy and also some stickiness in the price determination process.

THOSE FACTS UNDERPIN THE TWO PILLAR APPROACH OF THE EUROSYSTEM

As you know, the Eurosystem's monetary policy strategy is grounded on two pillars: economic analysis, on the one hand, and monetary analysis, on the other. A wide set of shortterm indicators (economic analysis) are complemented by the longer-term determinants of inflation (monetary analysis). This setup is based on a premise and has one important implication.

The premise is that even if money has no systematic and immediate influence on prices, it can provide valuable and specific information on future inflation, at time horizons stretching beyond those usually adopted for the construction of central bank inflation projections. Because of the long-term relation between money growth and inflation, money has leadingindicator properties on future price developments. One could make the case that this is only an "empirical argument". But, in Central Banking, empirical realities do matter much. One could also argue that other strategies – such as targeting the price level or an average level of inflation over the long run – would have the same stabilizing properties as looking at money growth. I do not disagree in theory. But it is not clear to me that those strategies would be easier to implement or have the same anchoring effect on inflation expectations.

The implication is the need to cross-check the information on inflationary pressures and risks to price stability; this cross-checking implies that we bring together and compare different analytical strategies and that we use systematically all the information relevant to decisionmaking.

Of course, monetary policy does not react mechanically to monetary developments, but rather responds to the information in monetary aggregates that is relevant for maintaining price stability over the medium term. This is the rationale behind the definition of "a reference value" for monetary aggregates.

The monetary pillar supports a risk management approach to monetary policy. It allows for an early assessment and detection of potential imbalances. It sheds light on those risks at a longer time horizon than the one usually contemplated by monetary policy, but still relevant for the ultimate objective of price stability.

This is of special significance and importance when financial imbalances build up in the economy, which are fueled by excess money or liquidity growth. Unwinding of those imbalances can be brutal and discontinuous – the so called non linear reaction – and, as such, very destabilizing. Empirical evidence suggests that asset booms have typically occurred when money and credit growth were above their long-term average. Whatever the loss function and ultimate objectives of Central Bankers, all would agree that monetary policy should not willingly contribute to the formation of such credit and asset booms.

TO MAKE BEST USE OF THE INFORMATIONAL ROLE OF MONEY, HOWEVER, WE HAVE TO FACE NUMEROUS AND INCREASING CHALLENGES

One major difficulty is to identify in real time the nature of monetary developments and their implications for future price developments. The challenge of monetary analysis is to see through the noise in monetary data to recover those underlying trends which are relevant for monetary policy decisions. Meeting this challenge has not been straightforward in recent years as the euro area economy was hit by several shocks: financial instability in the aftermath of the stock market collapse in 2000, exceptionally high economic and geopolitical uncertainty between 2001 and 2003, just to name a few.

First of all, short-run monetary developments are often affected by transitory shocks. We need to identify and account for such temporary "special factors" or "distortions" that may affect monetary developments and blur their information content. To some extent it is the aim of the methodology developed at the ECB which allows for periodic adjustments to measured monetary aggregates in order to account for portfolio shifts which impact the demand for money without any incidence on future inflation. This approach has met with great success in the period 2000-2004.

Second, and more permanently, it is necessary to disentangle, in monetary and credit evolutions, those which reflect structural and permanent changes from those which simply result from moves in the level of interest rates and the position in the economic cycle. Here, no mechanistic or ad hoc approach would do the trick. We need to look at the fundamental determinants of money demand. Ideally, we should have a full and comprehensive model of portfolio allocation and choices which, as an aside, would produce a determination of the demand for money. We might be a long way from building such a model.

But we can have some intuitions. We could start from the fact that money is both substitutable and complementary to financial assets. Because it is substitutable, money demand depends on changes in relative returns – i.e. the actual and expected moves in interest rates. But money is also a complement to financial assets, and as such reacts to permanent changes in the supply, availability and characteristics of those assets. Our economies are becoming more and more "financial" in the sense that the ratio of financial wealth to GDP is constantly increasing. Since economic agents , – especially financial intermediairies and corporates – need to keep part of their total financial assets in liquid holdings, there may be a structural increase in the demand for money (everything equal). The euro and the integration of European capital markets may have accelerated this evolution.

This could help explain the apparent break in the trend of the income velocity of money that took place in the euro area in 2000/2001. In effect, since 2001, income velocity has been declining by 3.5% a year, much faster than the rate embedded in the reference value.

According to one possible interpretation, this trend is a reflection of two consecutive shocks: from 2000 to 2004, a temporary "demand" shock, mainly reflecting portfolio shifts; and, since 2004, a "supply" shock i.e an increase in liquid assets triggered by the fall in the opportunity cost of holding money in a context of historically low interest rates.

But the fact that this situation has now lasted since 2001 may suggest another explanation: that the apparent break in trend velocity that took place at that time is of a structural nature. On-going econometric research carried out at the Banque de France confirms this intuition[1]. The sharp decrease in interest rates, of course has played a role. Nevertheless, econometrics seems to show that this only accounts for a very small part in the break in the trend visible since 2001. So we might be facing a permanent increase in the demand for money.

Consistent with this hypothesis is the fact that money holdings by corporates and financial institutions have grown much faster, in recent years, than those of households. Money and credit growth could then be related to a common cause: financial development and the increasing weight of financial assets in our economies.

A lot of work, however, remains to be done to fully understand the changes we are facing. This, in my view, is the beauty of our monetary analysis. It invites us – indeed it forces us – to face the complexity of our world and the ever changing nature of our environment and our behaviour. This is precisely the aim of this conference.

I thank you for your attention.

1 Christian Bordes, Laurent Clerc and Velayoudom Marimoutou (2007): "Is there a structural break in equilibrium velocity in the euro area?", Note d'Etudes et de Recherche no. 165, Banque de France, February.

COMMENT

BY HARALD UHLIG, UNIVERSITY OF CHICAGO

1 MICHAEL WOODFORD IS RIGHT!

In his essay, Michael Woodford criticizes the "monetary pillar" of the strategy of the European Central Bank. He argues that the ECB would do better to focus directly on inflation forecasts and projections instead. I shall argue that Michael Woodford is right. In doing so, I shall try to avoid two misunderstanding. First, the argument of Michael Woodford does not say that money is unimportant for inflation. Second, to be convinced by the arguments of Michael Woodford does not mean that one needs to be a New Keynesian. Rather, his arguments simply say, that if a central bank wishes to focus on inflation, it should do exactly that rather than circumnavigate around its primary goal by also worrying about money. Once the focus is directly on inflation, there is no need to "assign an important role to tracking the growth of monetary aggregates when making decisions about monetary policy."

1.1 WE ARE ALL MONETARISTS NOW ...

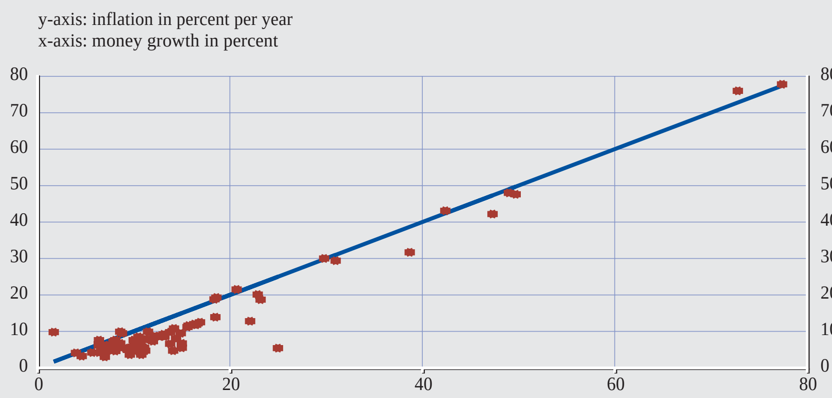
Is money important for inflation? Of course it is. According to Milton Friedman (1992), the founding father of monetarism, "inflation is always and everywhere a monetary phenomenon". While the modern picture is more complicated – for example, due to multiple currencies, multiple equilibria or due to a "fiscal theory of the price level" – this monetarist perspective has become one of the most solid foundations of the consensus view of the economics profession. We are all monetarists now!

These insights also apply to New Keynesian models. While it is true that money often does not even appear as a variable in these models, one can always modify these models so as to make real money matter for the utility of the agent, and therefore derive an additional money demand equation. In fact, if one wants these models to deliver implications for monetary growth rates, or if one wants to understand how a central bank in these models can actually deliver a certain nominal interest rate through open market operations, one must add such an equation. These models typically abstract from that feature because it is typically not necessary for the analysis. But these models do not deny the relationship between money growth and inflation! New Keynesian models are monetarist, too.

The monetarist perspective can be summarized by the quantity theory equation,

$$M\,V(i) = P\,Y$$

Chart 1 **Money growth versus inflation per year**



where M denotes the money stock, V denotes velocity, in dependence of the nominal interest i, P denotes the price level and Y denotes real output. This equation defines velocity, but combined with an assertion or theory, on how velocity depends on nominal interest rates, it becomes a theory of inflation. In particular, with stable velocity, it implies a long-run relationship between money growth and inflation. Take the quantity theory equation for two different points in time, and divide. If velocity is unchanged, one obtains that the long-run inflation rate must equal the long run money growth rate minus the long run real output growth rate.

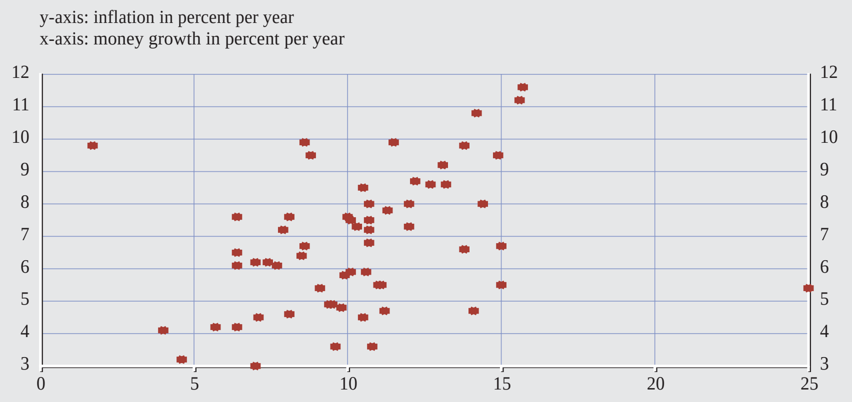
The chart above – based on numbers published in Barro's (1993) undergraduate macroeconomics textbook, and essentially reproducing a figure in McCandless and Weber (1995), reproduced in Lucas (1995) – shows the relationship between money growth and inflation across a large sample of countries vis-à-vis a 45-degree line. Clearly, there is a tight link between monetary growth and inflation. And it would seem, that therefore inflation can be controlled simply by controlling monetary growth. In fact, it seems that some desired and stable inflation rate can be achieved by sticking to a rule of fixed money growth, year by year, as Friedman suggested.

1.2 ... BUT THE MONEY-INFLATION RELATIONSHIP IS NOT TIGHT, IF INFLATION IS LOW

The picture becomes murky, however, once on restricts attention to low-inflation countries, zooming in on the countries in the lower left-hand corner. The following chart only includes countries for which the inflation rate was below 12 percent, as a somewhat arbitrary cut-off. While a positive relationship still seems to be there, the relationship is more of a cloud than a straight line.

These figures have not made any allowance for real GDP growth or for explainable changes in velocity, though, as quantity theory would demand. One can try to bring these elements back into the analysis, see the discussion in Teles

Chart 2 Money growth versus inflation (I)

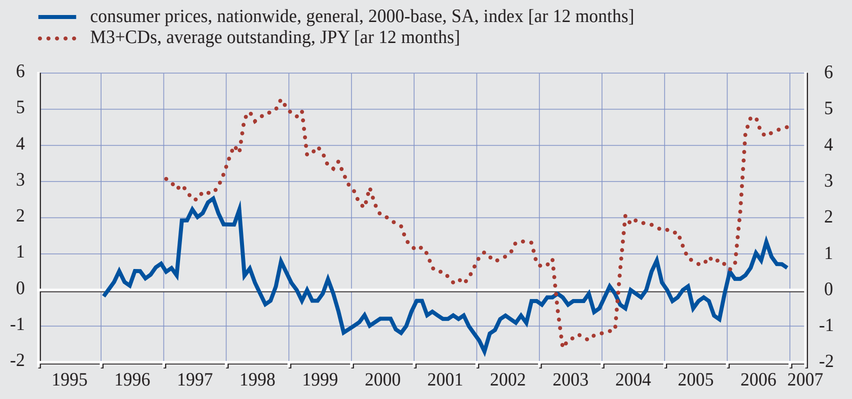


and Uhlig (2007). While some improvements can be found, the relationship remains loose for low inflation countries.

These lessons are confirmed by the experiences of the Bank of Japan and of the ECB, as the Charts 3 and 4 show. In Japan, the money stock as measured by M3 plus CD kept increasing between 1998 and 2007, sometimes at rates above 5 percent (and except for a short negative-growth period in 2003), but nonetheless, prices kept falling in many months, with inflation rarely edging beyond 1 percent since 1998. Quantity theory holds an explanation: it may well be that velocity decreases dramatically, as nominal interest rates approach zero, as they have done in Japan. As a result and in the extreme, money growth may be completely uninformative at a nominal interest rate of zero, except for its very long-run behaviour, see Cole and Kocherlakota (1998). Monetary growth ceases to be useful at all as an indicator for future inflation!

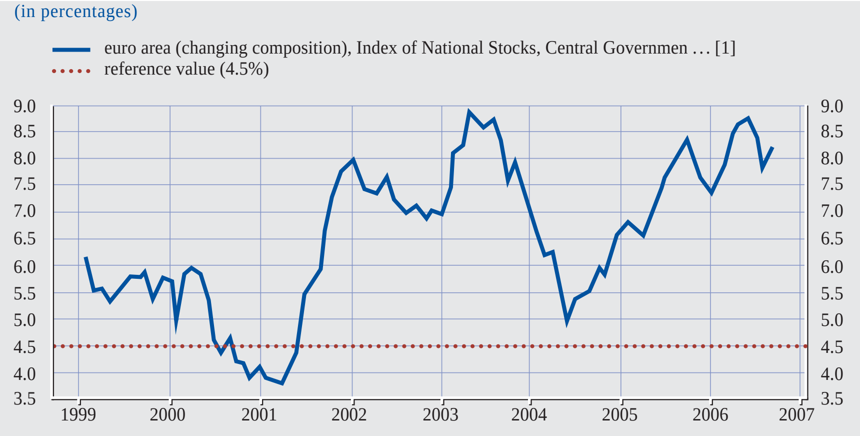
Chart 3 Money growth versus inflation (II)

(in percentages)



Source: Reuters EcoWin.

Chart 4 Money growth and the reference value



At the ECB meanwhile, it seems that money growth has been high and typically way above the self-imposed reference value of 4.5%, while the ECB has managed to keep inflation in check all along. Again, the relationship between money growth and inflation seems to have been tenuous at best, and largely been ignored by the ECB, if so.

1.3 CENTRAL BANKS OUGHT TO FOCUS ON INFLATION

The available empirical evidence therefore suggests, that the relationship between money growth and inflation is not sufficiently tight at low inflation rates in order to deliver the kind of stable inflationary environments we have become accustomed to and which central banks seem to be able to deliver. And indeed, there is an increasing consensus, that central banks ought to deliver low and stable inflation. Given this goal, this – and not monetary growth rates – should be the focus of the analysis at a central bank. And since one of the pillars at the ECB is the examination of all forces as they contribute to inflation – and one might just as well include money in the list of these forces – it remains unclear, why money should play any special, additional role. The additional monetary pillar is not enlightening, it is confusing, given that the primary objective of the ECB is price stability.

One may now wonder, how a central bank should go about delivering low and stable inflation. The answer is: just do it! Why? Because it can. Empirically, we observe that central banks are able to deliver low and stable inflation – and that suggests that they are pretty good at it. Why and how this is so will remain a fascinating topic of research. I do believe that a central bank will continue to do good to examine a variety of competing models in order to understand the forces acting upon inflation. A careful analysis is in order and is necessary! But I have my doubts that the emphasis on the monetary pillar is really what does it.

New Keynesian models are one particular branch of the analysis, and they also provide an answer for controlling inflation: watch the output gap! But in order to appreciate the convincing logic of the arguments in Woodfords paper, one does not have to be sold on New Keynesian models. If you are, that's fine, but if you are not, then I suggest to simply read the analysis in Woodfords paper as an example that it is possible to directly worry about inflation without having to take the "monetary detour". I suspect that there are many more such examples. All of these show that a monetary pillar is not necessary for providing low and stable inflation. It suffices that central banks are able to control inflation pretty well. And apparently, they are.

2 CHRISTIANO-MOTTO-ROSTAGNO TELL US: USE A MODEL!

The paper by Lawrence Christiano, Roberto Motto and Massimo Rostagno is a wonderful case for how careful analysis and reasoning through a state-of-the-art equilibrium model can help in illuminating the complex interrelationships in an economy. Their analysis demonstrates that a careful analysis beats guessing what is going on, beats oversimplifying the task of a central bank and forces one to think through all the elements and quantities carefully. In short, Christiano, Motto and Rostagno force us to think right!

In my discussion, I shall argue, that a simple intuitive reasoning has its pitfalls. I shall argue that Christiano, Motto and Rostagno demonstrate nonetheless, that this reasoning works out in a modern monetary general equilibrium model, providing a deeper understanding and a quantitative assessment. In particular, they point to faulty monetary policy as a key reason for the severity of the boom-bust cycle they investigate. I shall then empirically examine some boom-bust episodes, and argue, that monetary policy probably was not the culprit for the stock market boom-bust episodes we have experienced, but that this conclusion does not let monetary policy off the hook.

2.1 THE INTUITIVE STORY VS CHRISTIANO, MOTTO AND ROSTAGNO

The intuitive story for a boom-bust episode on the stock market runs as follows. Suppose that (irrationally?) exuberant people expect some kind of technological breakthrough in the future. This will induce a boom today. The stock market booms, since the value of companies with fancy new technologies rises. Economic activity booms, as investments have to be made in order to capitalize on these new technologies in the future. Should these expectations eventually be disappointed, everything will be reversed.

Unfortunately, the simple intuitive story has its holes. The standard first-order condition for the supply of labour states, that the ratio of the marginal utilities for leisure and consumption ought to equal the wage. Or, to put it differently, in order for agents to be willing to work harder, the extra wages earned better be worth it in terms of the extra happiness money can (or cannot) buy.

If wages stay the same, there is no reason to work harder than otherwise: giving up on leisure in order to consume more goods makes no sense, unless something has changed. What would do the trick is an increase in wages – but if people work harder, wages ought to fall, not rise, due to decreasing returns to labor. This is the first problem of the intuitive story. The second problem is this. Since consumption will increase in the future, after the technological breakthrough, interest rates ought to rise now, lowering the desire of agents to buy shares: the rise in interest rates ought to diminish the onsetting stock market boom.

In sum, the intuitive story has two problems, and seems hard to rescue. And without such a rescue, it is even harder to think through the question of whether and how much monetary policy may have contributed to such boom-bust cycles (and whether and how this can be avoided in the future).

Christiano, Motto and Rostagno show us that a modern general equilibrium model does resurrect the intuitive story, and provides us with a deeper understanding for it. And in particular, they show us how a Taylor-rule pursuing central bank may be making matters worse. The model features habit formation, costs to adjusting investment, sticky wages and an inflation-targeting authority. Their paper provides a careful and detailed examination of the mechanism and there is no need for me here to restate these clear explanations.

In particular, they show that monetary policy is to blame for these episodes. If only monetary policy had done what was right according to the optimal Ramsey-solution to their model, the boom-bust episode would have been much more modest, as their figure 9 shows. The net real interest rate should have been allowed to peak at 14 percent just as the bust occurs. Smoothing interest rates appears to be exactly the wrong thing to do. If monetary policy had pursued its correct course of action, the price of capital should have been falling rather than rising.

The analysis is intriguing, because it shows, what is important. Good monetary policy needs careful modelling to understand the forces hitting the economy and to react to them appropriately. Simple intuitive reasoning alone won't do the trick. And, just as importantly: a die-hard inflation-targeting central bank, employing a Taylor-rule, might do lots of wrong!

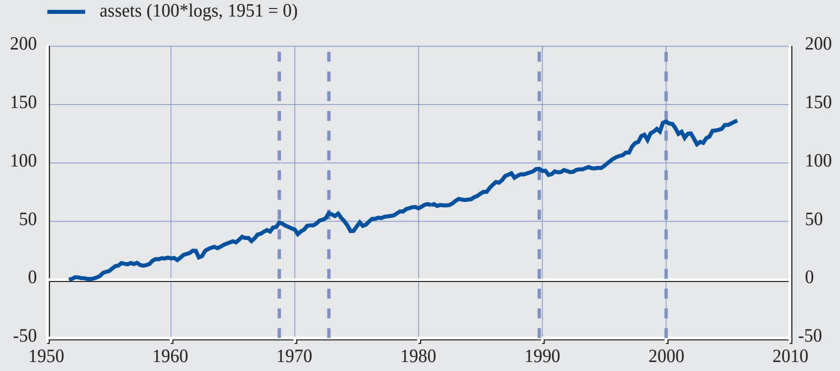
2.2 ... BUT IS IT RIGHT?

The Christiano-Motto and Rostagno story is an intriguing possibility for boom-bust cycles, dramatically worsened by bad monetary policy (which even does not seem obviously bad!). Should one buy their explanation? Should we now blame central banks for the woes of the 1987 or the 2001 stock market crashes? Let us not rush to that conclusion just yet.

The model provides for a possibility – it does not mean that things indeed happened this way, only that they might have. In order to examine this, one can compare the quantitative magnitudes predicted by the model to observations. A first hint that the story needs further modification comes from examining consumption. It moves a lot in the exuberant Christiano-Motto-Rostagno-type

Chart 5 Assets per person

(in percentages)



booms, as much as the price of capital. But casual evidence suggests, that the price for capital moves a lot more. Let us therefore investigate the data more closely.

In Chart 5, I have used the Lettau-Ludvigson "cay-"data to plot assets per person in the United States. As one can see, there are a number of boom-bust episodes, highlighted by vertical lines. Next I have investigated the behaviour of key macroeconomic aggregates around these dates, and compared them to the other, "normal" times.

Examination of data on nondurable consumption shows that not much is happening here. Consumption grows slightly faster in the run-up to the boom, and perhaps slightly slower afterwards, but all of this is within normal ranges, and, in any case, not quantitatively large.

Chart 6 Peaks versus normal times: consumption

(in percentages)

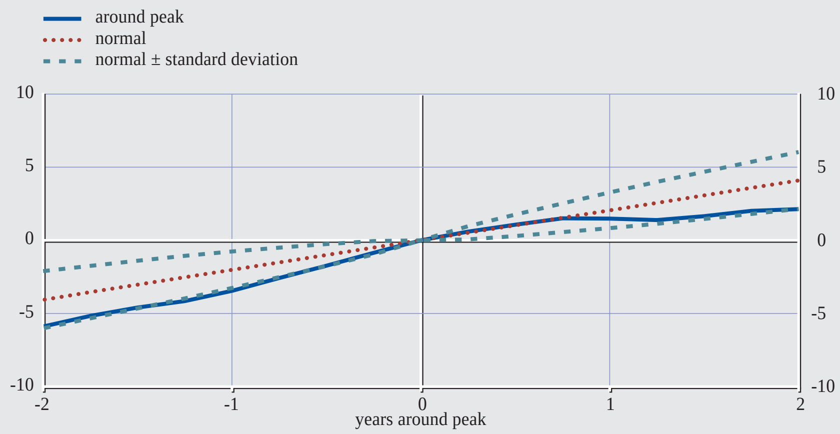
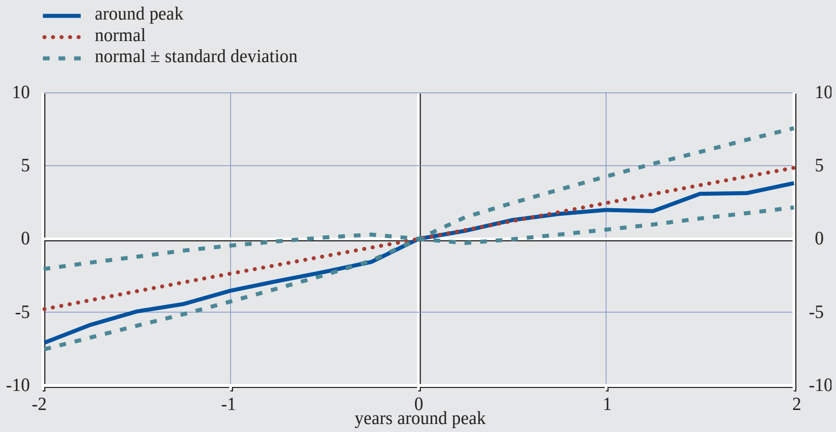


Chart 7 Peaks versus normal times: consumption

(in percentages)



The next three figures show that a similar picture emerges for income, hours worked and even investment. While there appears to be somewhat of a boom-bust-phase for investment, it is still within standard ranges – even though one may at least argue here that these are reasonably sizable (albeit not large) movements. The only place where we really see a substantial movement and a clear boom-bust cycle – and unsurprisingly so – is in the asset stock itself.

It would be interesting to have models that feature boom-bust episodes of the type and of the quantitative magnitude depicted in these figures. They seem to be typical to what we have experienced during the last 50 years. It would then

Chart 8 Peaks versus normal times: investment

(in percentages)

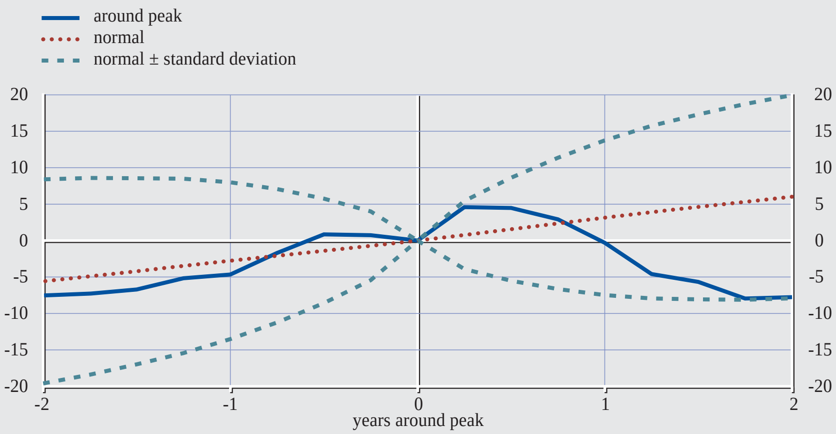
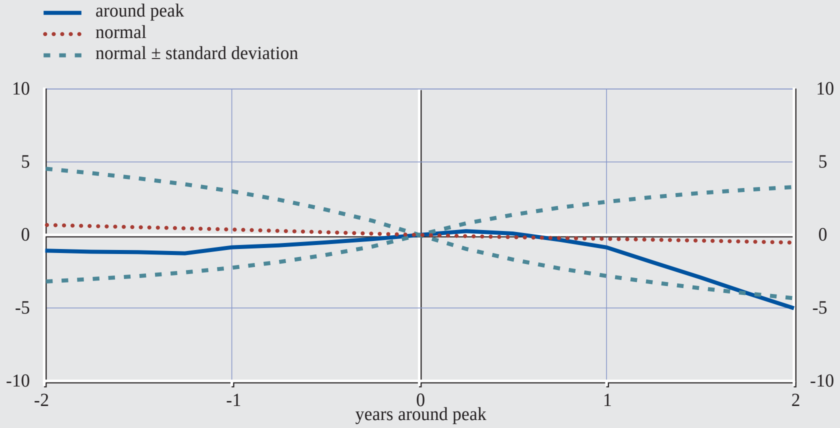


Chart 9 Peaks versus normal times: hours

(in percentages)

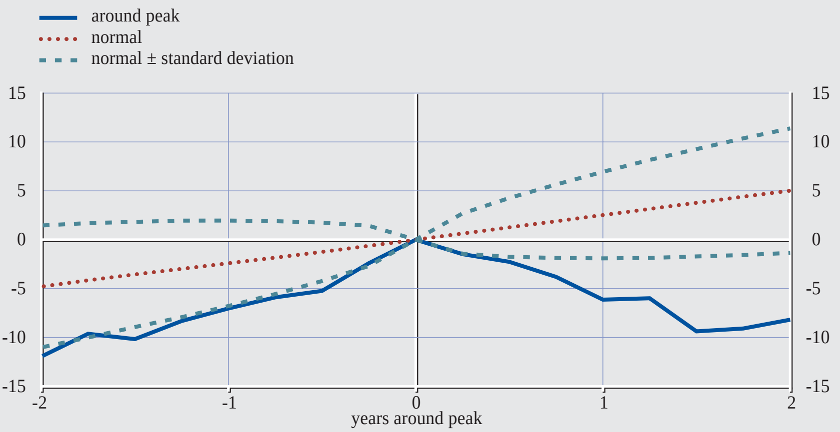


be interesting to ask how much monetary policy ought to be blamed for that, and my guess is that it is not very much.

But that does not mean that monetary policy is off the hook. The kind of careful analysis provided by Christiano, Motto and Rostagno provides us with a warning. Monetary policy requires careful analysis and a careful understanding of the economic forces at work, and how to react to them appropriately. Excellent monetary policy is more complicated than choosing a Taylor rule and sticking to it. Of course, this is something that central banks have always told us. This model demonstrates that they are right.

Chart 10 Peaks versus normal times: assets

(in percentages)



3 EPILOGUE

The European Central Bank along with most other major central banks in the world should be applauded for what they have achieved. We now live in a world where we take low and stable inflation for granted, but this is by no means a small feat. The fathers of the monetary framework of the European Central Bank, in particular Ottmar Issing, have given Europe the substantial gift of sound monetary policy, that we should not fail to appreciate. I have no doubt that the European Central Bank, with its openness to an honest debate such as the one witnessed here, with the kind of careful and yet critical economic analysis of the type that we have seen here and with its excellent staff of economists will continue to provide Europe with this gift.

If I had one wish at this point, then it would be that the same kind of open-minded and high-level debate and careful analysis would be applied to other policies, such as fiscal policy or social and labour market policy as well. It seems to me that the other arenas of economic policy and other economic policy institutions could learn a tremendous amount from the example of the European Central Bank. I hope they will. And we all would be so much better off.

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Lars Svensson commented on the argument of Christiano that a certain type of inflation forecast targeting could lead to instability. Svensson explained that the assumed mechanical reaction in the Christiano paper is not in line with observed central banking practice, where more subtle approaches, in particular flexible inflation targeting, are applied. He pointed to the lack of any empirical evidence in the Christiano et al. paper. Svensson argued that in the exceptional circumstances of Japan, an exchange rate oriented policy would have been more appropriate than one focused on money. **Stefan Gerlach** stressed that it is not the correlation between money and inflation and the existence of a stable money demand equation per se that gives money a special role in monetary policy. Rather the well documented leading indicator role of money for inflation is the crucial issue, as for example established by Gerlach and Svensson. Furthermore, in work with Assenmacher-Wesche, it is shown that there is a unidirectional causality from money to inflation in the respective longer-term components, even when taking into account the impact of the output gap. In that respect, Woodford's contribution is incomplete. Furthermore, Gerlach argued that the standard NKM might by construction reach the conclusion that current and past inflation contain all relevant information about the state of the economy by assuming that firms that do not reoptimize their prices link them to the central bank inflation objective. **Jordi Galí** argued that although he would see the general acceptance that there is a long-run link between money and prices, it remains unclear, why the ECB should assign a special role to money growth, as a number of other nominal variables, for example exchange rates, growth in wages and in unit labour costs, show a long-run link with inflation in theory and in empirical work as well. **Willem Buiter** commented on Woodford's presentation by stating that within a class of models in which monetary policy is modelled through an interest rate rule it still has to be true that a central bank is made responsible for controlling inflation. In a world where money plays no or no special role a central bank has still to be in a position to set the nominal interest rate or any of its instruments that is also the numeraire in terms of prices. But then the crucial question is: who determines the numeraire? In a fiat system the unit of account is defined as the liability of central banks. But, of course, the unit of account in private contracts is a social convention, which did and does not have to be equal to the numeraire. Monetary policy makers must thus worry about what ensures stability of the object that defines the numeraire, otherwise the monetary policy maker could choose something irrelevant. **Diana Choyleva** expressed her view that none of the approaches by either Christiano or Woodford appears to be complete. In the former, money was used when things went wrong, i.e. at a stage when it was too late. In the model by Woodford, money is assumed only to be used for spending of goods and certain interest bearing assets, ignoring thereby all other types of assets such as real estate and equity. In her view, the injection of liquidity can work through the balance sheets of non financial and financial corporations, which use excess liquidity to go on a "spending spree". Assuming that this happens in a situation in which the economy is at its trend level and inflation is in line with the inflation objective, one could not detect any financial market imbalances that are building up. Excess liquidity will lead to excessive M&A activities that boost equity prices, induce falling yields and boost household wealth with a potential impact on spending activities. If central banks do not look at money, they overlook the build up of this scenario that might lead to a costly adjustment process. **Mark Gertler** expressed his appreciation for the construction of a boom bust model in a standard NKM as done by CMR. He expressed, however, disagreement concerning the view that boom-bust cycles would pose a problem for inflation targeting regimes. In his view, it is important to distinguish the targeting rule from the instrument policy that engineers the targeting process. Refering to a paper by Bernanke and himself he advocates the view that the policy rule should take a lot more variables into account than just inflation. For example, wage rigidities should be taken into account when specifying the targeting rule. **Volker Wieland** suggested that future research should try to start from the benchmark case in which money is recursive in a standard NK model as suggested by Woodford. That model could be extended by implementing features of the current ECB strategy with the aim to study the impacts of those features in comparison to the benchmark model. In his view, the CMR model tries to go in this direction, but does that in a not fully systematic way. **Benjamin Friedman** expressed the view that the ECB monetary policy strategy seems to take an a priori notion that money is special in monetary policy. He insisted that this should be an empirical question rather than an ex-ante assumption. Even in the example presented by Christiano concerning boom-bust cycles, it seems not to be clear a priori that looking at money during boom bust cycles in asset prices would guarantee that money can be used successfully as an appropriate indicator. **Christian Noyer** insisted that it is important to take into account the specific situation of the euro area. The strategy had to be decided at a time where one was moving in an unknown territory during a phase where EMU and the singly currency did not exist and when it was unclear, whether the start of the euro area would trigger a regime shift in economic relations. Under those conditions, without indications that any economic relation would move in the expected direction, it was prudent to use one of the most stable economic relations, namely the relation between money and inflation. He did not agree with the suggestion of Galí that other economic indicators did not get a special role, as all indicators mentioned by Galí are covered by standard economic relations included and analysed within the economic pillar. In addition the use of money helped to inherit the credibility from national central banks with high credibility from Day One of the euro area onwards. He stressed as well the importance of the fact that the monetary pillar did not only include M3 but a broad set of indicators including components and counterparts of M3.

Larry Christiano underlined in his reply that the results from his model concerning the consequences of boom bust cycles on monetary policy are not the results of a “reversed engineering exercise”. Rather, they would stem from a standard New Keynesian model that tries to answer the question whether monetary policy is relevant in the build up of financial market boom-bust cycles. The model shows that this has been the case. **Michael Woodford** replied that he generally agrees with the statement of Mr. Noyer that money matters under exceptional circumstances. At the same time he expressed his opinion that in practice, as for example during the Volcker disinflation, merely talking about having a target was considerably more important than actually having the target.

Therefore, the commitment of a central bank to undertake possibly even drastic steps is seen by him as more important than the true actions themselves. Another example on this issue is the quantitative easing in Japan. Despite a massive increase in base money, the period of deflation in Japan remained rather prolonged. Woodford considered it more important that the Bank of Japan would have then communicated its clear commitment for a price target, e.g. a commitment to "reflate" inflation. In his view, the actual increases in base money of more than 50% did not lead to the expected outcome as the clear commitment was missing to leave the freshly injected money in the economy once the normalisation process had started.

Jordi Galí, Philipp M. Hildebrand, Lucrezia Reichlin, Huw Pill, Michele Lenza, Björn Fischer and José Manuel González-Páramo (from left to right)

SESSION 2

HOW USEFUL ARE MONETARY AND CREDIT AGGREGATES IN THE CONDUCT OF MONETARY POLICY?

MONEY AND MONETARY POLICY
THE ECB EXPERIENCE 1999-2006

BY BJÖRN FISCHER, ECB
MICHELE LENZA, ECB
HUW PILL, ECB
LUCREZIA REICHLIN, ECB[1]

ABSTRACT

The paper analyses the practical experience of monetary analysis at the ECB since its beginning. The analysis is based on both a narrative description of the internal briefing and a quantitative evaluation of the forecast exercises. We exploit a rich data basis containing the vintages of data and models over the period in order to evaluate the role of money in the input and the output of monetary policy as it has been in real time.

1 INTRODUCTION

Since the announcement of the ECB's monetary policy strategy in October 1998, the "prominent role" assigned to money within it has been the subject of an intense debate. The purpose of this paper is to shed light on this debate from the perspective of ECB staff members who have been involved in the conduct of the monetary analysis over recent years. Our focus will not be on what the role of money should be in the ECB's strategy, but rather on the ECB's monetary analysis in practice and how it has evolved over time.

The paper presents both a narrative history of the ECB's monetary analysis and a quantitative evaluation of models used to construct money-based inflation risk indicators. To help the narrative history, we have also constructed qualitative indicators of the monetary analysis: an indicator of the input to the policy discussion, based on the coding of the words used in the quarterly monetary assessment on which the monetary analysis briefing is based; and two indicators of the output of the policy discussion, based on the words of the President's introductory statement of the press conference following the interest rate decision. The indicators of the output are similar to those developed by Gerlach (2004).

We address three issues: what tools have been used to conduct the monetary analysis and how have they evolved over time? what are the policy relevant signals drawn from the analysis conducted on the basis of these tools? and what

1 We would like to thank Jordi Galí and Philipp Hildebrand for their comments. Javier Rupay provided excellent research assistance. The opinions in this paper are those of the authors and do not necessarily reflect the views of the European Central Bank.

impact have these signals exerted on monetary policy decisions? A number of appendices are attached to the paper, which offer more detailed descriptions of the tools and methods used to assess monetary developments since the introduction of the euro in January 1999.

A distinctive and still novel feature of the paper is the close attention it pays to ensuring a "real time" perspective on the evaluation of the ECB's monetary analysis. In other words, the paper attempts to characterize and evaluate the monetary analysis and its impact on interest rate decisions on the basis of the information that was available at the time the analysis was conducted and the policy decisions were taken. In both the simulated out-of-sample exercise on which the model evaluation is based and in the narrative history, the paper pays close attention to ensuring that the correct vintages of the monetary time series and analytical models are used. To do so, we draw heavily on the internal analysis prepared over the past eight years by the staff of the ECB and the experience of staff members who prepared that analysis. Indeed, an important aim of the paper is to confront two distinct real time perspectives on the ECB's monetary analysis.

The first, more practical perspective reflects the need to prepare briefing material on monetary developments for policy makers at the ECB in a timely way, so that it can inform monetary policy decisions. This is captured in the documentation that has been provided to the decision making bodies of the ECB on a quarterly basis since 1999. The other, more academic perspective reflects the growing recognition in the economic literature that any ex post evaluation of policy and policy analysis needs to control carefully for the information constraints faced by policy making institutions at the time their analysis was produced or decisions taken. The paper aims to combine the rigour implied by the second perspective with the anecdotal and experiential richness offered by the first.

The remainder of the paper is organized as follows. Section 2 provides an overview of the tools used in the ECB's monetary analysis and how they have evolved over time, referring as necessary to the more detailed descriptions in the appendices. This section concludes by identifying two data series that can form the basis of further, more quantitative analysis: first, a money-based forecast of inflation that can be seen as an incomplete summary of the monetary analysis undertaken by the ECB; and second, a categorization of the period since 1999 into four distinct phases, according to the policy-relevant signal stemming from the monetary analysis. Section 3 takes the former and conducts a thorough real time evaluation of the performance of the money-based inflation forecast. Section 4 takes the latter and presents a series of event studies illustrating how the monetary analysis has influenced interest rate decisions. On the basis of the results of these exercises, Section 5 presents some brief concluding remarks.

2 MONETARY ANALYSIS AT THE ECB

In taking interest rate decisions aimed at the maintenance of price stability in the euro area, the Governing Council of the ECB draws on both economic analysis and monetary analysis (ECB, 1999b and 2003b). The former attempts to identify the economic shocks driving the business cycle and thus embodies a thorough assessment of the cyclical dynamics of inflation. The latter analyses the monetary trends associated with price developments over the medium to longer term. While, in principle, there is no arbitrary segregation of the available data between the two forms of analysis, in practice the economic analysis is largely focused on developments in economic activity and price and cost indicators whereas the monetary analysis relies on a close scrutiny of the monetary aggregates, their components and counterparts, as recorded in the consolidated balance sheet of the euro area monetary financial institutions (MFIs) (ECB, 1999a and 2000b).

2.1 THE STRUCTURE OF BRIEFING: THE BROAD MACROECONOMIC PROJECTIONS EXERCISE AND THE QUARTERLY MONETARY ASSESSMENT

Although complemented by a large body of higher frequency material, on a quarterly basis the economic and monetary analyses become concrete in the form of two key exercises, the results of which are ultimately presented to the Governing Council.

The Broad Macroeconomic Projections Exercise (BMPE) is conducted by Eurosystem staff twice a year (for the June and December Governing Council meetings), with the ECB staff repeating the exercise in the intervening quarters.[2] The exercise uses conventional macroeconometric tools (including area-wide and multi-country models of the euro area), augmented by the judgmental input of sectoral and country experts, to produce projections of inflation and economic activity for the coming two to three years (ECB, 2000a). These projections are published, in the form of ranges, on the day the Governing Council discusses them and subsequently in the ECB Monthly Bulletin.

The Quarterly Monetary Assessment (QMA) is undertaken by ECB staff (drawing on the expertise of NCB staff as necessary). Three aspects of the assessment are particularly noteworthy. First, the monetary analysis is instrumental, in the sense that it is intended to shed light on the outlook for price developments and the implications for monetary policy rather than simply to explain monetary developments in their own right. Second, consistent with the view that the policy-relevant information in money is in its lower frequency or trend-like developments, the focus of this assessment is on identifying the underlying rate of monetary expansion that is related to inflation dynamics over the medium to longer term. Seen in this light, the quarterly frequency of the analysis looks through the often erratic month-to-month variations in monetary

2 The exercises conducted by ECB staff in the intervening quarters are defined Macroeconomic Projections Exercises (MPE). In the following, we will refer to BMPE to indicate both MPE and BMPE outcomes without distiguishing between the two.

growth.[3] Third, the analysis does not rely solely on developments in the key broad monetary aggregate M3. Rather a holistic assessment of the monetary data is made, encompassing the analysis of components, counterparts, sectoral contributions, financial accounts, financial prices and yields and other data sources as necessary.

2.2 THE QUARTERLY MONETARY ASSESSMENT

While the QMA has not been published in a systematic manner by the ECB, the analysis contained therein underpins the description and assessment of monetary developments regularly presented in the Monthly Bulletin, especially in the longer quarterly format of the commentary section. Moreover, many of the tools used in the QMA have been described in papers and articles produced by ECB staff (e.g. Masuch, Pill, and Willeke, 2001; ECB, 2004). A quantitative outlook for price developments derived from the monetary data in the QMA (so-called "money-based forecasts of inflation" or "money-based inflation risk indicators", as analysed in detail in subsequent sections of this paper) has been published on several occasions in the Monthly Bulletin (ECB, 2005a and ECB, 2006b, 2007).

The first QMA was produced in December 1999 and analysed data through the third quarter of 1999. Although the monetary analysis has faced several significant challenges in the ensuing years, the basis structure of the QMA has proved remarkably stable over this period. A first section simply describes the latest monetary data, placing them in the context of longer-term trends. A second section attempts to explain recent monetary dynamics, drawing on various interrelated tools (including econometric and statistical models, a thorough analysis of the components and counterparts of M3, and a detailed investigation of "special factors" influencing monetary developments) so as to recover a quantitative proxy for the prevailing underlying rate of monetary expansion corrected for shorter-term distortions. The final section transforms the appropriately filtered monetary series into an outlook for price developments, so as to permit an assessment of the risks to price stability implied by the monetary analysis.

From the outset, a key aspect of the analysis presented in the QMA has been an attempt to quantify both the contributions made by various explanations of monetary developments and their implications for the inflation outlook. Adopting such a quantitative approach has ensured continuity in the analysis from one quarter to the next, thereby maintaining its medium-term orientation. Moreover, this quantitative approach has led to the creation of a rich "real time" data set which can now, with the benefit of hindsight, be exploited to conduct a thorough ex post evaluation of the information content and policy relevance of the monetary analysis.

3 The monthly data are analysed in order to help identify specific "special factors" that may distort the data, but which are not reflective of underlying monetary dynamics. Monthly money data are not used to assess contemporaneous short-term inflation developments ("now-casting").

2.3 TOOLS USED IN THE QMA

While the basic structure of the QMA has remained stable over time, the nature of the analysis conducted has evolved through several phases, reflecting the successive challenges faced in interpreting the monetary data. With this in mind, when presenting the ECB's monetary analysis since 1999, it is useful to distinguish three broad sets of tools that have been employed, namely: (i) money demand equations; (ii) judgemental analysis; and (iii) reduced-form money-based forecasting or indicator models for inflation. The three types of tool have been used throughout Stage III in the preparation of the monetary analysis, although their relative importance has fluctuated over time as circumstances evolved. Moreover, as is apparent from the following discussion, the uses of the three types of tools are highly interrelated.

(i) MONEY DEMAND EQUATIONS AT THE ECB: SPECIFICATION AND USES

At the beginning of Stage III, the assessment of monetary developments was focused on an analysis of the deviations of M3 growth from the ECB's reference value of 4½%. In December 1998, the ECB defined a reference value for the annual growth rate of M3, which was derived so as to represent the rate of money growth over the medium term that would be consistent with the maintenance of price stability at that horizon. In line with the ECB's strategy, such deviations were viewed as triggers for further analysis to identify the cause of the deviation and assess its implications for the outlook for price developments (ECB, 1999b). Money demand equations constituted a natural starting point for this analysis. Appendix C describes the evolution of the specification and use of money demand models at the ECB in detail.

The role of money demand models may be best described as providing a semi-structural framework that allows judgemental factors stemming from a broad monetary analysis to be combined with results from standard money demand equations, as presented in Masuch, Pill and Willeke (2001). This approach is based on the assumption that a long-run money demand relation exists, but that the complex short-run relationships between money and its economic determinants makes them difficult to model in a single, consistent framework over time.

In practical terms, this approach takes concrete form in the use of Vector Error Correction (VEC) models to analyse and explain the evolution of M3. For example, the Calza, Gerdesmeier and Levy (2001) specification (henceforth CGL) – which has been the workhorse M3 money demand equation used in the QMA since 2001 Q1 – is a VEC model of order 2 (meaning that two lags of each variable modeled in the system are included). The CGL model embodies one stationary cointegration relation that is interpreted as the long-run demand for real money (m-p). This relationship takes a semi log-linear functional form, relating money demand to real GDP (y) and the spread between the short-term market interest (s) rate and the own rate of return on M3 (OWN):

$$m_t - p_t = k + 1.3 y_t - 1.1 (s_t - OWN_t) \qquad (2.1)$$

Using such a money demand framework in the QMA led to three types of conclusions. First, monetary dynamics were seen as complementing the information coming from the economic analysis. For example, money demand equations might suggest that strong monetary growth was a result of strong real income growth and/or a low level of interest rates in the economy. Strong monetary dynamics would thus be seen as confirmation of signals coming from conjunctural indicators. Indeed, some suggested that monetary data would be available sooner and may be more reliable than alternative indicators (Coenen and Wieland, 2001), although in practice this argument has played a modest role in the ECB analysis.

Second, money demand equations provided a vehicle to distinguish between monetary dynamics that were more transitory in nature and those which were more persistent. For example, in the model specification of Brand and Cassola (2004) the relatively steep euro area yield curve observed in late 1999 was viewed as implying a temporary dampening effect on monetary growth, such that the headline annual growth rate of M3 understated what was the underlying rate of monetary expansion relevant for comparison with the reference value. (Note that the derivation of the reference value implicitly assumed that the slope of the yield curve would be at its steady-state level, since it focused on the medium to longer-term relationship among money and other macroeconomic variables). Money demand equations were thus seen as offering a framework for translating the observed rate of M3 growth into an indicator that could be more meaningfully compared to the reference value.

Third, money demand equations gave a benchmark for assessing the liquidity situation, by identifying an equilibrium level of money demand. Given that the policy relevant signal in monetary developments was of a longer-term or lower frequency nature, measures of excess liquidity (rather than the current rate of M3 growth) could be viewed as more meaningful indicators since they accumulated past deviations of monetary dynamics from the normative rate consistent with price stability over the medium term. At a minimum, the money demand equation allowed an assessment to be made of the impact of the liquidity situation on monetary dynamics and was thus thought to allow a more meaningful comparison of prevailing M3 growth with the reference value. For example, if the money demand equation suggested that M3 growth was subdued because of a correction of excess liquidity accumulated in the past, (other things equal) this would be viewed less benignly in terms of inflationary pressures than the same subdued rate of monetary growth stemming from other determinants.

(ii) JUDGMENTAL ANALYSIS AND DEVELOPMENT OF CORRECTIONS/ ADJUSTMENTS TO M3

From the outset, it was clear that money demand equations alone would not be able to account for all the identifiable movements in M3. As a result – and as is the case with other macroeconomic models used in a policy context – the analysis based on money demand has always been complemented by and integrated with a broad judgemental investigation of monetary developments.

The quantification of this judgement has led to production of a (real-time) adjusted or corrected M3 series, which has been used as an input to the reduced-form money-based inflation forecast models that have been used in the QMA (see next sub-section).[4]

Broadly speaking, three main types of judgement can be identified in the ECB's analysis, with the relative importance of each having varied over time as conditions dictated.

First, judgemental adjustments to the monetary series used in the internal analysis have been made for various technical factors. One example is the adjustment made to M3 to account for the impact of the introduction of the Eurosystem's system of required reserves in January 1999. In some countries of the euro area, the introduction of remuneration of required reserves on terms similar to market rates at the start of Stage III removed an implicit tax on banking intermediation and thus led to the repatriation of funds, including from offshore accounts (such as in London). Such behaviour raised M3 growth, but was deemed unlikely to represent a risk to price stability as it simply represented a transfer of existing deposits from offshore to onshore accounts. The magnitude of this effect could be identified rather closely from the MFI balance sheet data and, in internal analysis, a correction to the M3 series could be introduced.[5]

Second, judgemental adjustments have been made to address specific statistical problems that have arisen in the data. Most important among such adjustments is the treatment of non-resident holdings of various marketable instruments issued by MFIs. In 1998, the ECB decided to define the broad monetary aggregate M3 to include these instruments (ECB, 1999a), even though at the start of Stage III the statistical framework to distinguish resident and non-resident holdings did not yet exist. This decision was based on two grounds: first, econometric evidence suggested that inclusion of marketable instruments led to marginal improvements in the stability and leading indicator properties of the resulting monetary aggregate; second, the overall stock of marketable securities was rather small compared with the stock of M3 and was thus thought at that time to have little practical importance. However, from mid-2000 (due to portfolio diversification in Asia, the specific attractiveness of some German MFI securities which enjoyed a state guarantee and tax reasons), non-resident holdings of these securities increased substantially, having an appreciable – but, from the statistical perspective, erroneous – impact on the growth rate of M3. Internal analysis relying on the monetary presentation of the balance of payments

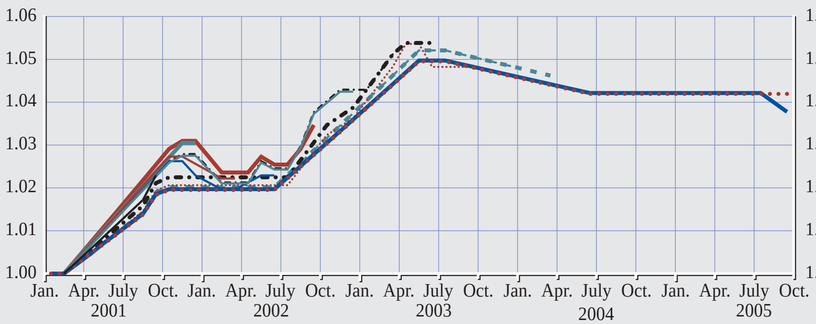
4 Note that the judgement has been applied by making an adjustment to the M3 series itself, rather than by introducing a velocity shift in the quantity equation and/or a dummy variable in a money demand equation. This choice largely reflects presentational concerns, since substantively there is little difference in deciding where the quantitative adjustment is introduced.

5 Other technical adjustments have been introduced for events such as the impact of the cash changeover on holdings of currency in the euro area (Fischer, Köhler, and Seitz, 2004), the volatile behavior of central government deposits in 2002-05 due to changes in the management of those deposits and the migration of inter-bank trading of repurchase agreements to electronic trading platforms operated by non-monetary financial institutions in the money-holding sector (Deutsche Bundesbank, 2005).

and various national data sources was able to construct a proxy measure for non-resident purchases of MFI marketable instruments. It was thus possible to create a quantitative measure of the "true" M3 series. However, these adjustments were deemed insufficiently reliable for use in official statistics. Thus for some time a gap emerged between the adjusted data underlying the internal analysis underpinning monetary policy decisions and the official published M3 series. Notwithstanding the ECB's efforts to highlight this gap in the monetary developments press release and the Monthly Bulletin, communication difficulties resulted in 2001 as interest rates were cut notwithstanding strong official M3 growth data, which was not representative of the internal analysis of the true underlying rate of monetary expansion. Eventually a revised official M3 series was published thereby closing the gap between the published data and the series used for internal analysis. As the statistical system underlying the production of the monetary data has improved and matured, the likelihood of such problems in the future has diminished. Nonetheless, this episode illustrates well the practical challenges faced by the ECB over the past eight years and the methods used to address and overcome them.

Third, judgmental adjustments have also been introduced to account for economic behaviour that was not captured by the conventional determinants of money demand included in the standard econometric models estimated and employed at the start of Stage III. The most prominent example of such adjustments concerns the portfolio shifts into monetary assets that took place between late 2000 and mid-2003, as a result of the heightened economic and financial uncertainty prevailing at that time. In an environment of falling equity prices (following the collapse of the dot.com boom in stocks) and geo-political tensions (the terrorist attacks of 11 September 2001 and the ensuing military conflicts in Afghanistan and Iraq), financial volatility rose and returns on risk-bearing assets fell. Seeking a safe haven from such developments, euro area residents shifted their wealth portfolio from riskier assets – in particular, foreign equities – into safe, liquid and capital-certain domestic assets contained in M3. The internal analysis identified these flows at an early stage on the basis of its scrutiny of the components and counterparts of M3 (ECB, 2003a and ECB, 2004). Specifically, on the components side, holdings of money market mutual fund shares/units – instruments typically used by households to "park" savings at a time of market volatility – rose substantially. On the counterparts side, the MFI net external asset position rose significantly, as euro area residents sold foreign securities to non-residents. Using this information and a broad set of other data (see Appendix B), ECB staff were able to construct quantitative, real-time adjustments for the impact of these portfolio shifts on headline M3 dynamics. The staff judged that these portfolio shifts were a temporary – albeit potentially prolonged – phenomenon, which would tend to unwind as economic, financial and geo-political conditions normalized. As such, the adjusted M3 series was more representative of the underlying trend rate of monetary expansion relevant for the outlook for price developments over the medium term than the official (unadjusted) M3 series. The internal analysis therefore viewed the adjusted series as providing the modal view of monetary developments, while recognizing both that the construction of the adjustments was surrounded by many uncertainties and that the strong M3 growth in the

Chart 1 Different vintages of real time adjustment factors for portfolio shifts



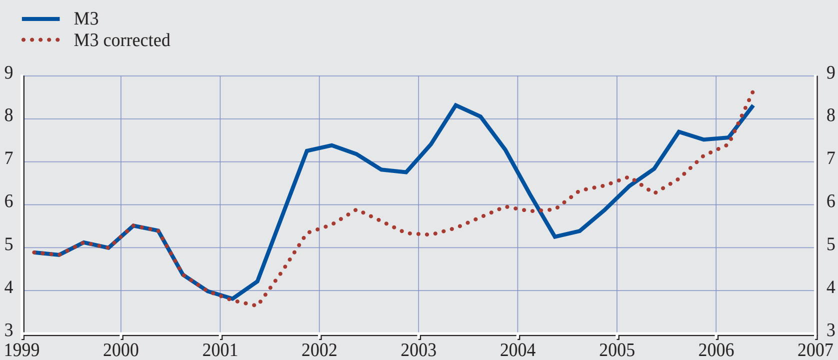
Note: The figure shows the vintages of the adjustment factors as available in real time. A value of 1.05 indicates that the level of M3 is corrected by 5%.

official (unadjusted) series caused by the surge of portfolio shifts implied upside risks to this interpretation of monetary dynamics (and thus the implied outlook for price developments over the medium to longer term).

The rich internal analysis underlying the identification and quantification of portfolio shifts eventually took final, concrete form in the construction of an adjustment factor (shown in Chart 1), which was used to adjust the level of headline M3 and produce a series corrected in real time for the estimated impact of portfolio shifts.

Three important messages stem from this chart. First, the adjustment made was timely, in the sense that the first adjustment for portfolio shifts was first introduced in 2001 Q3 for the data from 2001 Q2. Second, the real time assessment largely corresponds to the current ECB staff assessment of this period, since the quantified judgemental correction has not changed significantly as new vintages of data have become available. Finally, the adjustment made has been very significant in magnitude, peaking at over 5% of the money stock.

Chart 2 Annual growth rates of M3 and M3 corrected – latest available vintage



This is also reflected in the evolution of the annual growth rates for the official M3 series and the M3 series corrected for the estimated impact of portfolio shifts (on the basis of the latest vintage of data and analysis available as of today, see Chart 2).

A natural question that arises in this context is the relationship between the judgemental adjustments made to the M3 series to account for the estimated impact of portfolio shifts and the use of money demand equations discussed above. Indeed, it could be argued that rather than making such adjustments in a somewhat ad hoc judgemental manner, the structural explanation of portfolio shifts should be incorporated into a standard money demand. Indeed, some attempts in that direction have been made.[6]

However, the possibility of estimating the parameters associated with these additional variables rested on the availability of data through the period when the portfolio shifts were taking place (which was necessarily only available after a period of several quarters), whereas the real time analysis had to make such assessments as the portfolio shifts were occurring. Such augmented money demand equations – which implicitly provide estimates of the magnitude of portfolio shifts that correspond quite closely to the real time adjustments made by the ECB staff – are thus better seen as providing ex post support for the staff's judgemental assessment rather than a plausible alternative framework for making that assessment in real time.

More generally, when evaluating the judgemental analysis, it is important to recognize that measures to correct the M3 series were taken in real time on the basis of the encompassing staff assessment of monetary developments and before econometric evidence suggested instability in the standard money demand equations that were being used at that time. Thus these measures should be understood as an attempt to explain and quantify an economic phenomenon observed in real time, not as an attempt to "fix" a failing money demand specification. Indeed, given the very short samples of data available and the difficulty of estimating long-run structural parameters when the end of the sample is "contaminated" by temporary but significant deviations from normal long-run behavior, the reliability of conventional stability tests is open to question. By the same token, such adjustments were not made to re-establish leading indicator properties of money in a specific forecasting framework.

Nonetheless, the judgemental adjustments and the money demand models had to be reconciled to maintain the internal consistency of the analysis. In practice, two concrete measures were taken to achieve this. First, from 2001 Q4 onwards ECB staff fixed the parameters of the baseline money demand equation then used in the QMA (CGL) at the values estimated for the sample 1980 Q1 to

6 Greiber and Lemke (2005) and Carstensen (2003) tried to incorporate additional explanatory variables such as those used for the ECB judgemental correction into standard money demand specifications. The ex-post evaluation of such models is that while they fit the specific portfolio shifts period quite well, this came at the expense of introducing other anomalies in the money demand behavior at other points in the sample and, more importantly, did not lead to a more comprehensive explanation of monetary developments through 2006.

2001 Q2. Since then, this model has been treated as a historical benchmark for the analysis, recognizing that the stability of the specification in recent years (post-2001) on the basis of standard econometric tests is – at best – questionable. One could characterize the approach as a form of calibration, where the pre-portfolio shift period estimates are viewed as more representative of behaviour during "normal times" and thus as more reliable calibrated values than empirical estimates that include the post-2001 data.[7] Second, instability of M3 demand relative to this historical benchmark was seen as having been captured by a stochastic term in the money demand equation which represents identifiable economic factors beyond the conventional determinants of money demand. The analysis then focus on capturing this term through the judgemental assessment of portfolio shifts.

Given this approach, the monetary analysis and its communication have changed in nature. In particular, the instability of standard money demand specifications has inevitably complicated the assessment, explanation and – above all – presentation of deviations of M3 growth from the ECB's reference value. Since there is no reliable estimated money demand equation which covers the entire sample period, it is not possible to construct a decomposition of such deviations into the contributions of developments from the various conventional determinants of monetary dynamics on the basis used prior to 2001. As a result, the interpretation of such deviations – in particular, the identification of those which have implications for the outlook for price developments over the medium term – has lost meaning. For much of the 2001-04 period, the main reason for deviations of M3 growth from the reference value has been the impact of portfolio shifts, which are identified and quantified outside the money demand model. This has led to greater emphasis being placed on the M3 series corrected for the estimated impact of portfolio shifts in both the internal and external communication of the monetary analysis.

(iii) MONEY-BASED INFLATION FORECASTS AND INDICATORS

As a complement to the money demand equations and judgemental analysis, money-based forecasts and indicators of inflation have also been employed in the QMA. Over time, reduced-form money-based inflation forecast models (such as those proposed in Nicoletti-Altimari, 2001), based on the methodology outlined in Stock and Watson, 1999) have played a more prominent role. These are bivariate equations where an autoregressive equation for inflation is augmented by, respectively, the growth rate of M3 and the growth rate of M3 corrected for portfolio shifts. We will discuss the exact specification of these equations in the next section. Let us here just outline the forecasting model.

Define HICP inflation at time t as π_t. The bivariate models to forecast inflation at time $t + h$ is:

$$\pi_{t+h} = a + b_t \pi_{t-1} + \cdots b_p \pi_{t-p} + c_1 x_{t-1} + \cdots + c_p x_{t-p} + \varepsilon_{t+h} \qquad (2.2)$$

7 Indeed, recursive estimation of money demand equations in the sample 1980-2001 would reveal several episodes of "instability" that turned out to be temporary when analyzed in the light of the full sample.

where x_t denotes the growth rate of either M3 or M3 corrected. At each time t the parameters are estimated and the estimates are used to produce a forecast.

The use of such simple indicator models can be seen as a straightforward method of transforming – in a rather mechanical way – the detailed monetary analysis into a outlook for price developments, which represents a "summary statistic" for the monetary analysis that can be discussed and digested both internally and externally.

Such simple bivariate forecasting models have increased in prominence over time at the expense of forecasts that were produced on the basis of money demand equations. Initially, the entire VEC system (of which the money demand equation was a part) was simulated to produce forward-looking paths of the key macroeconomic variables in the system, including inflation. Such an approach was discontinued from 2001, given that these models did not provide a satisfactory forecasting performance. Money demand equations continued to be used to provide a forecast of inflation based on the "real money gap" P-star models (as in Hallman, Porter and Small, 1991). Appendix C shows the form of the forecasting equation derived from these concepts. The P-star approach, however, has never been prominent in the QMA, since by the time it was introduced, greater reliance was already being placed on the bivariate approach in a context where the specifications of money demand underlying the P-star model were of questionable stability. Indeed, the rising prominence of the bivariate approach can be interpreted as one practical response to a situation from 2001 onwards where growing questions emerged about the stability of money demand equations used in the QMA.

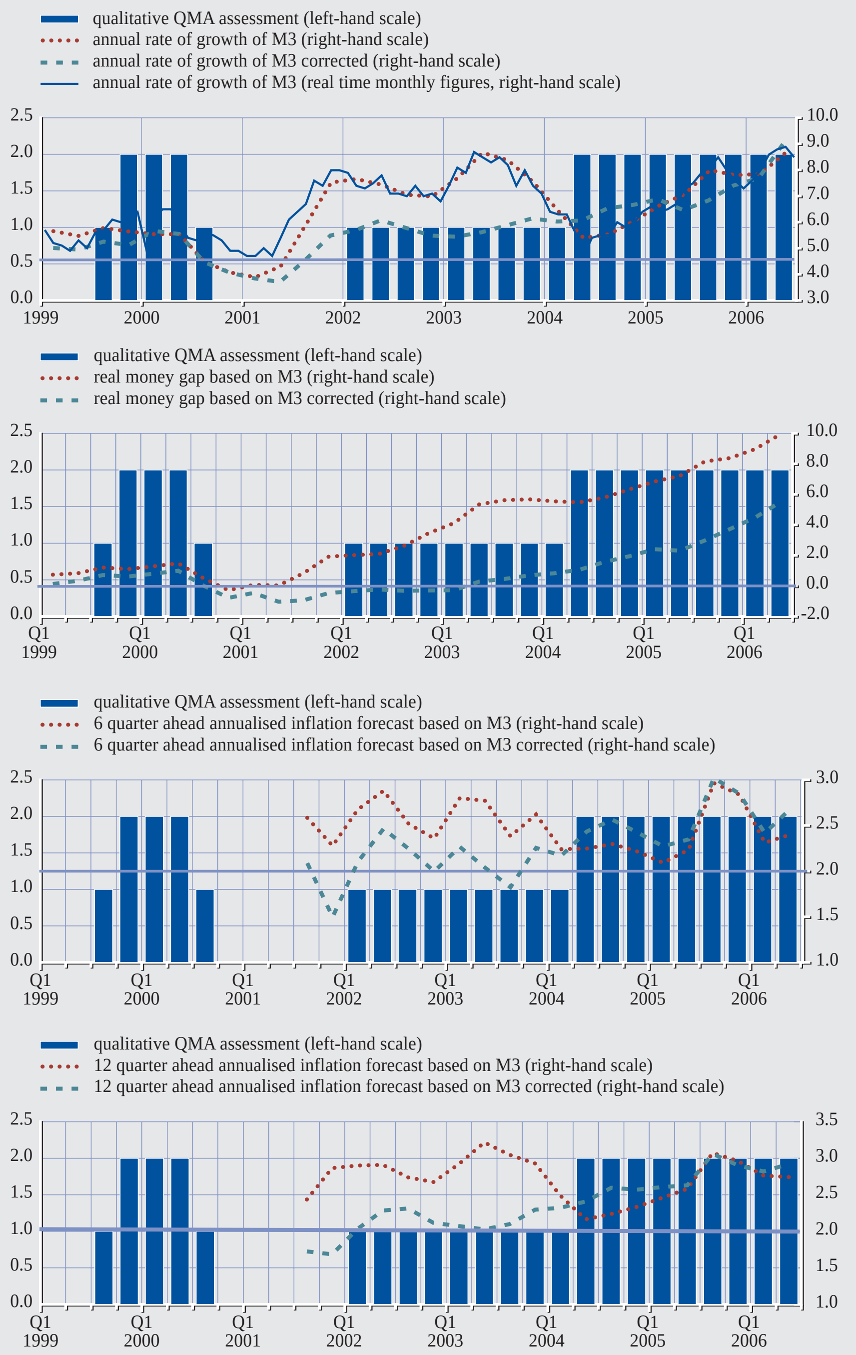
2.4 THE QMA: SUMMARY INDICATORS OF THE OVERALL ASSESSMENT

As we have seen, the evaluation of the risk for price stability produced by the QMA is rather complex, since it is based on a variety of approaches and models and relies on a significant degree of expert judgement. This raises the question of whether and how to characterize the "policy message" stemming from the monetary analysis. As suggested in the preceding section, the simple transformation of M3 and M3 corrected into a quantitative outlook for price developments on the basis of bivariate indicator models is one approach. This sub-section explores other characterizations to assess its robustness.

To obtain a synthetic indicator of the overall assessment, we have coded the wording of the introduction of the QMA. The latter indicator is derived from coding the overall conclusion of the QMA concerning risks to price stability stemming from the monetary pillar, where the coding ranges from -2 (clear downward risks to price developments) to +2 (clear upward risks to inflation). Chart 3 plots the qualitative indicators against the evolution of both the official M3 series and the M3 series corrected for the estimated impact of portfolio shifts and other distortions identified by the judgemental analysis.

The chart shows that the growth rate of the M3 series corrected and the inflation forecasts based on this variable on one hand and the qualitative indicator on the

Chart 3 Qualitative assessment of the QMA, M3 and M3 corrected



Source: ECB, own calculations.
Note: The horizontal line in the two two charts represent the ECB's reference value from monetary growth. The horizontal line in the bottom two charts represents the ceiling of the ECB's quantitiative definition of price stability. The qualitative coding goes from -2 (clear downward risks to price stability) to +2 (clear upward risks to price stability).

other hand, evolve in similar patterns. In particular, the turning points in this series are aligned, which allows them to be used to identify several different phases of the signal drawn from the monetary analysis.[8]

More precisely, four phases are discernible from these summary indicators: early 1999-mid 2000; mid 2000-mid 2001; mid 2001-mid 2004; and mid-2004 onwards. Using these dates as a starting point, a deeper analysis of the material presented in the QMA suggests that these phases can be distinguished along three dimensions: first, the signal offered by the baseline of the monetary analysis with regard to risks to price stability over the medium to longer term (which is broadly captured by the money-based inflation forecasts); second, the degree of uncertainty surrounding the interpretation of monetary developments, which governs the strength of the policy signal that can be drawn from the monetary analysis; and third, the risks to the baseline outlook derived from the monetary analysis.

The first phase lasted from early-1999 through mid-2000, during which the monetary analysis pointed to upside risks to price stability at medium to longer-term horizons. The strength of this signal increased over the course of the period, as uncertainties surrounding the monetary data associated with the transition to Monetary Union (e.g. the impact of the change in the required reserves regime) receded.

The second phase lasted from mid-2000 until mid-2001. During this period, the monetary analysis pointed to a relatively benign outlook for price developments, with inflationary pressures at longer horizons diminishing over time. However, the monetary data published in real time (though not the more recent vintages of data) obscured this signal due to the statistical distortions to the M3 series. In both of these phases, the risks surrounding the signal offered by the monetary analysis were relatively balanced.

Between mid-2001 and mid-2004, the uncertainties surrounding the interpretation of monetary developments were multiplied by the incidence of portfolio shifts (first an inflow into monetary assets, and then an unwinding of those flows). The signal from the monetary analysis during this third phase was therefore blurred and thus weaker. While the baseline outlook for price developments constructed on the basis of the monetary analysis was rather benign in terms of implications for price stability, the risks to this outlook were viewed as skewed strongly to the upside given the accumulation of liquidity that was taking place. However, signals from monetary analysis among others could help to rule out any deflationary pressures in the period between late 2002 through the course of 2003. At that time, some commentators were concerned that the euro area might be heading for deflation and called for more aggressive loosening of monetary policy.

8 The growth in the official M3 series and the resulting inflation forecasts were used to make a risk assessment around the modal view captured by the corrected measures. This is supported by the qualitative indicator that mainly captures the pattern of the corrected measures.

Finally, from mid-2004 the monetary analysis pointed to increasing upside risks to price stability at medium to longer-term horizons. Over the course of this fourth phase, the signal stemming from the monetary analysis strengthened for two reasons. First, the analysis pointed to a strengthening of the underlying rate of monetary expansion over time. Second, the view that this strengthening of monetary dynamics was fundamentally different from the previous strengthening associated with portfolio shifts into money was progressively confirmed. This strengthening of the signal from the monetary analysis contrasts with the lack of clarity emerging in the real time data from the economic analysis, against the background of the emerging gap between soft and hard data. At the same time, given the accumulation of liquidity remaining from the 2001-03 period, the risks to this baseline view were also seen as skewed to the upside.

As shown in Chart 3, the M3 corrected-based inflation forecasts capture the transition from the third to the fourth phase (unavailability of such real time forecasts prior to 2002 limit the scope to assess other transitions). The next Section will evaluate the accuracy of such forecasts in tracking future inflation.

3 FORECASTING EVALUATION

In order to provide a structured quantitative assessment of the ECB's monetary analysis, this section describes a formal statistical evaluation of the money-based forecasts regularly presented in the QMA. Since only the bivariate money equations were consistently used for forecasting purposes, the evaluation will only focus on a small subset of the models used in the QMA.

In the previous Section we have described the assessment made in the QMA of the outlook for price stability. That assessment, as we have seen, embodies a rich set of quantitative and qualitative analyses of which the money based forecasts are only one element. The money-based forecasts should be seen as "summary statistic" capturing the broad thrust of the assessment, not as a "sufficient statistic" providing an exhaustive summary of the information extracted from monetary developments. Moreover, the forecast evaluation we discuss in this section will focus only on the first moment of the forecast (i.e. the baseline outlook) which does not capture the higher moments (e.g. the risks surrounding the baseline), typically of importance for monetary policy purposes. The question we will analyze is therefore narrower than establishing the role of the monetary analysis for the broad assessment of price stability.

Precisely, we will consider both the BMPE projections and the money-based forecasts and ask how well they each tracked future inflation and how they related to each-other (other models will be considered only to help the interpretation of results). This exercise has to be read in light of the fact that, in line with the ECB's strategy, the BMPE projections and money-based forecasts are prepared independently, to allow for cross-checking the assessment of price stability.

The analysis will mainly concentrate on the six quarter ahead horizon. This horizon was chosen to permit a comparison between the monetary analysis and the economic analysis[9] and because short-sample problems make longer horizon evaluations very unstable and therefore unreliable. A number of caveats should be taken into account in focusing on the six quarters horizon. First, since money is typically seen as containing information about the outlook for price developments over the medium to longer term, one may question the appropriateness of this horizon. To partly address this problem we will focus on the annualized rate of HICP inflation over the next six quarters. Second, the economic analysis is meant to provide signals for the short/medium outlook for price stability and then focusing only on the six quarters horizon does not allow an evaluation of the analysis over all its relevant horizons. However, we only look at the BMPE projections to provide a benchmark for the money based forecasts. A thorough evaluation of the BMPE is beyond the scope of this paper in particular as those projections (at least during the evalution period) were conditional on the assumption of a constant short-term interest rate over the projection horizon.

The evaluation of the money-based forecasts and the comparison of those forecasts with alternative benchmarks, is based on an out-of-sample exercise using data and models that were available to the forecasters in real time. To be able to conduct such analysis, we are exploiting a very rich data-base, containing all the vintages of data and models used at the ECB in the production of the QMA since 1999.

The structure of the exercise is as follows. We estimate the models using the sample 1980Q1-2000 Q3 and produce the first forecast for 2002Q1 (six quarter ahead). The next quarter, 2000 Q4, we will produce a new forecast, using data and models available up to then. For each subsequent quarters we will do the same so as to produce eighteen forecasts (corresponding to the period 2002 Q1-2006 Q2) that can be compared with the realized inflation. Notice that, as time progresses from 2000 Q3 to 2004 Q4 (last vintage we evaluate), not only do we have new data points, but also new vintages of data reflecting revisions to the time series and to the model specifications.

As has been observed by the literature, the historical evaluation of economic policy or, in our case, the evaluation of the analysis underlying monetary policy, is only possible if the informational assumptions are realistic in the sense of reflecting what people knew at the time the analysis was undertaken and policy decisions made. Based on this observation, for example, a large literature in the US has evaluated the size of revision errors of variables and key indicators such as the output gap and the implications of those revisions for historical interpretation of monetary policy (e.g. Orphanides, 2001). Recently, revisions of the structural forecasting model at the Federal Reserve Board have also been analyzed (e.g. Ironside and Tetlow, 2005). The present paper is the first to conduct a fully real time evaluation of the ECB money based forecasts which

9 The published Eurosystem – ECB staff macroeconomic projections (BMPE) have a maximum horizon of nine quarters.

takes in consideration not only the evolution of the data but also of the models. In addition, it evaluates those forecasts against relevant internal and atheoretical real time benchmarks.

In the next subsections, we provide details on the forecasting models, the procedures to prepare the forecasts and the statistics we use for the forecast evaluation. Finally we report the outcomes of the evaluation.

3.1 MODELS

In the first part of the paper, we have seen that several models have been used as inputs of the QMA. However, the only two money-based forecasting models that have been consistently used in the forecasting process throughout the period under consideration, are bivariate equations where an autoregressive equation for inflation is augmented, respectively, by the growth rate of M3 and the growth rate of M3 corrected.

We will consider these equations in the exact specification used by the QMA. In addition, we will also consider 11 alternative bivariate forecasts with selected nominal and real variables: GDP, short and long term nominal interest rates, the term spread, nominal wages, the unemployment rate, total employment, import prices, oil prices, the Euro-dollar exchange rate and unit labor costs. Bivariate equations including these variables constitute a useful benchmark for the ECB monetary models since these variables are alternative indicators of real and nominal pressures on inflation and because of the availability of real time data vintages for them. Precise definitions, sources and transformations are described in Appendix A. To preserve comparability of results, the equations specification is the same as that of the money-based forecasts.

The variable we are interested in forecasting is the annualized h-period change in HICP. Defining HICP at time *t* as P_t, the h-period annualized change is given by:

$$\pi_{t+h} = 100 * [(\frac{P_{t+h}}{P_t})^{4/h} - 1]$$

where *h* will be six quarters.[10]

For each vintage of data *v*, the bivariate models are nested by the following equation

$$\pi_{v,t+h} = a_v + b_v(L)\tilde{\pi}_{v,t} + c_v(L)x_{v,t} + \varepsilon_{v,t+h} \quad (3.3)$$

where $\tilde{\pi}_{v,t} = 100 * [(\frac{P_t}{P_{t-2}})^{4/2} - 1]^{11}$ and $x_{v,t}$ denotes the four quarter moving average of the M3 or M3 corrected growth rate or one of the 11 alternative real

10 At the end of this section we will also show some results for the 12 quarters horizon.

11 The choice of the two quarter moving average for the money based inflation forecasts has been done in order to reduce the volatility of the forecasts.

and nominal variables and $b_v(L)$ and $c_v(L)$ are finite polynomial of order *p* in the lag operator *L*:

$$b_v(L) = 1 + b_{v1}L + \cdots + b_{vp}L^p$$
$$c_v(L) = 1 + c_{v1}L + \cdots + c_{vp}L^p.$$

We also present results from three benchmark models: a constant, set at 1.9% to capture the ECB's definition of price stability as "below but close to 2%", a simple univariate autoregressive model (AR) defined as:

$$\pi_{v,t+h} = f_v + g_v(L)\tilde{\pi}_{v,t} + \xi_{v,t+h} \tag{3.4}$$

and results from the random walk model computed in real time, defined as:

$$\pi_{v,t+h} = \pi_{v,t} + \epsilon_{v,t+h}.$$

Clearly, if in our sample the random walk turned out to be the best forecasting model for inflation, this would imply that inflation realized six quarters ago was the best forecast of today's inflation. In other words, this would imply that inflation is close to non forecastable since a naive forecast would perform better than more refined models.

In addition to the bivariate models based on single variables and the three benchmarks, we produce forecasts from combinations of individual forecasts where aggregation is achieved by simple averaging (equal weights). Formally,

$$\pi^{comb}_{v,t+h} = \frac{1}{N}\sum_{s=1}^{N}\pi^{\mathcal{M}_s}_{v,t+h}$$

where $\pi^{\mathcal{M}_s}_{v,t+h}$ denotes a generic individual forecast (produced by model $\mathcal{M}_s$) and *N* the number of forecasts being combined.

Finally, results are reported for the BMPE projections.[12] It should also be kept in mind that money based forecasts are finalized about 36 working days after the end of the last available quarter while the BMPE after around 43 working days and, in practice, without knowing or taking into account the results based on the money forecast.

3.2 FORECASTING PROCEDURES

Our prediction sample for the h = 6 forecast horizon is 2002 Q1-2006 Q2 (18 observations),[13] since money-based forecasts are only available from the QMA prepared in 2000 Q4 and based on data through 2000 Q3.

12 For the sake of simplicity and to allow the derivation of statistics, we use throughout the paper the mid points of the BMPE ranges.
13 For the *h* = 12 quarters ahead, the prediction sample is 2003 Q3-2006 Q2, with 12 observations.

To prepare the forecast we will follow the same steps actually followed by ECB internal practice. They are described in what follows.

MODEL SPECIFICATION

Lags for the dependent variables are chosen in each exercise by minimizing the Schwartz information criterion. The maximum allowed lag for inflation and the independent variables is 5. Due to the choice of the maximum lag and the fact that dependent and independent variables enter the forecasting models, respectively, in the form of six and four quarter moving averages, 14 data points are lost at the beginning of the sample. Thereby, the first observation for the dependent variable in the regressions is 1983 Q3 in each exercise.

ESTIMATION OF MODELS AND PRODUCTION OF FORECAST

The forecasting models are estimated by simple OLS. For each exercise, we estimate in sample the relationship between annualized inflation over the next *h* quarters, inflation lags and those of the monetary or non monetary variables. The estimated OLS coefficients are then applied to the last available observations in sample to produce a direct forecast of inflation six periods ahead. More formally, defining a_v^{ols}, $b_v(L)^{ols}$ and $c_v(L)^{ols}$ as the filters (with the implied coefficients) for the bivariate models estimated with data relative to vintage v and up to time *t*, the inflation forecast is defined as

$$\pi_{v,t+h}^{x} = a_v^{ols} + b_v(L)^{ols}\tilde{\pi}_{v,t} + c_v(L)^{ols}x_{v,t}$$

The same procedure is adopted to produce the autoregressive forecast.

Forecast errors e_t for the generic forecast from model *M* are defined as

$$e_{t+h} = \pi_{v,t+h}^{\mathcal{M}} - \pi_{t+h}$$

where actual inflation π_{t+h} is defined as that observed at the time of the last available vintage (i.e. 2006 Q2).

Finally, the random walk forecast which we use as one of our naive benchmarks is defined as

$$\pi_{v,t+h}^{RW} = \pi_{v,t}.$$

UPDATE

After a forecast based on vintage v, the database is updated to vintage $v + 1$. The new forecast, based on the new data, takes into account one more data point but also revisions in the history of the variables. The last vintage available for the forecasting evaluation is 1980 Q1-2004 Q4, related to the exercise performed in 2005 Q1.

3.3 STATISTICS OF FORECASTING EVALUATION

The statistics used for the forecasting evaluation are the mean squared forecast error ($MSFE = \frac{1}{T}\sum_{t=1}^{T} e_{t+h}^2$, where T=18 in our case), the bias ($Bias = \frac{1}{T}\sum_{t=1}^{T} e_{t+h}$) the standard deviation of the forecast ($SDF = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(\pi_{v,t+h}^{\mathcal{M}} - \frac{1}{T}\sum_{t=1}^{T}\pi_{v,t+h}^{\mathcal{M}})^2}$) and the relative mean squared errors

$$Rel.MSFE = \frac{MSFE^{\mathcal{M}}}{MSFE^{uni}}$$

where $MSFE^{\mathcal{M}}$ and $MSFE^{uni}$ are, respectively, the mean squared errors of forecast of the generic model *M* and of a univariate benchmark (autoregressive or random walk in this paper).

Finally, since the MSFE is affected by both the variance of the errors and the bias, that is

$$MSFE = \frac{1}{T}\sum_{t=1}^{T}(e_{t+h} - \frac{1}{T}\sum_{t=1}^{T} e_{t+h})^2 + Bias^2$$

we will report results for both components.

3.4 EXERCISES AND RESULTS

EXERCISE 1: BMPE AND MONETARY MODELS

Table 1 illustrates the results for seven alternative models (indicated in column one): the AR model, the random walk, the BMPE, the two monetary equations and the simple average between the BMPE and the M3 growth equation (BMPEM3).

Column two indicates the mean square forecast error (MSFE) and columns three and four the ratio between the MSFE of the model relative to, respectively, the random walk (RW) and the univariate AR. The following columns report bias, standard deviation of the forecasts, variance of the forecast error and bias squared.

Results can be summarized as follows.

1. Both the equations augmented with the official M3 data and BMPE projections are outperformed by the random walk and naive models and they are biased.

2. The equation augmented by M3 corrected indeed corrects the bias, but retains and partly accentuates the excess volatility observed for the M3 model, as it can be seen from the relative high value of the variance of the forecast and of that of the forecast error relatively to the BMPE. The consequence is that it is outperformed by the random walk in terms of the MSFE criterion.

Table 1 Internal forecasts

Model	MSFE	MSFE/RW	MSFE/AR	Bias	SD fore.	Var. f.e.	*Bias²*
AR	0.18	1.76	1	0.16	0.48	0.15	0.03
RW	0.10	1	0.57	0.12	0.25	0.09	0.01
1.9%	0.09	0.92	0.52	-0.27	0	0.02	0.07
BMPE	0.24	2.40	1.37	-0.45	0.20	0.04	0.20
M3	0.19	1.86	1.06	0.28	0.23	0.11	0.08
M3c	0.11	1.04	0.59	0.01	0.27	0.11	0
BMPEM3	0.05	0.48	0.28	-0.08	0.10	0.04	0.01

3. The random walk outperforms all models in terms of the MSFE criterion except the constant 1.9% inflation (and this by less than 1%) and, most strikingly, the simple average between money growth and BMPE projections. The latter forecast achieves an improvement of over 50% with respect to the random walk.

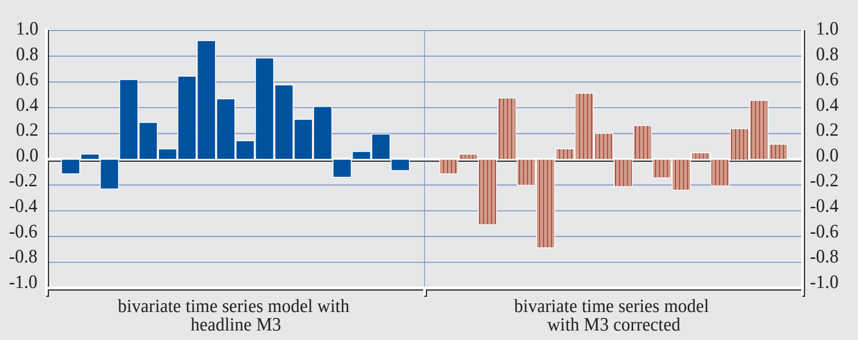
That simple statistical benchmarks outperform the internal forecasts is not a surprising result. Similar findings have been produced for the US (see, for example, Atkeson and Ohanian, 2001 and Giannone, Reichlin, and Sala, 2004). It should also be noted that forecasts for the euro area produced by other institutions such as the IMF and the OECD are very correlated with the BMPE projections.[14] What is more interesting for our discussion, is the fact that M3 and BMPE projections have large systematic biases with opposite sign.

Chart 4 reports the forecast errors of the M3 and M3 corrected based forecasts. The forecast based on M3 has systematically over-predicted inflation over the relevant sample period. This feature is corrected by the forecast derived from M3 corrected which, although very volatile, is centered around actual inflation. The latter result suggests that the judgemental assessment of monetary developments succeeded in capturing average inflation, although this did not correct for the excessively volatile forecast.

Moreover, Table 1 shows that the Mean Squared error of Forecasting on the BMPE projections is to a very significant extent owing to the (negative) bias component. Coupled with the low volatility of the BMPE forecast errors this allows to conclude that BMPE projections have systematically under-predicted six quarter ahead annualized inflation.[15]

Excessive volatility is corrected by the BMPE-M3 combination. The latter forecast is not only smooth, but also unbiased. The bias correction is mechanically explained by the fact that the combination is an average of a forecast which is biased upward and a forecast which is biased downward while the adjustment

Chart 4 Forecast errors of real time M3 and M3 corrected based forecasts



14 In the regular presentation of the BMPE outcomes in the Monthly Bulletins the ECB publishes also forecasts from other public and private institutions.
15 For additional evidence on this point, see Pill and Rautanen (2006).

of the high volatility of the M3 forecast is achieved by the smoothing effect of averaging models.

Visual inspection of Chart 4 and results in Table 1 suggest that, although the BMPE projections are strongly biased downward, they are the only ones that track inflation dynamics. A formal way to assess whether M3 provides an improvement beyond what achieved by the BMPE for what concerns dynamics (i.e. after having netted out the bias), is to test whether the M3 based forecast is not encompassed by the BMPE projection.

More precisely, the question we address is whether it is possible to find a convex linear combination of the BMPE projections $(\pi^B_{v,t+h})$ and money $(\pi^M_{v,t+h})$ forecasts that *significantly* outperforms the BMPE projections. A simple regression procedure to address this question has been suggested by Harvey, Leybourne and Newbold (1998) and references in West (2006).

Assume that the relationship between realized inflation and the combination of forecasts is:

$$\pi_{t+h} = k + (1-\lambda)\pi^B_{v,t+h} + \lambda\pi^M_{v,t+h} + \eta_{t+h} \tag{3.5}$$

where we allow for a bias term k owing to the fact that the BMPE projections and the monetary forecasts are biased. The OLS estimate for λ in this equation minimizes the sum of the squared errors η_{t+h}, hence it provides the estimate of the optimal weights in the forecast combination. Moreover, if λ is significantly different from zero, the forecast $\pi^M_{v,t+h}$ adds information to (i.e. it is not encompassed by) $\pi^B_{v,t+h}$.

By subtracting $\pi^B_{v,t+h}$ from both sides of equation (3.4), we obtain:

$$u^B_{t+h} = k + \lambda(\pi^M_{v,t+h} - \pi^B_{v,t+h}) + \eta_{t+h} \tag{3.6}$$

where $u^B_{t+h} = \pi_{t+h} - \pi^B_{v.t+h}$.

Table 2 shows results for both the M3 and M3 corrected inflation forecasts. Since long horizon forecast errors can be autocorrelated, the standard errors reported in parenthesis in Table 2 are corrected by the Newey-West procedure.

Results in Table 2 show that, at the 5% level we cannot reject the hypothesis that the monetary forecasts are not encompassed by the BMPE projections. This further suggests that money helps forecasting beyond the BMPE projections.

Table 2 Encompassing tests: results

Parameter	κ	λ
M3	0.27*** (0.06)	0.24** (0.09)
M3 corrected	0.35*** (0.04)	0.22** (0.08)

Newey-West corrected standard error in parenthesis. Three stars indicate the coefficients is significant at 1% level, two stars at 5% level, one at 10% level.

Notice the value of λ suggests that, after controlling for the constant (and therefore for the bias), the optimal combination between the M3 based forecasts and the BMPE projections should attribute a weight of 24% to the M3 based forecast.

However, back of the envelope calculations from the results in Table 1 show that the combination that sets the bias to zero gives a weight of $^2/_3$ to the M3 based forecast.

This is because the M3 based forecast is better apt capturing inflation on average over the period while the BMPE projections are better apt capturing inflation fluctuations around the mean.

This implies that whether the M3 based or to the BMPE projections should have more weight in the combination depends on the relative weight of the bias and the variance of the forecast errors in one's loss function. This, in turn, depends on whether one's objective is the forecast of average inflation or of its fluctuations around the mean.

For the minimization of the mean squared error of forecasting, which gives equal weight to the variance and the bias, the optimal combination assigns approximately equal weight to the two forecasts.

EXERCISE 2: CAN WE ACHIEVE THE SAME REDUCTION OF THE MSFE BY COMBINING THE BMPE WITH INDICATORS OTHER THAN MONEY?

Here we will consider the alternative eleven bivariate equations based on our selected variables as well as their combination, the combination of all nominal variables and the combination of real variables (all combinations are computed as simple averages).[16]

The questions we we want to ask here are: (i) can we identify one or a set of variables that scores better than the single indicators considered so far? (ii) does M3 have a special role or there are other indicators that generate bias correction if combined with the BMPE projections?; (iii) does an average of nominal variables generate the same bias correction achieved by M3?

16 Results based on principal components rather than averages give very similar results.

Table 3 reports MSFE for different models and the analysis of the bias and the variance.

Table 3 Alternative bivariate forecasts

Model	MSFE	MSFE/RW	MSFE/AR	Bias	SD fore	Var. f.e.	*Bias²*
Gdp	0.22	2.19	1.25	-0.01	0.48	0.22	0
Unemp	0.27	2.65	1.51	0.18	0.49	0.24	0.03
Emp	0.29	2.85	1.62	0.16	0.52	0.26	0.03
Impp	0.17	1.65	0.94	0.13	0.33	0.15	0.02
Oilp	0.19	1.87	1.06	0.14	0.36	0.17	0.02
Exc	0.20	2.01	1.14	0.17	0.36	0.17	0.03
Sir	0.23	2.28	1.30	0.19	0.44	0.20	0.04
Lir	0.23	2.27	1.29	0.23	0.40	0.18	0.05
Spread	0.18	1.73	0.99	0.06	0.39	0.17	0
Wages	0.10	0.96	0.55	-0.13	0.21	0.08	0.02
Ulc	0.12	1.20	0.68	0.10	0.26	0.11	0.01
Combtot	0.16	1.63	0.91	0.09	0.36	0.15	0.01
Combreal	0.25	2.48	1.39	0.11	0.49	0.24	0.01
Combnom	0.15	1.45	0.81	0.09	0.32	0.13	0.01

Notes: The row Gdp in the table refers to the bivariate model augmented with Gdp, Sir with the nominal short term interest rate, Lir with nominal long term interest rate, Spread with the term spread, Wages with wages, Ulc with unit labor costs, Unemp with unemployment, Emp with employment, Impp with import prices, Oilp with oil prices, Exc with the exchange rate. Combtot, combreal and combnom are, respectively, the combinations of the forecast with all the 11 variables, the real and the nominal. Precise definitions can be found in Appendix A.

The results can be summarized as follows.

1. All bivariate models are outperformed by the random walk with the possible exception of nominal wage growth.

2. No model produces the reduction of MSFE that we have seen for the M3-BMPE combination.

3. Most models, both nominal and real, have a positive bias.

4. All nominal variables perform better than the BMPE and so does the average of all nominal variables (see Table 2 for comparison).

The fact that most models have positive bias, suggests that variables other than M3 can be used in combination to the BMPE projections to correct the bias.

As for dynamics, we can assess whether variables other than M3 are not encompassed by the BMPE by running the same encompassing test considered for M3 and M3 corrected.

Table 4 reports results from the encompassing tests.

Table 4 Are alternative forecasts encompassed by BMPE?

Parameter	α	λ	
Gdp	0.42*** (0.05)	0.08	(0.08)
Unemp	0.41*** (0.06)	0.06	(0.09)
Emp	0.43*** (0.06)	0.04	(0.09)
Impp	0.35*** (0.05)	0.16**	(0.08)
Oilp	0.40*** (0.04)	0.08	(0.08)
Exc	0.33*** (0.03)	0.18***	(0.05)
Sir	0.39*** (0.06)	0.10	(0.08)
Lir	0.39*** (0.10)	0.09	(0.08)
Spread	0.39*** (0.06)	0.12	(0.09)
Wages	0.36*** (0.04)	0.29***	(0.09)
Ulc	0.35*** (0.06)	0.19**	(0.10)
Combtot	0.38*** (0.05)	0.13*	(0.08)
Combreal	0.42*** (0.06)	0.06	(0.09)
Combnom	0.36*** (0.05)	0.15**	(0.08)

Wage and exchange rate growth rates are not encompassed by the BMPE at 1% confidence level, while the growth rate of unit labor costs and import prices are not encompassed at the 5% confidence level. Money is therefore not the only variable not to be encompassed by the BMPE.

Notice that, since the variables considered in Table 4, unlike M3, do enter as input of the BMPE, these results might suggest that either the restrictions implied by the BMPE distort their signal or the assumptions embedded in the BMPE projections on the future path of variables that are treated exogenously in the underlying models hinder the accuracy of the projections.

Since there are variables other than M3 that are biased upward and that are not encompassed by the BMPE, we now consider each of them in combination with the BMPE projections.

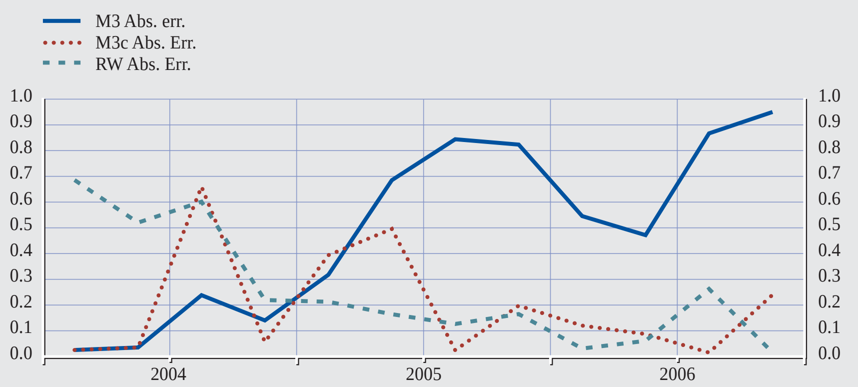
Results are reported in Table 5.

Table 5 Combinations with BMPE

Model	MSFE	MSFE/RW	MSFE/AR	Bias	SD fore	Var. f.e.	*Bias*^{2}
Gdp	0.13	1.31	0.74	-0.23	0.28	0.08	0.05
Unemp	0.10	1.00	0.57	-0.14	0.28	0.08	0.02
Emp	0.11	1.12	0.64	-0.14	0.30	0.09	0.02
Impp	0.08	0.79	0.45	-0.16	0.18	0.06	0.02
Oilp	0.09	0.91	0.52	-0.16	0.21	0.07	0.02
Exc	0.07	0.73	0.42	-0.14	0.17	0.06	0.02
Sir	0.09	0.86	0.49	-0.13	0.26	0.07	0.02
Lir	0.08	0.80	0.45	-0.11	0.24	0.07	0.01
Spread	0.10	1.02	0.58	-0.20	0.22	0.06	0.04
Wages	0.12	1.19	0.68	-0.29	0.13	0.04	0.08
Ulc	0.08	0.78	0.44	-0.18	0.16	0.05	0.03
CombAR	0.08	0.78	0.44	-0.14	0.21	0.06	0.02
CombRW	0.07	0.68	0.39	-0.17	0.16	0.04	0.03

Note: CombAR and CombRW in the last two rows refer, respectively, to the combination of the BMPE projections with the univariate autogressive and random walk forecasts.

Chart 5 M3, M3 corrected and random walk. Absolute forecast errors for annualized inflation 12 quarters ahead



Clearly, nominal variables in combination with the BMPE outperform the forecasts based on bivariate models seen in Table 3. Combining BMPE with nominal variables seems to be a good idea both for smoothness (variance of forecast error) and for bias correction. However, all forecasts are still biased downward like the BMPE. This suggests that the M3-BMPE success is due to the fact that both models have large bias of opposite sign. Notice that, the bivariate model based on M3 has a larger bias than all bivariate models of Table 3. The result of M3-BMPE combination is due to the fact that we are combining two models which produce forecasts that are systematically biased in opposite directions.

As a last exercise, we have conducted an evaluation of the forecast at twelve quarter ahead since money is typically considered to help forecasting in the medium and long run.

Unfortunately, due to the very short prediction sample, which, for this exercise, is 2004 Q3-2006 Q2 (twelve observation), results are not robust and should not be trusted.

Chart 5 provides absolute forecast errors for the random walk and for the money based forecasts at the horizon h = 12 quarters ahead. They show that M3 corrected forecast errors are similar to those of the random walk and are quite volatile.

3.5 WHAT CAN WE CONCLUDE FROM THE QUANTITATIVE EVALUATION?

Overall, the results of the quantitative exercise can be summarized as follows.

- The forecasts based on the M3-BMPE average model combination produce a striking result in terms of reduction of the MSFE relatively to the random walk. This result has to be better understood. In particular, it should be evaluated whether the opposite sign of the systematic bias can be explained formally and exploited in future refinements of the monetary analysis.

- M3 based inflation forecasts are not encompassed by the BMPE, which suggests that models based on money may have a role in helping to track the dynamics of inflation. Although encompassing tests show that other nominal variables can do the job of M3 for what concerns the tracking of dynamics, the bias correction is achieved by M3 in combination with the BMPE and not by the combination of BMPE with other nominal variables.[17]

- The forecast based on M3 corrected is dominated in terms of MSFE by the BMPE-M3 combination, but it is unbiased. This suggests that the real time analysis of monetary developments succeed in obtaining a good estimate of average inflation, although this comes at the cost of an excessively volatile forecast.

To sum up, the forecast evaluation suggests that monetary developments do contain information about the outlook for inflation (at least when focusing on the specific annualized HICP inflation over the next six quarters measure). Given the constraints surrounding and specificities of the exercise, drawing firm conclusions at this stage on the basis of such a short sample would be unwise. Certainly, the performance of the money-based forecasts needs to be monitored closely in the future and this section can be seen as describing a framework within which to conduct such monitoring in a structured way, which over time will lead to more meaningful tests of the validity of the ECB's monetary analysis. In the meantime, we can conclude that, on the evidence provided by the forecast evaluation exercise, one would not reject the hypothesis that there is information in monetary aggregates about the inflation outlook that is potentially relevant for monetary policy decisions.

4 MONEY AND MONETARY POLICY: NARRATIVE EVIDENCE

4.1 MONETARY ANALYSIS AND MONETARY POLICY DECISIONS

Sections 2 and 3 addressed the question of whether there is information in monetary developments that is relevant for monetary policy makers. Against this background, it is natural to assess how the ECB's monetary analysis has, in practice, influenced monetary policy decisions since the introduction of the single monetary policy in 1999.

One way to confront this question is to adopt the narrative approach to identifying monetary policy actions, pioneered by Friedman and Schwartz (1969) and used more recently in a series of papers on the Federal Reserve by Romer and Romer (1989; 1994). Approached in this way, what relationship emerges between the monetary analysis and the ECB's interest rate decisions?

17 Although the combination of the BMPE projections and the bivariate forecast based on the nominal long term interest rate achieves a result relatively close to that of the BMPE-M3 combination in terms of bias correction.

Chart 6 Policy rate and main monetary and economic indicators

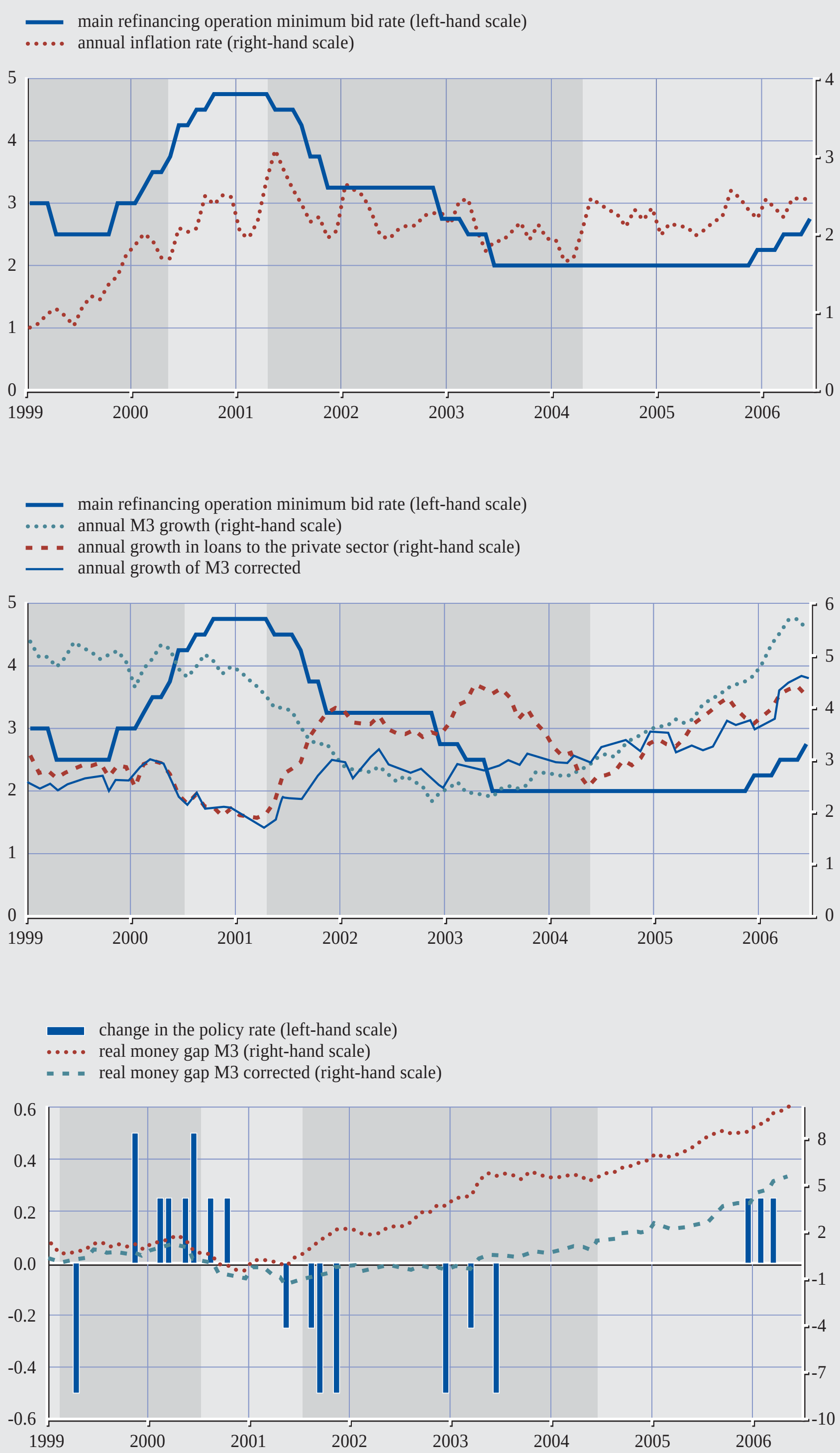
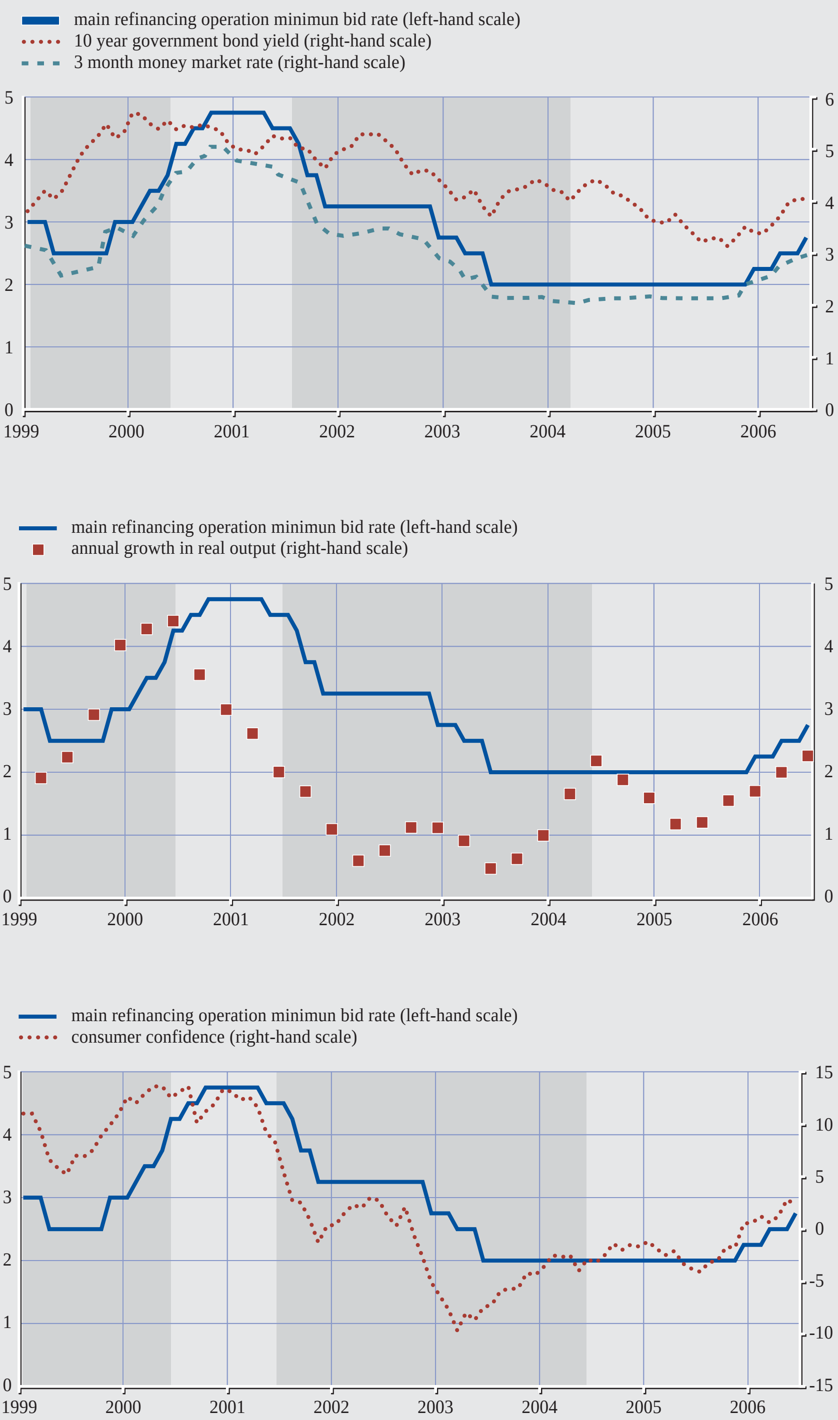


Chart 6 Policy rate and main monetary and economic indicators (cond't)



To address this key question, the remainder of this section provides a relatively detailed narrative summary of developments in the monetary analysis over the period 1999-2006 and their relationship with the four distinct phases of the monetary analysis identified in Section 2. In support of the narrative, Chart 6 shows the evolution of key macroeconomic time series since 1999.[18]

Given the objective of this paper, the discussion focuses rather narrowly on the impact of the monetary analysis on monetary policy decisions, thereby inevitably neglecting the important role of the economic analysis. Hence this discussion is not intended to offer a comprehensive description of how interest rate decisions have been made, but rather to identify more clearly what the input from the monetary analysis has been to that decision making process. Since there has been a high degree of correlation between the signal emanating from the monetary analysis and the economic analysis, from an analytical perspective identifying the distinct role of the former in interest rate decisions remains problematic.

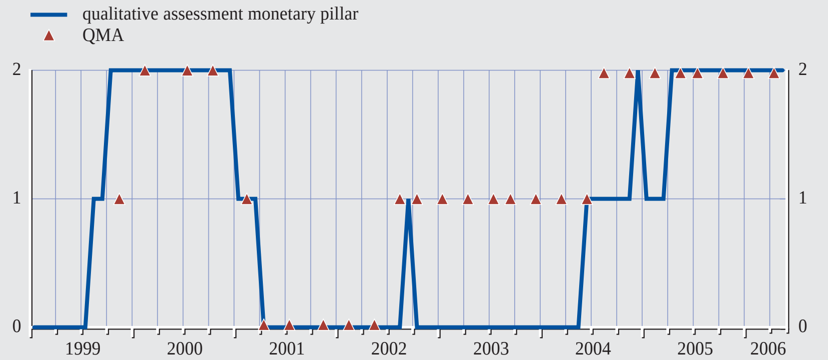
One way to shed light on the key issue of how important a role monetary analysis has played in policy decisions is to investigate more closely the actual decision-making process. To this end, an indicator has been constructed to capture the Governing Council's assessment of the intensity of the risks to price stability deriving from the monetary analysis, at least insofar as this is reflected in the language used in the President's Introductory Statement following the ECB's monetary policy meetings.[19] (A positive value of the index indicates an upside risk to price stability.) Of course, just as with the other synthetic quantitative indicators introduced in Section 2 and the money-based inflation forecasts evaluated in Section 3, such indicators should be seen as a simple and imperfect summary of the information in the Introductory Statement, not as a comprehensive assessment of the views expressed therein.

Using this indicator, a very simple assessment of how the Governing Council treats the monetary analysis can be made. More concretely, some insight into the Governing Council's interpretation of the analysis can be obtained by investigating how the "input" to their discussions – captured in simple form by the qualitative indicator of the overall thrust of the QMA (introduced in Section 2 and constructed along similar lines) – is transformed into the "output" that rationalizes and explains monetary policy decisions in the Introductory Statement – as captured by the qualitative indicator described in the previous paragraph. The comparison of these two indicators over the period since January 1999 is shown in Chart 7.

18 Note that the figures show the latest vintage of the data, which needs to be kept in mind when assessing some of the narrative discussion.

19 Other authors, like Gerlach (2004), have also attempted to construct such indicators of the intensity of the risks to price stability stemming from the monetary analysis on the basis of the Introductory Statement. The indicator used in this paper (and shown in Chart 7) is strongly correlated with other similar indexes constructed elsewhere in the literature.

Chart 7 QMA and Introductory Statement's assessment of risks to price stability stemming from monetary analysis



Note: The qualitative coding goes from -2 (clear downward risks to price stability) to +2 (clear upward risks to price stability).

Overall, the input and output series follow a very similar pattern, suggesting that the internal staff analysis provided via the QMA has generally been endorsed by the Governing Council, at least in the sense that its main elements have been reproduced in the Introductory Statement. Although only tentative conclusions can be drawn, this would be consistent with the Governing Council assigning some significance to the monetary analysis in taking interest rate decisions for the bulk of the period since 1999. However, the generally high correlation between monetary analysis input and output to the Governing Council's discussion has not been uniform through the entire sample period. The exceptional episodes are treated in more detail in the narrative analysis below.

PHASE 1: EARLY 1999 - MID-2000

At the outset of Monetary Union, M3 growth rose from levels close to the 4½% reference value that had been announced in December 1998 to rates well above 5% (see Chart 6). This strengthening of headline monetary dynamics took place in an environment where consumer price inflation was very low by historical standards and the economic outlook was uncertain (in the aftermath of the Asian and Russian economic crises of 1997-98). At that time, the observed strengthening of monetary growth was associated in part with a variety of technical factors (discussed in Section 2), notably the impact of the introduction of the remuneration of required reserves at essentially market rates. More generally, given the inevitable uncertainty introduced by the regime shift to Monetary Union, at that time all data were treated with some circumspection. In this context, higher monetary growth on the headline M3 definition was not necessarily seen as reflective of the underlying rate of monetary expansion and, as such, was not deemed an impediment to the decision to cut interest rates by 50bp in April 1999. In the course of 1999, the reliability of the monetary data became better established. Moreover, the M3 data pointed to continued strength of monetary dynamics, which could no longer be accounted for on the basis of special factors associated with the start of Monetary Union. The view that monetary growth had strengthened was consistent with the signals identified from the economic analysis, with the outlook for economic activity in the euro area improving and inflation and inflationary pressures rising. Against this background, interest rates were raised by a total of 225bp in a series of steps through mid-2000, starting with a 50bp rise in November 1999.

With the benefit of hindsight, the narrative assessment of the monetary analysis during this period points to a number of issues. First, in general developments in the data were treated with some caution, as it was recognized that the start of Monetary Union and the introduction of new statistical systems had raised the uncertainty surrounding the published statistics. Second, broadly speaking, the signal extracted from monetary developments during this period was that of building inflationary pressures pointing overall towards a need to raise interest rates. This signal strengthened over the course of 1999 and into early 2000, both on account of stronger M3 growth and as the special uncertainties associated with the new policy regime and novel data series dissipated somewhat. Third, in retrospect, policy relevance was attached to developments in monetary growth which – by the standards of subsequent years – now look rather modest. Fourth, with the exception of the first few months of 1999, the signal stemming from the monetary analysis was broadly consistent with that derived from the economic analysis.

Overall, one can conclude that from mid-1999 through mid-2000 the monetary analysis pointed to inflationary pressures and a need to raise interest rates, which was reflected in monetary policy decisions. However, since a broadly similar signal was extracted from the economic analysis over this period, it remains difficult to identify the relative weights of the monetary and economic analysis on the decision making process.

PHASE 2: MID 2000 - MID-2001

By mid-2000 – and, in part, reflecting the increases in short-term interest rates – headline M3 growth showed some moderation, especially with regard to its shorter-term dynamics which, at annualized rate, fell below the reference value of 4½%. Translated into an outlook for price developments, the moderation in the rate of monetary expansion was seen as pointing to some easing of inflationary pressures at medium-term horizons. Although the changes in monetary dynamics on which this assessment was based look modest by the standards of subsequent developments, at the time they were interpreted as suggesting that the monetary policy actions from November 1999 had served to contain inflationary risks. The analysis thus pointed to a change in the broad outlook for monetary policy, implying first a stabilization of and then scope to lower the level of short-term interest rates. Again, with the benefit of hindsight, this narrative assessment suggests that the broad signal from the monetary analysis is consistent with the actual path of interest rat decisions during this period, with the key rate in the Eurosystem's main refinancing operations peaking at 4.75% in October 2000. However, since the economic analysis provided a similar general message – notably with concerns of a slowdown in economic activity stemming from the sharp correction in global equity markets and weaker growth in the United States – the importance of the monetary information in driving policy decisions is difficult to identify separately ex post. Overall, in the first two years of Monetary Union, an ex post narrative assessment of the signal derived from the monetary analysis suggests that this was consistent with the broad thrust of interest rate decisions. However, from early 2001 onwards the situation is more complicated.

In early 2001, the economic analysis pointed to some deterioration in the outlook for economic activity. However, monetary growth on the headline M3 measure – at least on the basis of the data published at that time – strengthened relative to what had been previously expected. Prima facie, the two forms of analysis therefore appeared to give somewhat contradictory signals, with the economic analysis pointing to some moderation of inflationary pressures in the medium term[20] whereas the monetary developments suggested an intensification. In May 2001, interest rates were cut despite continued strong M3 growth (and publication of an annual growth rate of M3 for March 2001 at the end of April – just before the Governing Council meeting at which the decision was taken – that exceeded market expectations by 0.5pp).[21]

Based on the reaction of market interest rates at the time of the policy announcement, the decision to cut key ECB interest rates in May 2001 came as a surprise to market participants. They appear to have concluded that the apparent strengthening of monetary dynamics relative to what had been originally anticipated strongly reduced the likelihood of an interest rate cut in May. However, the internal assessment of the underlying trend rate of monetary growth was quite different from that suggested by a naive mechanical inspection of the published headline M3 growth figures. Not only had the underlying rate of monetary expansion moderated since early 2000 (as was also apparent in the published figures), but the annual growth rate of M3 corrected for the internal estimate of non-resident holdings of marketable instruments issued by MFIs had fallen substantially below the ECB's reference value of 4½%. Thus, viewed in an encompassing manner and contrary to the naive signal offered by the published M3 data, the monetary analysis pointed to reasons to cut interest rates, in line with the signals stemming from the economic analysis.

To emphasize: the comprehensive internal monetary analysis undertaken at the ECB in early 2001 not only did not act as an impediment to the interest rate cuts observed from May 2001, but rather signaled the need for them, thereby supporting the conclusions of the economic analysis. Although the ECB publicly referred to the need for the crucial data correction in a qualitative way, external observers did not appreciate the significance of such guidance for the interpretation of monetary developments and appear to have concluded, at least in part, that the monetary analysis was being ignored in favor of the economic analysis.

20 However, the economic analysis pointed to some short term upside risks due to one-off shocks.

21 Note that subsequent revisions to the M3 data deriving from a correction of the statistical issues discussed in Section 2 have reduced the strength of M3 growth during this period in the latest vintages of the data and are thus not visible in Chart 6.

PHASE 3: MID-2001 - MID-2004

From mid-2001, monetary developments were also influenced by the impact of portfolio shifts into safe and liquid monetary assets, in the environment of heightened economic and financial uncertainty that followed the global stock market correction and the terrorist attacks of 11 September 2001. Annual M3 growth started to rise more strongly from mid-2001 on account of these portfolio shifts. In the face of these developments, the internal analysis of monetary developments recognized three key issues.

First, the magnitude and causes of these portfolio shifts appeared to be unprecedented and, as such, analysis and interpretation of the monetary data was surrounded by more than usual uncertainty. In consequence, the signal stemming from the monetary analysis was more blurred – and thus weaker – than had been the case in preceding years.

Second, the baseline or modal view developed by the monetary analysis treated the portfolio shifts as a temporary development, which would be reversed once financial market conditions normalized. As such, the strengthening of monetary growth associated with the portfolio shifts was not deemed to reflect a pick-up in the underlying rate of monetary expansion, which would signal inflationary pressures at medium to longer horizons. Rather it was seen as confirming the evidence from the economic analysis – apparent in the sharp decline in business and consumer sentiment surveys and measures of economic activity – that the private sector was retrenching in the face of the high degree of uncertainty.

Finally, although the baseline conclusions derived from the monetary analysis pointed to a rather benign interpretation of stronger M3 growth, the risks surrounding this baseline were viewed as heavily skewed towards upside risks to price stability. In particular, the accumulation of liquidity resulting from strong money growth was deemed to constitute a risk of inflationary pressures should it lead to stronger spending in a context where consumer and business sentiment were to recover as heightened uncertainties receded.

The signal drawn from the monetary analysis in the periods of strong portfolio shifts into money (late 2001 and late 2002 through early 2003) were therefore rather nuanced. On the one hand, strong M3 growth on the official headline measure was not seen as an impediment to the interest rate cuts that were prompted by the economic analysis. These cuts led to a progressive lowering of the minimum bid rate in the Eurosystem's main refinancing operations, which reached the historically low level of 2% in June 2003. On the other hand, growth in the internal M3 series corrected for the estimated impact of portfolio shifts (which was subsequently published in the Monthly Bulletin) remained quite sustained and, of itself, did not point to a need for interest rate cuts over this period. Both conclusions were viewed as rather tentative and thus did not provide a strong signal for monetary policy.

Overall, the monetary analysis appears to have played a more subdued role in guiding the broad outlook for short-term interest rate decisions in this period, although the upside risks to the modal rather benign view of strong M3 growth developed in the internal analysis may have acted as a break on more aggressive interest rate cuts in 2002-03, when many commentators were calling for a substantial further easing of monetary policy at a time when deflationary risks were identified by some. Moreover, the portfolio shifts into money themselves demonstrated the confidence of the euro area private sector in the soundness of the European banking sector, which may have served to allay fears of debt deflation and financial crisis that some observers argued implied a need for more aggressive easing.

At this point, it is worth commenting further on Chart 7 and the relationship between the input provided by the QMA to the Governing Council's discussions and the output of those discussions as reflected in the Introductory Statement. Indeed, the main exception to the generally strong correlation between the input and output measures of the monetary analysis is the period from mid-2002 through mid-2004. During this period, the staff assessment – while embodying a baseline view that strong monetary growth and the consequent accumulation of liquidity stemming from portfolio shifts was rather benign in terms of the outlook for price developments over the medium term – emphasized that the risks to this baseline view were heavily skewed to the upside. In other words, while the most likely outcome was that inflationary pressures coming from monetary dynamics were modest, it was hard to construct a scenario on the basis of the monetary data where deflationary risks would emerge, whereas there were scenarios where inflation could rise significantly. By contrast, output of the Governing Council's discussion as reflected in its communication via the Introductory Statement tended to downplay the role of the monetary analysis in general and, in particular, did not place such emphasis on the upside risks to the baseline interpretation of monetary dynamics.

This discussion sheds important light on the oft-repeated question of how much "weight" is assigned to the monetary analysis in the Governing Council's interest rate setting process. Two important points can be made. First, the weight assigned to the monetary analysis has varied over time, as the clarity and reliability of the policy-relevant signal coming from monetary developments (relative to those offered by the economic analysis) has fluctuated. It is clear that the Governing Council chose to discount some of the signals coming from monetary indicators at a time when portfolio shifts implied that monetary developments were harder to interpret than usual. Second, the decision to form a somewhat different assessment from the input from the staff when communicating the monetary analysis suggests that the Governing Council undertook an active discussion of how the analysis and monetary developments themselves should be interpreted. Thus throughout Stage III – and in particular when portfolio shifts were at their height – the Governing Council has fulfilled its commitment, as embodied in the ECB's monetary policy strategy, to analyze monetary developments closely and assess their relevance for interest rate decisions, while eschewing any mechanical policy response to the evolution of a particular aggregate.

With the cessation of major military operations in Iraq by mid-2003, financial and economic uncertainty began to recede and portfolio allocation started to normalize. As had been anticipated in the baseline scenario of the monetary analysis, annual M3 growth moderated substantially between mid-2003 and mid-2004 as past portfolio shifts into monetary assets unwound. However, consistent with a symmetric interpretation of the impact of portfolio shifts on the policy-relevant signal in monetary developments, this fall in headline M3 growth was not interpreted as a signal that further interest rate cuts were warranted. Rather it was seen as providing evidence from the monetary side corroborating the view that the levels of uncertainty and risk aversion – which had proved to be a brake for consumption and investment spending during the economic slowdown - were returning to historical norms. Indeed, the internal M3 series corrected for the estimated impact of portfolio shifts continued to grow at a sustained (and slightly increasing) rate through this period, supporting the view that the underlying rate of monetary expansion was not being reflected in the substantially lower rate of headline M3 growth.

PHASE 4: MID-2004 ONWARDS

Through the course of 2004, the analysis of a broad set of indicators (see Appendix B) provided evidence of a further unwinding of portfolio shifts, albeit at a slower pace than would have been anticipated on the basis of historical norm (derived from behaviour in the two decades prior to the start of Monetary Union) for the elimination of accumulated liquidity holdings. Yet headline annual M3 growth increased from mid-2004 and has remained on a sustained upward trend through mid-2006.

The drivers of monetary dynamics during this period were judged to be quite different from those underlying strong monetary growth between 2001 and 2003 (ECB, 2006b). On the counterparts side, M3 growth was driven by strengthening credit expansion. On the components side, monetary growth has derived largely from the dynamism of the more liquid components of M3. Such characteristics have led to the conclusion that the strengthening of monetary growth since mid-2004 reflects the then prevailing low level of interest rates in the euro area and, latterly, the recovery of economic activity and associated improvements in consumer and business sentiment. Moreover, the strengthening of headline M3 growth has been seen as broadly representative of the underlying rate of monetary expansion and this indicative of growing upside risks to price stability over time.

Given the uncertainties experienced in the preceding years and the low frequency nature of the information in money, the strengthening of monetary dynamics from mid-2004 did not have an immediate impact on interest rate decisions, but rather cumulated over time. Through the course of 2005, the interpretation of the strengthening of monetary growth and the accumulation of liquidity was viewed as progressively more reliable and thus offered an intensifying signal of the need for interest rate increases to address upside risks to price stability over medium to longer-term horizons. Interest rates were raised by 25bp in December 2005 and a progressive withdrawal of monetary accommodation has followed.

It should be recalled that, at the time, many observers viewed the decision to start raising interest rates in December 2005 as potentially premature, given question marks that they identified regarding the robustness and sustainability of the economic recovery in the euro area and the low rate of so-called core inflation measures (such as inflation of the HICP excluding energy and unprocessed food prices). Indeed, at that time it was common to identify a gap between the strength of the so-called "soft data" (i.e. surveys of business and consumer confidence) and the "hard data" (i.e. concrete statistics, such as retail sales, industrial production and national accounts indicators). Moreover, an intense debate was pursued over whether headline or core measures of inflation should be given greater prominence in the policy debate, with the former being elevated, in part due to oil price rises, but the latter more subdued. In short, a degree of uncertainty surrounded the economic analysis, while, on balance, pointing to upside risks. Nevertheless, the relatively stark signal of longer-term inflation risks offered by the monetary analysis by the last quarter of 2005 may have played an important role in the decision to raise interest rates in December (Trichet, 2006).

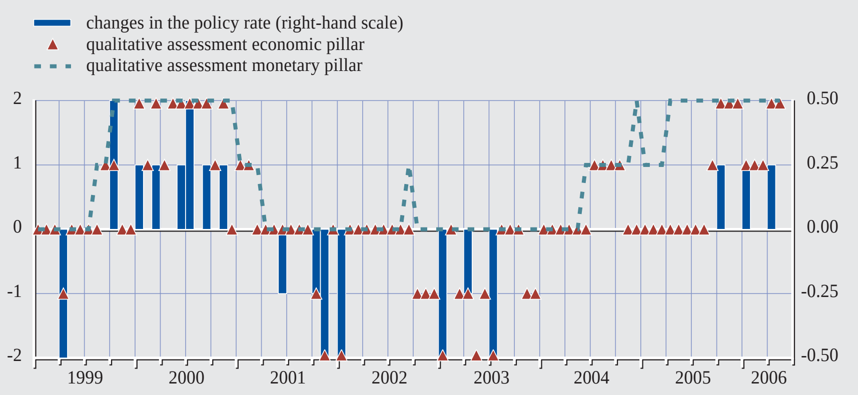
4.2 THE PRESENTATION OF MONETARY ANALYSIS AND ITS ROLE IN INTEREST RATE DECISIONS

Another issue concerns the relative importance of the monetary analysis (as compared with the economic analysis) in explaining interest rate decisions. Using the same qualitative indicator of the language used in the Introductory Statement that underlies Chart 7, Chart 8 shows a comparison with an equivalent indicator (constructed using the same methodological approach) for the economic analysis. For reference, the time series of changes in key ECB interest rates made since the start of the single monetary policy in January 1999 is also shown.

A number of observations can be made on the basis of Chart 8.

First, as is reflected in the narrative discussion, there is a high degree of collinearity between the communication regarding the monetary and economic

Chart 8 Qualitative assessment of risks to price stability from monetary and economic pillar in Introductory Statement



Note: The qualitative coding goes from -2 (clear downward risks to price stability) to +2 (clear upward risks to price stability).

analyses, which presumably reflects the typically common thrust of the analyses themselves. This makes identifying the independent effect of monetary analysis – at least insofar as it is captured in the official communication – difficult to assess.

Second, there are two broad exceptions to this generally collinear picture. Between mid-2001 and mid-2003, the monetary analysis as described in the Introductory Statement pointed to relatively balanced risks to price stability, whereas the economic analysis saw risks on the downside. Overall, the successive cuts of interest rates of this period suggest that the economic analysis played the decisive role in explaining monetary policy decisions. The substantive reasons behind this approach, notably the high degree of uncertainty attached to the interpretation of monetary developments at that time, have been outlined in preceding sections. The second exception concerns 2005, where for most of the year the monetary analysis pointed to upside risks, whereas the economic analysis suggested a more balanced outlook. Although with some lag, the progressive increase of official interest rates from December 2005 were – in real time – motivated to an important degree by the monetary analysis. Again the reasons for such communication – notably the uncertainties surrounding the interpretation of the economic analysis at a time when "soft" and "hard" data were giving somewhat contradictory signals – have been described in previous sections.

5 CONCLUSIONS

The paper has analysed three issues. First, in the interests of transparency and to promote a better understanding of the ECB's approach over the past eight years, the paper is intended to provide a rich description of the ECB's monetary analysis, the tools on which it is based and the evolution of these tools over time. Second, almost eight years after the introduction of the euro in January 1999, the paper attempts to offer some evaluation of the monetary analysis. Finally, we assess qualitatively what has been the role of the monetary analysis in policy decisions.

As regards the first question, a number of key points should be underlined. First, describing the ECB's framework for monetary analysis is complicated by the changing nature of that framework over time. The tools and methods used have evolved significantly over the past eight years, as practical solutions have been sought to the various challenges faced by monetary analysis in real time. Second, one important aspect of this evolution has been the rising importance of judgmental adjustments to the monetary series at the expense of a focus on conventional specifications of money demand. This shift of emphasis reflects both, on the one hand, the recognition that a structural or behavioural explanation of monetary developments is required in order to assess their possible implications for the outlook for price stability and, on the other hand, the failure of conventional money demand equations to offer convincing structural explanations of the monetary dynamics observed in the euro area, especially during the portfolio shifts phase. Third, in parallel with the rise of such adjustments, reduced form money-based inflation forecasts have come to play a more prominent role in the presentation of the monetary analysis. In sum, the ECB's monetary analysis is much richer and broader than is sometimes recognized, drawing on a much broader set of monetary, financial and economic data to understand what implications monetary developments have for the outlook for price stability.

In this context, it is also important to emphasize two aspects of the ECB's monetary analysis that are not always well understood outside. First, money demand is no longer seen as the centre-piece of the framework for monetary analysis. Conducting a rich monetary analysis is thus not contingent on the stability or otherwise of any single specification of money demand for a particular monetary aggregate. Second, the focus of the analysis is at the medium to longer-term horizon. The use of monetary aggregates to help forecast inflation or growth dynamics in the coming few months is not a core element of the ECB's monetary analysis.

Turning to the second question, it should be recognized from the start that the medium-term orientation of the monetary analysis complicates the assessment. By treating the real time dimension of the evaluation seriously, the sample periods available for the evaluation conducted in this paper are short, the degrees of freedom for econometric work are thus not numerous and consequently the scope to draw strong, policy-relevant conclusions is limited. This having been said, what conclusions can be drawn? First, the forecast evaluation suggests that there is information in monetary developments about future inflation dynamics beyond that which is contained in conventional macroeconomic forecasts or projections. Moreover, the fact that the inflation forecasts stemming from the monetary analysis and the economic analysis have biases of opposite sign, which are largely eliminated by combining the two forecasts can be seen as evidence in support of the view (offered in Issing 2006) that taking two complementary but distinct perspectives on the inflation outlook has made the ECB's analysis more robust and avoided the potentially the big mistakes that could have been made if an exclusive focus on either the monetary or the economic analysis had been taken. Second, the evaluation suggests that the ECB staff have been able to use judgment to identify and quantify in real time various factors affecting monetary developments that were not captured in conventional money demand equations. Related to this, the forecast evaluation demonstrates that monetary aggregates corrected on the basis of the expert judgment have been used to produce forecasts of inflation that have proved to be unbiased, if excessively volatile. Of course, whether the use of judgment in this manner will continue to be successful in the future is an open question, and we certainly recognize that past success is not necessarily a guide to future performance. With this in mind, it will remain crucial to continuously evaluate and systemize the monetary analysis and, in particular, its judgmental element.

Finally, to evaluate the role of monetary analysis in interest rate decisions, we distinguish between phases in which the signal from monetary analysis was in line with that from economic analysis from those in which it was not. Clearly the latter periods are the most informative for our question. Moreover, we try to assess the degree of clarity of the two respective signals over time and link it to the policy decision. We conclude that, although, in general, there was a broad correspondence between the two analysis and it is therefore difficult to assess their separate role, it appears that the economic pillar prevailed in influencing the decision when the monetary pillar gave a blurred signal.

Looking forward, this paper can be seen as offering a framework – the real time forecast evaluation – for monitoring one summary measure of the signal offered by the monetary analysis in a structured and systematic way. Moreover, it can also be seen as identifying a challenge for the monetary analysis, namely – now that data are more plentiful, both in terms of time series length and sectoral and instrument coverage – to systematize the procedures by which judgmental adjustments are made.

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6 APPENDIX A: DESCRIPTION OF THE REAL TIME DATABASE

Our real time database provides a snapshot of the exact data available to the ECB forecasters at the time they prepared their forecast.

It includes 14 variables. HICP is the target variable for both the money based and the BMPE projections.

The M3 and M3 corrected series are the main inputs to the Quarterly Monetary assessment. They are notional stocks and might differ from official data due to the corrections of statistical distortions (see Section 2.3 and Appendix B).

The other 11 variables are input to the BMPE projections. The exchange rate is the USD/EURO(ECU), BIS source. Oil prices are taken from the world market prices database of the BIS and refer to crude oil, USD basis. Short and long term nominal interest rates are ECB estimates from national sources for the pre-1999 period. Short interest rates are three months money market rates, while long rates are 10 years government bond yields. The term spread is given by the difference between long and short term nominal interest rates. The latter variables and wages, unit labor costs, the unemployment rate, total employment and import prices are taken from the BMPE forecast database for all the exercises from 2003 Q3 to 2005 Q1. For the exercises before 2003 Q3, we relied on the data input files of the area wide model (AWM). The only exception is unemployment data, which were taken from the AWM input files for the exercises from 2000 Q4 to 2001 Q3 (i.e. vintages 2000 Q3 to 2001 Q2) and from the Orange Book for the exercises between 2001 Q4 and 2003 Q2.

Table 6 provides an overview of the main features of the real time database. Columns two to four report the definitions of the variables, the transformations adopted to achieve stationarity (0=levels, 1=first differences and 2=first differences of logarithms) in the forecasting exercises and whether the variables are seasonally adjusted in real time or not. The fifth column reports the release date of the variables, i.e. how many days after the end of the quarter a given variable is first released.

Revisions in the generic variable *Y* in vintage *v* are computed as the difference between the last available annual growth rate in vintage v and the corresponding growth rate in the last available vintage (2006 Q2), that is:

$$rev_{y,t} = \left[y_{t,t} - y_{t,t-4} \right] - \left[y_{2006Q2,t} - y_{2006Q2,t-4} \right]$$

where *y* indicates the natural logarithm of *Y*.

In order to provide a description of the data uncertainty faced in real time forecasting, we compute statistics on the data revisions for the 18 vintages that we evaluate. Column five reports the average revision in the annual growth

Table 6 Real time database

Variable	St. Tr.	SA	Release	Mean	M.A.	M.A./ M.A.Y
HICP	2	SA	t+15	-0.10	0.12	0.04
M3	2	SA	t+26	-0.21	0.30	0.04
M3 Corrected	2	SA	t+26	-0.01	0.33	0.05
GDP	2	SA	t+45	0.23	0.24	0.11
Short Term Interest Rate	1	NSA	t	0	0	0
Long Term Interest Rate	1	NSA	t	0	0	0
Term Spread	0	NSA	t	0	0	0
Wages	2	SA	t+104	0.06	0.27	0.06
Unit Labor Costs	2	SA	t+104	0.09	0.28	0.09
Unemployment	1	SA	t+32	0.10	0. 12	0.23
Employment	2	SA	t+90	0.26	0.27	0.27
Import Prices	2	SA	t+80/90	-0.09	0.70	0.16
Oil Price	2	NSA	t	0	0	0
Exchange Rate	2	NSA	t	0	0	0

rates of each variable[22], column six the average absolute value of the revisions and column seven the ratio of the average absolute revision to the average of absolute values of the variable.

All variables are seasonally adjusted in real time, except the interest rates, oil prices and the exchange rate.

As for the date of release[23], interest rates, exchange rates and oil prices are available at any time. The first release of HICP is available after 15 days from the end of the quarter it refers to. Monetary aggregates become available 26 days after the end of the quarter. Real variables are less timely. In particular, since 2003 a flash estimate of GDP is available 45 days after the end of the quarter. Before 2003, the first available GDP release was the regular first release, available between 61 and 70 days after the end of the quarter. In the sample we evaluate, total employment was available 90 days after the end of the quarter[24]. The latest releases in our database are wages and unit labor costs, only available 104 days after the end of the quarter.

Column five shows that real variables, wages and unit labor costs tend to be revised upward, while import prices, HICP and M3 downward. The mean revision in M3 corrected is very close to zero.

22 Except for unemployment and interest rates for which we report the average revision in the 4 quarters difference.

23 Notice that some variables, for example the money aggregates, are available at shorter frequency than the quarter. However, the forecasting exercises are conducted at a quarterly frequency, so we report here the date in which the data for the former quarter become first available.

24 From 2006 Q1, total employment becomes available 74 days after the end of the quarter.

Column six reports the mean of the absolute value of the revisions, an absolute measure of the size of the revisions. Financial variables are not revised. The most revised variable is import prices. HICP is among the least revised variables, while M3 and M3 corrected among the most revised. Since the mean of the revision in M3 corrected is close to zero, the result in column seven is explained by the fact that revisions in M3 corrected alternate in sign across vintages. Wages and unit labor costs are revised almost as much as M3 and considerably more than HICP.

However, more volatile variables are more likely to be more revised, as well. Hence, column seven reports the ratio of the mean absolute revision in each variable to the mean absolute value of the variable itself. In relative terms, M3 and M3 corrected are among the least revised variables and the most revised variables turn out to be employment and unemployment.

7 APPENDIX B: JUDGMENTAL CORRECTION TO M3

When trying to extract those medium- to longer-term signals from money that are relevant for future inflation developments in real time, it is necessary to try to identify/correct for the recent short- to medium term components of M3 developments at the current end of the time series that are assumed to be unrelated to future risks to price stability, given the well-known end-point problem in signal extraction. Those corrections often have to be judgemental by nature, as a precise quantification, in particular in real time, is seldom available. This annex lists and motivates the main judgemental corrections that had been performed for M3 in real time between 1999 and 2006 and lays out the procedures that have let to the final quantification. In general, for deriving those quantifications, the ECB monetary analysis relied on a framework that was characterised by four main elements:

- A broad monetary and institutional analysis.
- A monitoring of short-term forecast errors from a univariate time series model of euro area monetary aggregates.
- A direct quantification method of factors that are assumed to be unrelated to risks to price stability using information from reporting agents, market participants and National Central Banks.
- Whenever a direct quantification was not possible, a quantification was performed by using intervention variables in the univariate time series model for the monetary aggregates, whenever possible, accompanied by alternative quantification for robustness reasons and further verified by a set of indicators related to the problem.

7.1 JUDGEMENTAL CORRECTIONS RELATED TO THE STATISTICAL DEFINITION OF MONETARY AGGREGATES

NEW REPORTING SYSTEM FOR MFI BALANCE SHEET STATISTICS IN JANUARY 1999

The introduction of a new MFI reporting scheme is likely to have distorted monetary developments around January 1999, as suggested by anecdotal evidence in combination with significant one-step-ahead forecast errors in January 1999 from univariate time series models for M3. The potential distortion for measuring M3 has been quantified together with the impact of the introduction of a remunerated minimum reserve system, which is described in the next section and entered the time series of M3 corrected for special factors that have been used in the Quarterly Monetary Assessment (QMA).

NON-RESIDENT DEMAND FOR MARKETABLE INSTRUMENTS IN 2000 AND 2001

At the outset of Monetary Union, in the construction of the monetary statistics securities not held by euro area MFIs were, on the basis of anecdotal evidence, assumed to held solely by the euro area money holding sector. However, due to portfolio diversification in Asia and the specific attractiveness of some German MFI securities with a state guarantee, the demand from abroad (i.e. from non-residents) for such paper increased significantly after the start of Stage III, and in particular in late 2000 and early 2001. Since such holdings remained within the published data (although conceptually they fell outside the definition of M3), this distorted the euro area M3 aggregate and diminished its role as an indicator for risks to domestic price stability. The strong increase in the issuance of foreign currency denominated MFI short-term debt securities, reports from traders about an increased interest in euro area MFI short-term debt securities by Asian banks, direct information from MFIs and balance of payment statistics allowed in real time to identify the measurement problem in M3. The official exclusion of non-resident holdings of marketable instruments has been done in two steps. First, in May 2001, non-resident holdings of money market fund shares/units were excluded from M3, using mainly direct information from money market funds on the residency of the holder. Second, in November 2001, non-resident holdings of MFI short-term debt securities were excluded from M3, mainly based on information on the type of first holder in security settlement systems. Before those corrections of M3 had been officially introduced, the M3 series corrected for special factors that was used in the QMA embodied (for the period late 2000 to late 2001) an estimated correction for non-resident holdings of all marketable instruments. After the official data was revised, it transpired that this correction had been a very precise estimate (the difference between the real time internal corrected series and the final revised official series was small, with a maximum 10 basis points difference in the annual rate of growth of M3, see Chart 9 and 10). By contrast, the problem of non-resident holdings of marketable instruments distorted the published annual rate of growth of M3 in real time by considerably more than 100 basis points at the peak of the effect in early 2001.

Chart 9 Real time assessment of non-resident holdings of marketable instruments

(Different vintages of internal estimates of annual M3 growth corrected for non resident holdings)

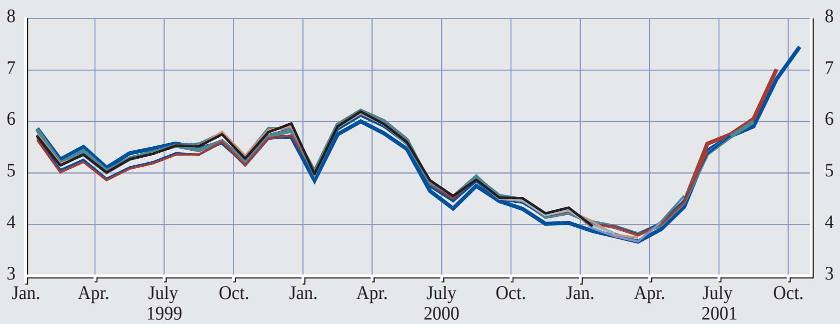
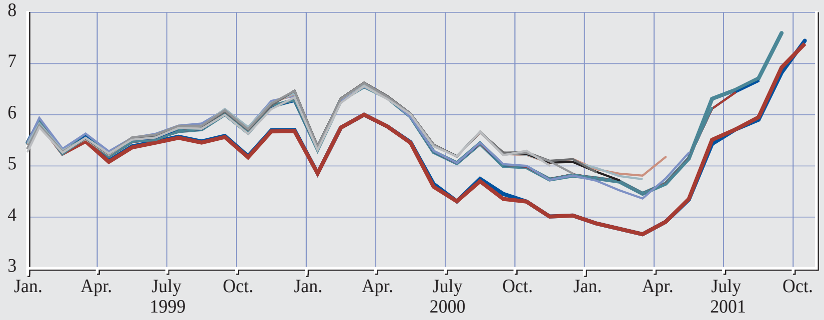


Chart 10 Real time assessment of non-resident holdings of marketable instruments

(Different vintages of official figures of annual M3 growth)



NON-RESIDENT DEMAND FOR EURO BANKNOTES

Due to the features of banknotes, the holder of banknotes is unknown to the reporting agents. It has thus been decided when defining monetary aggregates that all banknotes outside the hands of euro area Monetary Financial Institutions can be assumed to be held by the euro area money holding sector. Studies (see for example Fischer, Köhler, Seitz, 2004) suggested however, that already for the euro legacy currencies, this assumption had not been true. In fact, it was estimated that around EUR 35 billion of euro legacy banknotes had been used outside the euro area in the late nineties, mainly in Central and Eastern Europe. The introduction of euro banknotes in January 2002 led to some dynamics in those holdings. In the run-up to the euro cash changeover, euro legacy banknotes returned to the NCBs from abroad and had been substituted to a significant extent with euro denominated deposits in Eastern and Central Europe and partly substituted with US dollar and Swiss franc banknotes. After the euro cash changeover, the demand for euro banknotes from abroad seems to have been recovering quickly and can be estimated to be between EUR 60 billion and EUR 100 billion in mid 2006. Potential distortions to M3 stemming from the non-resident demand for euro banknotes had been regularly analysed in the QMA. However, given a large amount of uncertainties concerning the dynamics of the demand, this judgemental correction had not been introduced into the series of M3 corrected for judgemental factors.

CHANGES IN THE MANAGEMENT OF CENTRAL GOVERNMENT DEPOSITS BETWEEN 2002 AND 2005

Due to changes in the management of central government deposits in some euro area countries, highly volatile developments in central government deposits increased significantly the short-term volatility of M3, thus adding short-term noise in M3 in particular in 2003. In order to smooth this short-term volatility, flows of central government deposits had been added to M3 flows between early 2002 and early 2005 when deriving the series of M3 corrected for special factors that was used in the Quarterly Monetary Assessment.

ELECTRONIC TRADING PLATFORMS OF SECURITY DEALERS REPLACING INTERBANK OPERATIONS IN THE SECURITY MARKET, IN PARTICULAR IN 2005

In several countries, repurchase operations that were previously undertaken between credit institutions, have been switched to electronic trading platforms operated by security dealers resident in the euro area. As such transactions switch from being interbank operations to transactions intermediated by other financial intermediaries (OFIs), they may enter the definition of M3 and thus blur the evolution of underlying monetary dynamics. Based on information from the Deutsche Bundesbank (2005) and a number of other euro area central banks, this impact of financial innovation, most probably unrelated to future risks to price stability, had been corrected in particular in 2005 Q2 and 2005 Q3, where the impact of such operations on M3 had been sizeable. This correction was quantified with the univariate reg-ARIMA model as described in the next section and entered the series of M3 corrected from the Quarterly Monetary Assessment 2005 Q4 onwards.

7.2 JUDGMENT ON ECONOMICALLY MOTIVATED CORRECTIONS

INTRODUCTION OF A REMUNERATED MINIMUM RESERVE SYSTEM IN JANUARY 1999

The change to a remunerated minimum reserve system led to a repatriation of funds, especially from the UK to Germany without necessarily implying increased risks to euro area price stability. Anecdotal evidence and available data from branches and subsidiaries of German MFIs in the UK helped to form a judgemental view on the shape and size of the short-term effect. Together with the introduction of a new reporting scheme for the MFI balance sheet in January 1999, this effect was quantified with an intervention variable in a univariate reg-ARIMA model of M3 and entered the time series of M3 corrected for special factors in the QMA from 2000 Q4 onwards.

IMPACT OF THE EXTRAORDINARY LEVEL OF UNCERTAINTY ON MONEY DEMAND BETWEEN 2001 AND 2003 AND ITS REVERSAL BETWEEN MID 2003 AND MID 2004 AND LATE 2005

In the microeconomic theory of money demand, a central rationale for holding money is uncertainty, in particular surrounding future income, prices and interest rates. Money is portrayed as serving three main functions: unit of account; medium of exchange; and store of value. Each of these functions alleviates, at least to some extent, problems faced by households and firms as a result of uncertainty. Since the demand for money arises, at least in part, from a need to insure against uncertainties, developments in the demand for money are influenced by the prevailing level and character of uncertainty in the economy. Yet at the macroeconomic level, empirical models of money demand typically do not include measures of uncertainty as explanatory variables. In other words, some part of the evolution of monetary developments reflects the evolution of unobservable and, therefore, from the central bank's perspective, uncertain variables, which will always remain difficult to explain or check in the context of formal econometric models (ECB, 2005b). Given the elevated level of global geopolitical and financial market uncertainty between 2000 and

2003, the interplay between econometric models and judgement played an important role in assessing monetary developments of that period. Four sets of indicators have been used over time to study the potential impact of uncertainty and risk on monetary developments: real economic indicators; financial market indicators; developments in the components and counterparts of M3 and financial accounts/balance of payments indicators. In this respect, it must be noted that certain indicators provide first order evidence on uncertainty, such as financial market volatility, whereas others can only be seen as contributing second order information on the impact of such uncertainty, as for example developments in the net external asset position of MFIs or in money market fund shares/units. A first set of indicators which are thought to contain information on uncertainty are consumer confidence indicators and changes in the unemployment rate, both of which may reflect uncertainties about future income. A second group of indicators consists of price and volatility measures in financial markets, which capture uncertainties that affect the portfolio decisions of the euro area money-holding sector. With respect to equity prices, several channels relating monetary dynamics to stock price performance can be identified. During "normal" periods, the long-term wealth effect – higher stock prices imply higher wealth and thus higher money holdings in a balanced portfolio – dominates the relationship between money and stock prices. However, at extremes (e.g. sharp corrections in equity prices), a short-term substitution effect is likely to dominate over the longer-term wealth effect, as savers seek a safe haven from volatility in stock markets by holding safe and liquid monetary assets. The dominance of this substitution effect between equity and money in certain periods of high uncertainty suggests that stock prices can be a useful indicator of potential portfolio shifts into and out of money, at least on an episodic basis. Developments in the Dow Jones Eurostoxx Index might thus give some indications of portfolio shifts in such periods. Within the group of financial market indicators, financial market volatility measures (i.e. measures associated with variation in the second-order moments of prices) capture risks priced into financial markets. One such measure is the implied volatility of stock price indices derived from options prices on the index. A high value of such measures would indicate a reduced ability to predict futures asset price developments, possibly leading to actions by investors to reduce their exposure to these risks and, thus, a switch into lower-yielding but capital certain and more liquid monetary assets. The response of economic agents to global financial market uncertainties is potentially asymmetric and/or non-linear – they may respond quickly to significant losses, but more slowly to proportional gains. Risk measures designed to capture the impact of uncertainty on money demand should therefore take into account the impact of a time-varying risk aversion on the part of investors, which is likely to increase after profound losses. One possible measure of risk aversion that takes these regularities into account is the conditional correlation between stock returns and long-term government bond returns. This measure should constitute a reasonable proxy for risk aversion because government bond markets are less sensitive to shifts in investors' attitudes towards risk than equity markets. During periods of heightened risk aversion, the prices of the two asset classes should move in opposite directions (i.e. display a negative correlation). Otherwise investors would leave the equity market and buy bonds. In normal periods, by contrast, standard approaches to asset allocation would suggest a positive correlation between stock and bond returns, as low interest rates support equity prices. For robustness reasons, alternative indicators of risk appetite have also been used. One of these alternative indicators is the earnings yield premium in the euro area (i.e. the difference between the earnings yields for equity and the real long-term interest rate). Such an indicator reflects investors' perception of the risk premium. Turning to monetary indicators which may capture the effect of uncertainty on the demand for money, experience has shown that a detailed analysis of the components and counterparts of M3 is crucial. Such analysis often helps to explain aggregate M3 growth and facilitates the detection of the underlying driving factors. Specifically, in times of increased global uncertainty, the analysis of the net external asset position of MFIs is of particular interest, given a stronger home-bias of investors during periods of heightened geopolitical uncertainty. In such periods, one may expect portfolio flows into monetary assets to constitute a significant source of increased money demand, by contrast with more normal circumstances when money creation largely occurs via credit expansion. A similar form of analysis has been applied to the components of M3, in particular to developments in money market fund (MMF) shares/units. There are two reasons why the analysis of money market fund shares/units may reflect the impact of uncertainty on the demand for money. First, at times of high uncertainty investors may park money in money market fund shares/units, in part because the attractiveness of these funds at such times is likely to be high, given that they are capital-certain and liquid. Second, a large proportion of household share holdings are held through equity funds. Relatively limited switching costs between investment funds and money market funds, remuneration close to market interest rates and the high liquidity of money market funds allow the move out of equity funds into money market funds at times of uncertainty and permit a relatively fast reversion into equity funds at times of increasing confidence[25]. The fourth group of indicators have been constructed from balance of payments data and from financial account data. Balance of payments statistics offer a breakdown of the net external asset position of euro area MFIs. This breakdown permits the separate analysis of portfolio investment in equity, debt securities and direct investment in the euro area against the portfolio investment in equity, debt securities and direct investment abroad by euro area non-MFIs. Furthermore, an indicator of the estimated net purchase of non-monetary securities by the consolidated money holding sector was developed and regularly analysed. This quantitative indicator had been used to derive a rough indication of the importance of portfolio flows for monetary developments in times of heightened uncertainty. In deriving an estimate of the net purchase of non-monetary securities by the consolidated money holder sector, data from MFI balance sheet, from the annual monetary union financial accounts and from balance of payment had been combined on the basis of a number of additional assumptions. The rough direction of this indicator proved

25 In line with the view that close to market rates remunerated products in M3 are affected more by portfolio decisions than other components of M3, the analysis of Divisia indices for monetary aggregates played some role in analysing extraordinary portfolio shifts as well. Indeed, by giving less weight in the index to instruments remunerated close to market rates, growth rates of Divisia indices are considerably less affected by extraordinary portfolio decisions than simple sum aggregates.

in real-time to give relevant qualitative and quantitative indications of the importance of portfolio shifts on money demand patterns. A comprehensive list of indicators that have been used to assess the impact of uncertainty on monetary developments and a simple visualisation can be found in the annexed table.

7.3 THE QUANTIFICATION OF SPECIAL FACTORS WITH A REG-ARIMA MODEL

In case, a direct quantification of special factors in M3 developments that were assumed not to be related to risks to price stability was not available and the episodic nature of the type of event prevented the use of multivariate models in real time, judgemental corrections had been performed by designing intervention variables in a univariate reg-ARIMA model for the levels of M3. The use of a reg-ARIMA model offered the advantage of monthly availability, thus offering monitoring tools at higher frequency than the regular quarterly monetary assessment. Furthermore, such models can be theoretically understood as encompassing univariate models in a multivariate VECM money demand framework (see for example Maravall and Mathis, 1994). In addition, the residuals from this model had proved in the past to be very similar to the residuals of standard multivariate money demand models. The reg-ARIMA model for the log-levels (notional stocks) of M3 has been defined as:

$$\Delta\Delta^{12}\left(y_t - \sum_i \beta_i x_{it}\right) = \left(1-\theta_1 L\right)\left(1-\Theta L^{12}\right)a_t \qquad (7.7)$$

where Δ is the first difference, Δ^{12} the seasonal difference, y_t the log transformed index of adjusted stocks of M3, χ_{it} is the set of intervention variables and regressors, β_i the regression coefficients, θ_1 the regular moving average parameter and Θ the seasonal moving average parameter and a_t independently identical distributed (i.i.d.) white noise variable that is normally distributed with mean 0 and standard deviation σ_a. The appropriately identified intervention variables and regressors in the case of euro area M3 are calendar effects stemming from the fact that MFI balance sheet data are collected on the last day of the calendar month and that the day of the week of this date has a certain impact for the demand for banknotes and short-term deposits, the payment of taxes and salaries and other effects. The second group of regressors consists of seasonal level shifts in April 1998 and December 1997, stemming from the problems in backward extension of the time series. In addition, two temporary changes in March 1993 and September 1992 capture effects related to the ERM-II crisis modelled as additive outliers followed by an exponentially decaying effect with decay factor 0.7 in September 1992 and March 1993. In addition to the above-described intervention variables, three types of judgemental corrections between 1999 and today had been performed for M3 via the use of intervention variables in the reg-ARIMA model for M3, namely the correction for the impact of the introduction of a new reporting scheme for MFI balance sheet data and the introduction of a remunerated minimum reserve system both in January 1999, the impact of the extraordinary level of uncertainty on M3 between 2001 and 2003 and its unwinding between mid 2003 and late 2005 and finally the impact of financial innovation on M3 in 2005 Q2 and 2005 Q3. The distortion in M3 related to the introduction of a new reporting scheme for balance sheet data of Monetary Financial Institutions in 1999 and the impact of the introduction of a remunerated minimum reserve system in January 1999 was modelled as an intervention effect that combined a permanent level shift in January 1999 and an additive outlier in January 1999 followed by an exponentially decaying effect with a decay factor of 0.2. The decay factor had been chosen based on the minimisation of the out-of sample error in 1999 in real time.

For the intervention variables capturing the extraordinary portfolio shifts between 2001 and 2003 and the unwinding of those portfolio shifts in following periods, the following two variables had been designed (for a motivation of this design based on illustrative indicators, see Chart 11):

March 2001 to June 2002: Linear increasing effect between March and October 2001, then constant. In order to capture the impact of the significant inflows into money in September 2001 following the terrorist attack on September 11 2001, the increase in September was assumed to be twice as strong as during the other periods, whereas October was assumed to be only half as strong as the regular linear increase.

July 2002 to June 2004: Linear increasing effect between July 2002 and May 2003, followed by a linear decline with one fourth of the speed observed for the increase.

The following tables summarise the point estimates and the corresponding t-values for the stochastic and the regression variables integrated in the reg-ARIMA model up to 2004 Q2.

Table 7 Summary of the coefficient estimates of the stochastic part of the univariate reg-ARIMA model as estimated for data up to June 2004 when including all intervention variables listed in Table 2b

Parameter	Estimate	S.E.
Regular MA parameter	0.09	0.06
Seasonal MA parameter	-0.56	0.06
Variance of the error term	$8.60 * e^{-06}$	

All these parameters have a straightforward interpretation. Whereas the regular moving average parameter indicates, that the series displays a rather stochastic trend (close to a random walk plus drift), the seasonal moving average parameter indicates a medium stable seasonal component. Finally, the standard error of the error term indicates that the standard error of the one-step-ahead forecast is approximately equal to 0.29 percent of the level of the series.

Table 8 Summary of the coefficient estimates of the regression variables in the univariate reg-ARIMA model as estimated for data up to June 2004

Parameter	Estimate	t-value
Constant	-0.16	-1.7
Calendar Effect (Monday up to 1991)	1.4	4.4
Calendar Effect (Friday up to 1991)	-2.6	-9.2
Calendar Effect (Saturday up to 1991)	-1.1	-3.6
Calendar Effect (Friday from 1992)	-9.1	-3.8
Temporary change with decay factor 0.7 09/92 (ERM 2 crisis)	8.4	3.6
Temporary change with decay factor 0.7 03/93 (ERM 2 crisis)	9.0	3.8
Seasonal level shift 12/97	-8.0	-4.7
Seasonal level shift 04/98	3.4	2.1
Combination level shift and temp. change decay factor 0.2 01/99	4.8	4.0
Portfolio shift regressor phases 1 and 2	2.3	2.6
Portfolio shift regressor phases 3 and 4	2.6	3.3
Residual statistics	**Value**	**S.E.**
Skewness	0.25	0.15
Kurtosis	2.96	0.3

Notes: No signs of autocorrelation and non-linearities in residuals using the Ljung Box test statistics for residuals and squared residuals. Parameters in the Table are multiplied by 1000.

The parameter values of the intervention variables have again a straightforward interpretation. For example, the intervention variable dealing with the potential distortions linked with the start of Stage III have a permanent impact of around 0.5% on the level of M3. The parameter of the portfolio shift regressors indicate that the inflow into money had been more pronounced in phase 3 than in phase 1. Given that phase 1 lasted 8 months and phase 3 12 months, the overall maximum impact on the level of M3 due to portfolio shifts can be derived as having been around 5% (8*0.23% + 12*0.26%).

Other procedures to obtain an estimate for the impact of uncertainty on money demand between 2001 and 2003 were also produced for robustness reasons. The main alternative method was based on a simple structural Vector Autoregression model (SVAR) as described in Cassola and Morana (2002). This SVAR model comprised six key macroeconomic variables for the euro area: real M3, real GDP, the ten-year government bond yield, the three month money market rate, GDP deflator inflation and real stock market valuation. The system comprises four long-run relationships: (1) a long-run money demand function, (2) a constant yield spread, (3) a Fisher parity condition, (4) a relationship linking stock market valuation and output. One could obtain a model based estimate of the trend in M3 and identify a liquidity preference shock as a shock that negatively affect the stock market variable and positively the money variable (see Section 8.2.4 for further details). Those portfolio shifts had been very similar to those derived from the alternative judgemental approach. However, signs of instability in the model in late 2003 urged for caution when using this model and the model was thus not used as the main quantification approach.

A number of further methods to quantify portfolio shifts have also been proposed. However, such models are based on an ex post assessment of the data – they were not constructed in real time. The approach adopted in this literature has been to model the impact of uncertainties within money demand models directly, e.g.Carstensen (2003), ECB (2005b), Greiber and Lemke (2005) and Avouyi-Dovi, Brun, Dreyfus, Drumetz, Oung, and Sahuc (2006). The results of such models led to estimates of the impact of uncertainty on money demand that were broadly similar to those identified in the real time ECB analysis, both in terms of timing and magnitude. For the technical quantification of extraordinary portfolio shifts on M3, the period after June 2004 required a change in the estimation procedure within the univariate time series model. Upward shocks have been occurred to M3 that have less been related to extraordinary portfolio shifts but rather to the low level of interest rates. Indeed, the main sources of money creation during those phases have been the demand for loans rather than portfolio decisions. The impact of the low level of interest rates likely to be behind positive residuals in classical money demand equations and in univariate time series models. A straightforward estimation of portfolio effects with univariate time series, given the new type of shock, was therefore not possible. Thus, from July 2004 onwards, the parameter estimates of the intervention variables in the univariate time series model have been frozen and the portfolio shift regressor had been prolonged for the period July 2004 to July 2005 and for the period December 2005 to June 2006, assuming no extraordinary portfolio in- or outflows from M3, fully in line with the indications stemming from the list of variables that have been used to monitor the impact of uncertainty and risk on money demand (see Chart 11). For 2005 Q4, a large set of indicators signalled a clear reversal of portfolio shifts. In order to design a parsimonious intervention variable, the outflow of funds from M3 between August and November 2005 has been modelled in connection with the distortions in M3 between 2005 Q2 and 2005 Q3 as described below. Finally, intervention variables in the reg-ARIMA model have been used to quantify and eliminate the impact of specific security trading activities of security dealers, previously performed directly by credit institutions. Based on a detailed monetary analysis, signals from National Central Banks and the analysis of one-step-ahead forecast errors in the reg-ARIMA model for M3, in 2005 Q2 and 2005 Q3, significant other technical distortions within M3 had been identified. In several countries, repurchase operations that were previously undertaken between credit institutions, have been switched to electronic trading platforms operated by security dealers resident in the euro area. As such transactions switch from being interbank operations to transactions intermediated by OFIs, they may enter the definition of M3 and thus blur the evolution of underlying monetary dynamics. The elimination of those effects upwardly distorting M3 developments was estimated together with the downward influence of portfolio outflows from M3 in 2005 Q4 within one intervention variable, e.g. a linear upward sloping trend for 2005 Q2 and Q3, combined with a downward sloping trend for the reversal of portfolio shifts in 2005 Q4.

Chart 11 Illustrative indicators motivating design of intervention variables for quantifying extraordinary portfolio shifts into and out of M3

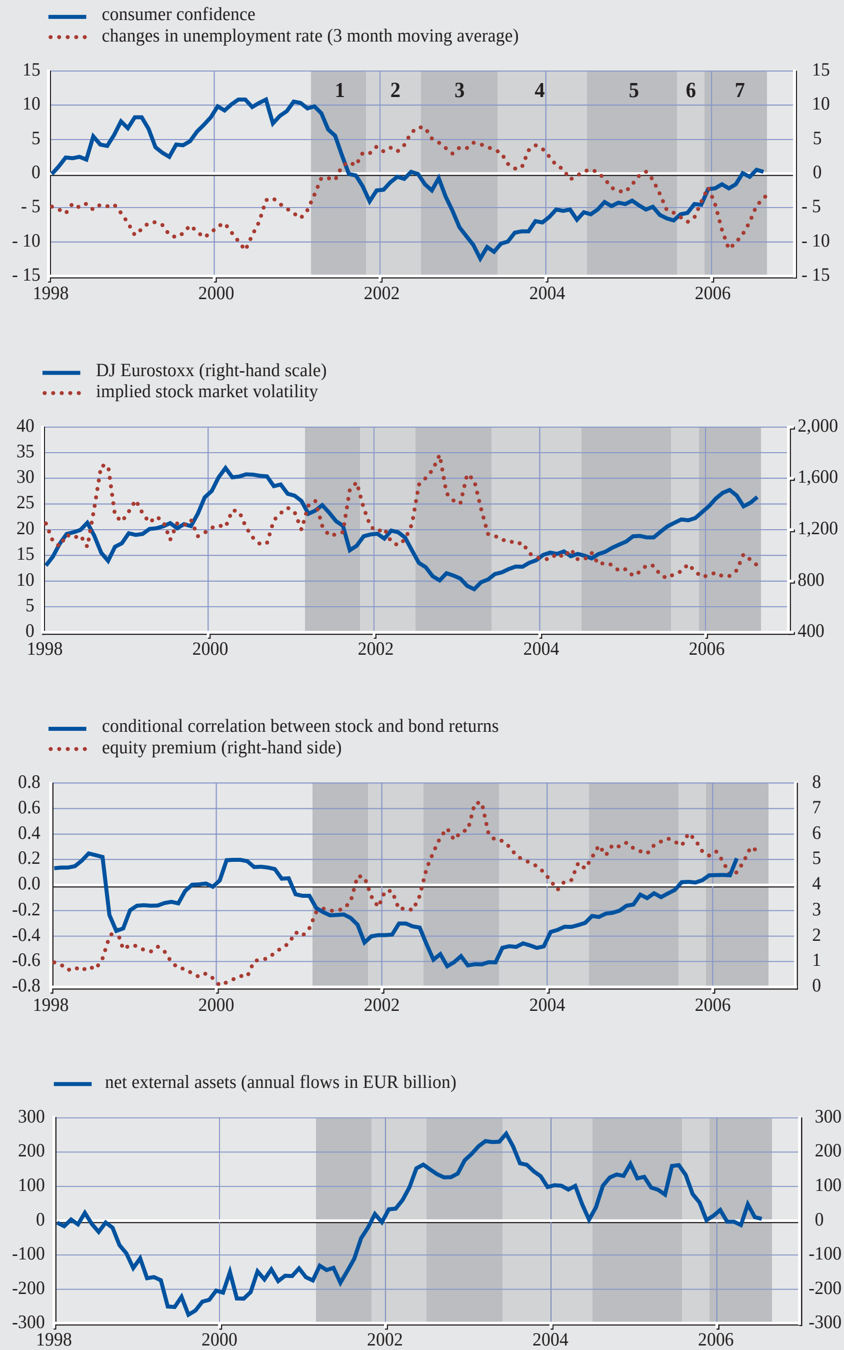
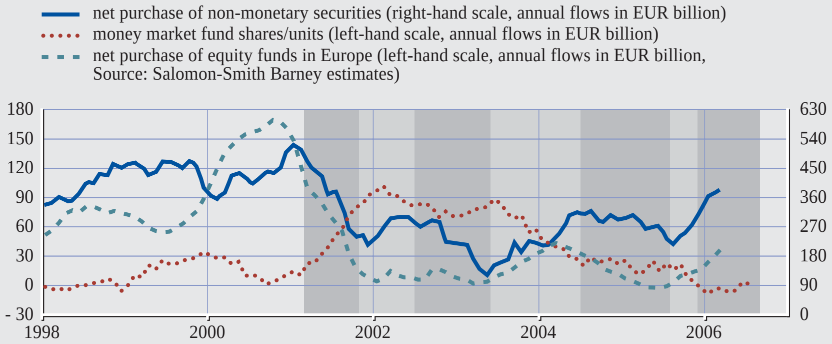
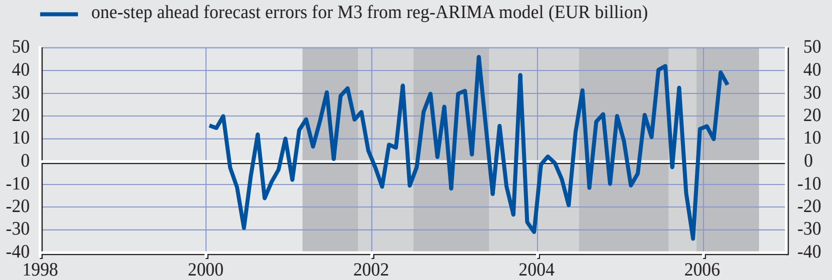
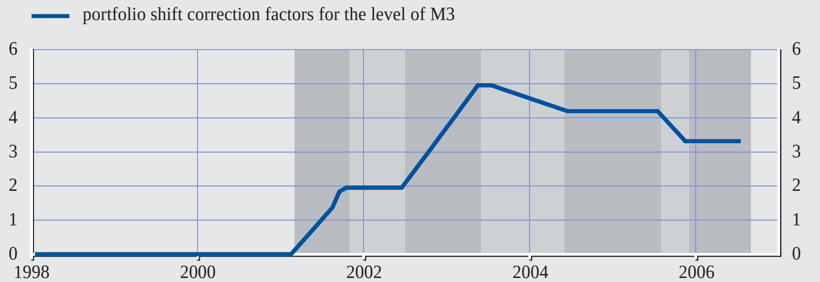


Chart 11 Illustrative indicators motivating design of intervention variables for quantifying extraordinary portfolio shifts into and out of M3 (cont'd)







Annex I Table of indicators used in real time to derive a judgemental adjustment of M3 for the extraordinary impact of portfolio shifts

Indicator	f	Available in	price/quantity	Motivation
Group 1: Measures of uncertainty				
Consumer confidence	m	t+1 WD	price	uncertainty measure
Changes in unemployment	m	t+23 WD		uncertainty measure
Group 2: Financial market indicators				
Exchange rate USD-euro	d	t+1 WD	price	rough capital flow indicator
DJ Eurostoxx index	d	t+1 WD	price	short term substitution effects with money/longer-term wealth effects on money
Implied stock market volatility	d	t+1 WD	price	immediate short term substitution between money and equity
Conditional correlation between stock and bond return	m	t+1 WD	price	risk aversion
Earnings yield premium	m	t+15 WD	price	risk premium, capturing asymmetric reaction to shocks, rapid to higher uncertainty, slow reversal due to time dependant risk aversion
Equity funds flows	m	t+28 WD	quantity	substitution equity/money
Group 3: Monetary indicators				
Money market fund shares/units	m	t+19 WD	quantity	money market funds are often used to park money in times of uncertainty due to low switching costs between equity/bond funds and money market funds
Loans to the private sector	m	t+19 WD	quantity	main factor for money creation
Net external assets	m	t+19 WD	quantity	captures main capital flows
Comparison US M2/euro area M3	m	t+19 WD	quantity	study of symmetric impact of global shocks on monetary aggregates
Divisia M3 index	m	t+28 WD		lower weight to components of M3 that are used mainly due to portfolio motives
Group 4: Financial account/ BOP indicators				
Monetary Presentation of BoP	m	t+36 WD	quantity	allows extraction of portfolio and direct investment flows from and into the euro area from net external assets
Net purchase of non-monetary securities	m	t+36 WD	quantity	Rough indicator to distinguish between portfolio considerations and money creation
Monitoring tools:				
One-step-ahead forecast error for M3 from reg-ARIMA model	m	t+19 WD	quantity	detection of specific "unusual events"
Standard money demand model	q	t+19 WD (now casts for real economic variables necessary)	quantity	analysis of new shocks
Liquidity preference shock derived from a small SVAR model	q	t+19 WD (now casts for real economic variables necessary)	quantity	alternative quantification of size of portfolio shifts via a historical decomposition of shocks

8 APPENDIX C: MONEY DEMAND EQUATIONS AND THEIR USE IN THE QUARTERLY MONETARY ASSESSMENT

This appendix draws on material prepared by ECB staff as background material for the QMA.

8.1 INTRODUCTION

For the ease of reading, the following conventions are taken throughout this annex:

- All coefficient estimates had been derived for the estimation period 1980 Q1 to 2001 Q2 if not indicated otherwise, as the parameters of the M3 money demand equations had been fixed at those values for period after 2001 in order to reflect the potential omitted variable problem that had been caused by high geopolitical and financial market uncertainties triggering an extraordinary flight to safe and liquid instruments that is not captured by the traditional determinants of money demand (ECB, 2004 and ECB, 2005b); see also the discussion in the main text).

- The naming of the different QMAs reflects the last available quarterly monetary data to which the note refers to. For example, the Quarterly Monetary Assessment that is delivered at the end of August 2006 to the Governing Council is named 2006 Q2.

- It is important to note the convention of the use of the term "levels" of monetary variables. The term "level" consistently refers to seasonally and end-of-month effect corrected notional stocks. The levels of monetary data (L_t) are affected by reclassifications (for example the enlargement of the euro area in January 2001 with Greece, the reunification of Germany in 1990, etc), exchange rate revaluations and other revaluations that do not reflect transactions by economic agents. Those "non-transaction-related factors" are reported by MFIs or are calculated at National Central Banks and the ECB and are used to derive monthly changes in levels (F_t) that are corrected for reclassifications and revaluations. Those changes are used to derive a chain index (I_t), called notional stocks (see equation 8.8 below).

$$I_t = I_{t-1}\left(1 + \frac{F_t}{L_{t-1}}\right) \tag{8.8}$$

Such a method is for example used as well by the Bundesbank or underlies the calculation of growth rates for monetary variables in the Bank of England.

8.2 MONEY DEMAND EQUATIONS

8.2.1 SINGLE EQUATION MONEY DEMAND MODEL FOR M3 (CV)

The CV[26] money demand equation was the money demand equation first used within the QMA in 1999 Q3. The model can be estimated as a single equation, rather than within a system. The equation relates changes in real M3 to deviations from a long-run money demand relationship, changes in GDP growth, inflation, short and long-term interest rates. The long-run money demand relationship links the level of real M3 to that of real GDP, the difference between short-term and long-term rates and inflation. Both inflation and the yield curve spread are incorporated in order to capture opportunity costs of holding M3. The estimated equation has the following form:

$$\Delta(m_t - p_t) = k + 0.07\Delta^2 y_t + 0.16(\Delta s_t + \Delta s_{t-1})/2 - 0.33\Delta l_{t-1} - 0.21\Delta(\pi_t + \pi_{t-1})/2$$
$$-0.009DUM86 - 0.11\left[m_{t-1} - p_{t-1} - 1.28y_{t-1} + 0.44(l_{t-1} - s_{t-1}) + 1.12\pi_{t-1}\right]$$

where *m* is the log level of M3, *p* is the log level of the GDP deflator, *y* is the log level of real GDP, *s* is the short-term (3-month) nominal interest rate, l is the long-term (10-year) nominal interest rate, π is the annualized quarter-on-quarter inflation rate of the GDP deflator[27], DUM86 a dummy that is 1 in the second quarter of 1986 and 0.5 for the other quarters of 1986 and Δ is the difference operator. The CV model was based on the scarce data availability at that time. Improving data availability, data quality and further research improved the CV money demand framework in a number of directions, leading to a relative quick replacement as workhorse model.

8.2.2 STRUCTURAL VAR M3 MONEY DEMAND MODEL (BC)

The BC money demand system[28] for euro area M3 has been developed using a structural cointegrating VAR approach of order 2. The core of this model consists of the following long-run relationships:

$$m_t - p_t = const + 1.33y_t - 1.7l_t \quad (8.9)$$

$$l_t = const + 0.4\pi_t \quad (8.10)$$

$$l_t - s_t = const \quad (8.11)$$

where m is the log level of M3, *p* is the log level of the GDP deflator, *y* is the log level of real GDP, *s* is the short-term (3-month) nominal interest rate, l is the long-term (10-year) nominal interest rate, π_t is the inflation rate of the GDP

26 See Coenen and Vega (2001).
27 Notice that only in this appendix we define π_t as the quarterly growth rate of prices (GDP deflator or HICP). In the rest of the paper, π_t indicates the h-period annualized inflation rate.
28 See Brand and Cassola (2004).

deflator. Equation (8.9) represents a money demand relationship explaining real money balances with output as transaction variable and the long-term interest rate as opportunity cost variable, equation (8.10) a stable relationship between long-term interest rates and inflation and equation (8.11) a stable relationship between short and long-term interest rates. An important feature of this dynamic system framework is that these three relationships feed into changes of inflation, interest rates, money and income. Therefore, all the variables are simultaneously determined. From an economic perspective, the main features of the model can be summarised as follows:

- If M3 happens to grow faster than foreseen on the basis of the model this can together with higher GDP growth lead to higher inflation.

- M3 developments reflect current developments in GDP and help predict future GDP growth.

- In the long-term, higher short-term rates would lead to a decrease in money growth.

The BC model improved the CV money demand framework by answering the critique that a single equation model was inadequate given the fact, that on theoretical grounds, three cointegration vectors could be expected among the given set of variables. The BC model was the workhorse model for the QMA during 2000 and excess liquidity measures constructed on the basis of this model were reported until 2003 Q4 as a robustness check based on that model. It was felt, however, that opportunity costs of holding money had not been captured within this framework in a convenient way so that a third money demand equation was introduced after deriving historical estimates for the own rate of return of M3.

8.2.3 M3 MONEY DEMAND MODEL USING THE OWN RATE OF RETURN OF M3 (CGL)

The CGL model[29] has been the workhorse M3 money demand equation used in the QMA since 2001Q1 until today and is a Vector Error Correction (VEC) model of order 2 that includes only one stationary cointegration relation which specifies the long-run demand for real money (m-p) as a semi log-linear function of real GDP (y) and the spread between the short-term market interest rate (s_t) and the own rate of return of M3 (OWN).

$$m_t - p_t = k + 1.31 y_t - 1.1(s_t - OWN_t) \quad (8.12)$$

In the short-run equation for real money, it includes (one-quarter lagged) changes in oil prices as an exogenous variable in order to take account of the difficulty for the GDP deflator to fully capture the impact of external developments on domestic prices at times of rapidly changing import prices. In addition, in the short-run dynamics, one-quarter lagged changes in the yield spread (defined as the difference between the ten-year government bond yield

29 See Calza, Gerdesmeier, and Levy (2001).

and the short-term market interest rate) are included as an exogenous variable in order to enhance the dynamics of adjustment to equilibrium. This variable is expected to capture the shifts between short-term instruments included in M3 and long-term assets due to changes in their relative rate of return. From the QMA 2003 Q1 onwards, the originally imposed but theoretically not founded short-run price homogeneity had been relaxed by adding current changes in annualised quarterly inflation as exogenous variable in the dynamic equation. In addition to the baseline model, ad-hoc extensions of the CGL model had been used in the QMA from time to time to illustrate in a simplified way the potential impact of stock market developments on money holdings similar to the work of Carstensen (2003). The extension in the long-run relation included a smoothed version of the return on equity (combined with the ten-year government bond yield to give a broad measure of the returns available on non-monetary assets), and a smoothed version of a stock market volatility measure.[30]

Moreover, the short-term dynamics of the CGL money demand model have been extended by the introduction of a further risk measure related to the stock market, namely the first difference of the earnings-yield premium. Those ad-hoc extensions were always used as simplified ex-post robustness checks for the estimated impact of portfolio shifts on M3 derived in real time. There are two reasons not to modify the workhorse model on a permanent basis: First, the ex-post statistical exercise of including additional variables in order to capture certain episodic effects does not guarantee stability of money demand for future periods and second, the introduction of further asset prices and uncertainty measures does not solve the problem of how to assess the risks to price stability from money in a proper way in real time. Nevertheless, the identified portfolio shifts were assumed to distort estimates of the longer-run parameters in the money demand models, therefore from the QMA 2001 Q4 onwards, the CGL and the BC money demand equations had been used in all main applications by freezing the parameters as estimated for the time period between 1980 and 2001 Q2. Despite those signs of instabilities, potentially driven by an omitted variable problem, those models with fixed parameter estimates could still be used as a natural benchmark, consistent with the overall framework presented in Section 2.3(ii), given the assumption that a stable long-run money demand relation exists, however that the attempt to model both, short- and long-run links between money and economic variables might be problematic due to the complex relation between money and those variables in the shorter term. It is nevertheless fair to say that the importance of money demand models within the QMA has diminished over time, in particular during the period of extraordinary portfolio shifts triggered by geopolitical and financial market uncertainties.

30 The annualised three-year log differences of the quarterly Dow Jones Euro Stoxx index have been used as an equity return variable. A two-year average of conditional variances from a GARCH(1,1) model derived from the yields of the daily Dow Jones Euro Stoxx index has been used as a stock market volatility measure.

8.2.4 A STRUCTURAL VECM MODEL TO INTEGRATE STOCK MARKET VARIABLES INTO MONETARY POLICY (CM)

This structural Vector Auto Regression[31] model was derived to study the role of the stock market in the monetary transmission mechanism and had been used in the QMA between 2002 Q1 and 2004 Q1. It comprises six key macroeconomic variables for the euro area: real M3 (rm) (in log levels), real GDP (y) (in log levels), the ten-year government bond yield (l), the three-month money market rate (s), GDP deflator inflation (π), and real stock market valuation (f) (in log-levels, deflated with the GDP deflator). Hence, in the context of the model, deviations of M3 from trend can be regarded as a temporary, or "cyclical", phenomenon. The system comprises four long-run relationships: (1) a long-run money demand function, (2) a constant yield spread, (3) a Fisher parity condition, (4) a relationship linking stock market valuation and output (see table below).

Table 9 Estimated cointegration relations in the CM model

N	Y	f	rm	i	l	π
1	-1.43	0	1	0	0	0
2	0	0	0	-1	1	0
3	0	0	0	1	0	-1.59
4	-4.69	1	0	0	0	0

Further structural analysis of the model allows analysing how different economic shocks affect the dynamics of the variables. The following six shocks have been identified: (1) a permanent productivity shock; (2) a permanent nominal shock; (3) a temporary shock to the term structure; (4) a temporary liquidity preference shock; (5) a temporary aggregate demand shock; and (6) a temporary shock to the Fisher parity/real interest rates.

The stylised interactions between money and stock prices under different shocks demonstrates that, on the basis of this model, different types of shocks lead to different reactions of money and stock prices. Only the permanent real output shock has a permanent positively correlated impact on real monetary balances and the stock prices. This correlation is due to the fact that on the one hand money balances react positively to higher output and at the same time the stock prices incorporate higher productivity and therefore higher corporate earnings. By contrast, the transitory liquidity preference shock leads to a negatively correlated but only temporary impact on money and stock prices. The estimation of this temporary shock allowed a robustness check for the estimation of extraordinary portfolio shifts into M3. However, due to signs of instability, the model had been used with caution and was dropped after 2004 Q1.

Other money demand models

Within the broad monetary analysis of the ECB, not only the demand for the monetary aggregate M3 but also the demand for the narrow monetary aggregate M1 (comprising currency and overnight deposits) and the demand for loans

31 See Cassola and Morana (2002).

were monitored within a Vector Error Correction Mechanism framework. The monetary aggregate M1 has played an important role, as it contains those components of M3 that are very interest rate sensitive and are therefore in particular adequate in monitoring the importance of the low level of interest rates on money demand. Finally, in order to monitor the impact of the euro cash changeover on the demand for currency, a currency demand model had been regularly used in the QMA.

8.2.5 M1 DEMAND MODEL

The money demand equation for M1[32] that had been used in the QMA from 2000 Q4 onwards, reflects the expected non-linear long-run link between interest rates and real M1 balances driven by the fact that the reaction to changes in the opportunity costs of holding real M1 balances when they are at low levels are likely to be stronger than the reaction to similar opportunity cost changes in case of higher levels of opportunity costs. The functional form for the long-run demand is as follows:

$$m1_t - p_t = k + 0.67 y_t + \frac{1.38}{(S_t - OWN_t)} \qquad (8.13)$$

where $m1$, p and y denote (logs of) the stock of M1, the price level (as measured by the GDP deflator) and real GDP, respectively; while the inverse of (S-OWN) stands for the opportunity cost of holding M1 as measured by the difference between the short-term market interest rate and the own rate of return on the instruments included in M1. Following the general-to-specific approach, the cointegrated VAR-system is subsequently reduced to a single equation. This equation includes two dummies: (1) dumJan99 to account for an exceptionally large jump in the demand for M1 in January 1999; and (2) dum2K for the temporary rise in the demand for M1 prompted by the possible “Y2K” effects between late 1999 and early 2000.[33]

8.2.6 CURRENCY DEMAND MODEL

In order to be able to monitor whether the euro cash changeover has triggered a structural change in the use of currency, a simple Vector Error Correction model of order two for the demand for real currency in the euro area estimated over the period 1980 to 2000 had been used in the QMA[34]. This model explains real currency balances (cur-p) as a function of a transaction variable and a measure of the opportunity cost of holding cash. As a transaction variable, real private consumption (c_t) is used. As a proxy for the opportunity costs, the three-month money market rate (s_t) for the euro area is used (the EURIBOR from January 1999 onwards and an M3-weighted short-term money market rate for the euro area countries for the period before). In addition, as a proxy for the non-resident demand, the real effective exchange rate (e_t) of the euro is

32 See Stracca (2003).

33 On the basis of a monthly regARIMA(0,1,1)(0,1,1)12 model for M1, the original dummies have been re-designed as follows: dumJan99 takes the value 0 before 1999, 1 in 1999 Q1 and 0.7 afterwards, while dum2K is an impulse dummy taking the value of 1 in the first quarter of 2000 and 0 elsewhere.

34 See Fischer, Köhler, and Seitz (2004).

introduced in the model[35]. Finally, the change in the unemployment rate is included as an exogenous variable to approximate business cycle developments that might influence the precautionary holdings of currency. All variables are in logarithms (including the interest rate), except the change in unemployment. The long-run equilibrium relationship reads as:

$$cur_t - p_t = -k + 1.08c_t + 0.39e_t - 0.033s_t \tag{8.14}$$

The variables show the signs expected on the basis of standard economic theory. Increased opportunity costs lead to a reduction in real currency holdings. The restriction that the transaction elasticity is one cannot be rejected. Finally, an appreciation of the euro by one percent leads to an increase in currency holdings by 0.4 percent reflecting foreign influence on the demand for euro area currencies in the form of "currency substitution". The coefficient of the error correction term of -0.11 shows that overhangs are corrected relatively slowly. A modification and simplification of the above-described currency demand equation has been used in the Quarterly Monetary Assessment to allow monitoring better the potential re-optimisation of currency holdings after the euro cash changeover given the availability of large denomination banknotes[36]. The following long-run equation has been estimated for the period from 1980 to 2000 (all variables were taken in logarithms except interest rates):

$$cur_t - p_t = k + y_t + 0.599e_t - 0.747s_t \tag{8.15}$$

where *k* is a constant, *y* real output, *e* the real effective exchange rate of the euro against a basket of currencies of major trade partners and *s* the three month money market interest rate. In order to estimate an error correction model for the demand for currency for periods including the euro cash changeover, it is necessary to include a number of deterministic dummy variables that intend to capture the extraordinary character of the year before the euro cash changeover and the period after the euro cash changeover. Developments during this period can obviously not be explained solely by the macroeconomic determinants of currency demand. In detail, the following dummy variables have been introduced: A first dummy (dprecc) tries to capture the strong decline in 2001 during the run-up to the euro cash changeover. It is defined as a logistic function of the period of time remaining until the cash changeover (timetocc):

$$dprecc = \frac{1}{1 + exp(-timetocc)} \tag{8.16}$$

where timetocc equals, before 2002, the number of months or quarters until the cash changeover, and zero from 2002 onwards. A second dummy variable (dpostcc) tries to capture the catching-up process of banknote developments

35 The choice of real versus nominal effective exchange rates has no major impact of the results of the model.

36 This model has been derived by an ad-hoc Task Force of the Banknote Committee (ESCB committee) on forecasting the banknote developments.

and the re-optimisation of currency holdings after 1 January 2002. It is defined as a logistic function of the time which has elapsed since the cash changeover (timeaftercc):

$$dpostcc = \frac{1}{1 + exp(-timeaftercc)} \tag{8.17}$$

where timeaftercc equals zero before 2002 and the number of months or quarters after the cash changeover from 2002 onwards. In addition, impulse dummies for the second and third quarters of 2002 have been introduced.

8.2.7 LOAN DEMAND MODEL (CMS)

The demand equation for loans to the private sector[37] used in the QMA since 2001 Q4 is a Vector Error Correction (VEC) model of order five in levels comprising real loans (deflated by the GDP deflator), real GDP, the nominal composite lending rate and the annualised quarterly inflation rate (based on the GDP deflator). One cointegrating vector links the variables in the system. This vector is interpreted as a long-run demand function explaining real loans (loan - p) in terms of real GDP (y) and the real lending rate (CLR - π):

$$loan_t - p_t = \alpha + 1.5 y_t - 3.1(CLR_t - \pi_t) \tag{8.18}$$

The short-run dynamics of the model contain a dummy in 2000 Q2 and 2000 Q4 to capture M&A activities and the financing of the UMTS auctions at that period.

8.3 THE USE OF MONEY DEMAND MODELS WITHIN THE QUARTERLY MONETARY ASSESSMENT

Within the QMA and ECB’s monetary analysis more generally, money demand models have been used for a number of purposes. The main uses are presented below:

8.3.1 DERIVATION OF THE REFERENCE VALUE FOR M3

The ECB has defined price stability as an annual increase in the HICP for the euro area of below 2%[38]. In December 1998, when the Governing Council of the ECB derived the first reference value, in addition to the definition of price stability, the following assumptions had been used:

- Trend growth rate of real GDP in the range of 2 to 2½%
- Trend decline in M3 income velocity in the range of ½% and 1%

Those assumptions let to the definition of the first reference value of 4½%. The money demand equations offered a further tool to verify those assumptions, as

37 See Calza, Manrique, and Sousa (2003).

38 In the Governing Council’s evaluation of the that the ECB aims at annual HICP inflation “below, but close to” 2% over the medium term (ECB, 2003b).

the reference value can be derived s the steady-state rate of monetary growth that is consistent with price stability and the assumed trend behaviour of real GDP. Taking first differences of the long-run money demand equations of BC or CGL and substituting observed inflation with inflation in line with price stability and output with trend real GDP growth one gets

$$\Delta m_t^{ref} = \pi_t^* + \beta_y \Delta y_t^{pot} \tag{8.19}$$

8.3.2 DECOMPOSITION OF MONEY GROWTH BASED ON MONEY DEMAND MODELS

The money demand equations had been used in the monetary analysis to study the impact of the different determinants to money demand on current monetary developments, allowing a better understanding and analysis of the potential risks to price stability in the medium term. Indeed, for example the information that high monetary growth was caused by high current output or lower interest rates may be a clear signal of increasing risks to future price stability. The decomposition of monetary growth into its main determinants is done by first rewriting the money demand equation in terms of the levels of each variable:

$$\phi(L)m_t = \psi_1(L)p_t + \psi_2(L)y_t + \psi_3(L)opp_t + \psi_4(L)x_t + u_t$$

where $\phi(L)$ and $\psi_i(L)$ i=1 to 4, are polynomials in the lag operator L, m is the monetary aggregate, p is the price index, y is real GDP, opp is the opportunity cost measure and x is a vector of exogenous variables. It is then possible to rewrite the level of money (m) as a function of the several explanatory variables:

$$m_t = \frac{1}{\phi(L)}\left[\psi_1(L)p_t + \psi_2(L)y_t + \psi_3(L)opp_t + \psi_4 x_t + u_t\right]$$

The polynomials $\alpha_i(L)=\frac{\psi_i(L)}{\phi(L)}$, i=1 to 4, are used to compute the contribution of each variable to the level of money. For instance, the contribution of the price level to the level of money is: $\alpha_i(L)p_t$. Given that the annual growth rate of money is approximately equal to $m_t - m_{t-4} = \Delta_4 m_t$, the contributions of the explanatory variables to monetary growth can be obtained from the following expression:

$$\Delta_4 m_t = \frac{1}{\phi(L)}\Delta_4\left[\psi_1(L)p_t + \psi_2(L)y_t + \psi_3(L)opp_t + \psi_4(L)x_t + u_t\right]$$

These contributions are shown in the table for the annual growth rate. The part not explained by fundamentals $(\Delta_4 \frac{1}{\phi(L)} u_t)$ is further broken down in terms of the "new shock" (u_t) and the effect of lagged shocks $(\Delta_4 \frac{1}{\phi(L)} u_t - u_t)$. This is important, as the innovation in money growth, the "new shock" offers important information on potential special monetary developments in a certain quarter.

8.3.3 DERIVING MEASURES OF EXCESS LIQUIDITY

Excess liquidity can be measured in a variety of ways, each with its own strengths and weaknesses. One approach is to focus on the nominal and real money gaps, defined as cumulative deviations of M3 growth from the reference value. This is regularly done in the QMA (and is published in the Monthly Bulletin). The nominal money gap refers to the difference between the actual level of M3 and the level of M3, which would have resulted from M3 growth at its reference value. The real money gap measure shows the difference between the actual level of M3 deflated by the HICP and the level of M3 in real terms which would have resulted from nominal M3 growth at the reference value and HICP inflation in line with the definition of price stability. For both measures, a base period of December 1998 is used. The latter indicator takes into account the fact that part of the excess liquidity which has accumulated over the past few years has in the meantime been absorbed by higher prices, reflecting upward deviations of inflation rates from the price stability objective. For this reason, the measure of the real money gap shows a lower amount of excess liquidity. When analysing money gaps, some caveats have to be taken into account:

- The level of the money gaps will depend on the choice of the base period (for the money gaps based on the reference value) or the estimate of the constant in the long-run relationship (for the model-based money gaps).

- Whether the nominal or the real money gap gives the more reliable signal in terms of risks to price stability depends on the specific economic situation. If the development of the nominal money gap is mainly driven by high inflation due to one-off factors and it is unlikely that there are second round effects, the development of the real money gap may be a better indicator to assess inflationary risks arising from excess liquidity. However, when the absence of second-round effects cannot be taken for granted, one may consider focusing on the development of the nominal money gap.

The QMA contains two further measures of excess liquidity that are linked with money demand equations, namely the "monetary overhang" and model based real money gaps. The monetary overhang is defined as the difference between the actual level of real M3 and the "equilibrium" or "desired" level of real M3 given by the long-run relation from a money demand model. In order to check the robustness of the results, two versions of monetary overhangs had been used in the Quarterly Monetary Assessment based on the two money demand equations BC and CGL. These imply the following equilibrium values for M3:

$$OverhangBC = m3 - p - c_1 + \beta_1 y + \gamma_1 LT \tag{8.20}$$

$$OverhangCGL = m3 - p - c_2 + \beta_2 y + \gamma_2 (ST - OWN) \tag{8.21}$$

where $m3$ is the stock of M3, p the price level, y real GDP, LT the long-term interest rate and (ST-OWN) the opportunity cost of M3 defined as the difference between the three-month market interest rate and the own rate of return on M3. All variables are in logs except interest rates. The constants c1 and c2 are chosen so that the overhangs average to zero over the sample period. The main problem with the interpretation of overhang/shortfall measures is that in principle a zero overhang/shortfall could be compatible with any level of inflation. For example, a low level of this indicator does not necessarily imply absence of risks to future price stability since it would be compatible with strong economic growth that might be translated into subsequent inflation. As a consequence, the overhang/shortfall level might give under several circumstances false signals when assessing whether the medium-term inflation outlook is compatible with the ECB's definition of price stability. Nevertheless, it provides some indication of the extent to which the actual money demand is in line with the equilibrium values of the underlying economic model.

The money demand model-based real money gaps used in the QMA was derived from the BC or the CGL money demand equations for euro area M3. These model-based real money gaps (RMG) are defined as

$$RMG_t = (m3_t - p_t) - (c + \beta y_t^* + \gamma i_t^*) \tag{8.22}$$

where p is the price level (in logs), i^* is the equilibrium value of the opportunity costs variable, y^* the equilibrium level of real output and β and γ are the estimated coefficients of a long-run money demand equation. This model-based method has the advantage that it can take into account more detailed information on opportunity costs instead of assuming a deterministic trend in velocity, as is done for the gap measures based on the reference value. A further interesting feature of the money demand model based real money gap (RMG) is that it can be decomposed into the monetary overhang OH, the output gap YG (multiplied by the long-run income elasticity β) and the opportunity cost gap IG (multiplied by their long-run semi-elasticity γ):

$$RMG_t = OH_t + \beta YG_t + \gamma IG_t \tag{8.23}$$

where the monetary overhang is defined as the difference between the actual level of real M3 and the equilibrium level of real M3 given by the long-run relation from a money demand model. Furthermore, YG = y-y* and IG = i-i*. This decomposition allows analysing, if the information content of the real money gap for future inflation is stemming exclusively from the information of the output gap, or if the monetary overhang has additional information content.

An interesting feature of the real money gap is that it can be related to the P-star model of inflation, which is based on the quantity theory of money. The P-star model defines the (logarithm of the) price level pstar as the price level that is consistent with the current level of the nominal money stock M3 and the long run or equilibrium levels of both the income velocity of the nominal money stock and real output

$$p_t^* = m3_t + v_t^* - y_t^* \tag{8.24}$$

where $v_t^* = p_t^* + y_t^* - m3_t^*$ denotes the logarithm of the equilibrium level of the income velocity of the nominal money stock and y^* denotes the equilibrium level of real output. Relying on the quantity theory of money, the equilibrium level of the real money stock can be written as $m3_t^* - p_t^* = y_t^* - v_t^*$. The link between the real money gap and $p*$ is then evident:

$$RMG_t = (m3_t - p_t) - (y_t^* - v_t^*) = -(p_t - p_t^*) \tag{8.25}$$

The real money gap can, thus, be written as the negative of the price gap, which is, in turn, defined as the difference between the actual price level (in logs) and the P-star measure of the equilibrium price level. Equation (8.25) seems to imply that a real money gap measure may have leading indicator properties with regard to future inflation. Assuming that the actual price level moves towards the P-star measure of the equilibrium price level, according to a partial adjustment mechanism, the emergence of a positive real money gap would be associated with an increase in future inflation bringing the price level back in line with the equilibrium level $p*$:

$$\Delta p_t = c + \alpha(L)\Delta p_t + \beta(L)\Delta p_t^* + \lambda(p_{t-1} - p_{t-1}^*) \tag{8.26}$$

where c denotes a constant and α(L) and β(L) denote lag polynomials[39].

This hypothesis is confirmed by the results of empirical studies, not only for individual euro area countries[40] but as well for the euro area itself. More specifically, for the euro area Trecoci and Vega (2000) find that their real money gap measures lead inflation by one to one and a half years. Gerlach and Svensson (2000) come to a similar conclusion: their real money gap measure is positively linked to inflation one and four quarters ahead. The latter model has been used in the Quarterly Monetary Assessment to derive inflation forecasts assuming different scenarios for the future use of excess liquidity in the euro area. The Gerlach-Svensson approach (henceforth GS) consists of a model for forecasting inflation in the euro area on the basis of a measure of the real money gap. The model consists of two building blocks: one for inflation determination and another for money demand estimation. In the most general formulation of the GS model, the inflation block can be represented in terms of three equations:

$$\pi_{t-1} = \pi_{t+1,t}^e + \alpha_m RMG_{t-j} + \alpha_m Z + u_{t+1} \tag{8.27}$$

$$\pi_{t+1,t}^e = \alpha_\pi(L)(\pi_t - \pi_t^{obj}) \tag{8.28}$$

$$\pi_{t+1}^{obj} - \pi_{t+1}^{obj,B} = \gamma(\pi_t^{obj} - \pi_t^{obj,B}) \tag{8.29}$$

The first equation specifies inflation at time t+1 (π_{t+1}) as a function of inflation expectations for the same period ($\pi_{t+1,t}^e$) made at time t, the lagged real money

39 Tödter (2002) proposes a more general formulation of the price adjustment mechanism based on an extended Philips curve, where the output gap is replaced by the price gap. The rationale for this extension is the hypothesis that in their price-setting behaviour firms take account not only of microeconomic variables such as marginal production costs, but also of the deviations of money balances from their equilibrium level. This extension allows Tödter (2002) to incorporate the P-star model in a new-Keynesian type model.

40 See e.g. Hoeller and Poret (1991), Kool and Tatom (1994) and Tödter and Reimers (1994).

gap (RMG_{t-j}) and some exogenous variables (Z, for instance energy prices). The second equation specifies the behaviour of inflation expectations. Inflation expectations in each period are a function of the euro area central banks' implicit inflation objective for the following period (π_{t+1}^{obj}) and of the current and lagged deviations of inflation (π_{t-i}) from the average implicit inflation objective of the euro area central banks (π_{t-i}^{obj}). Finally, the third equation defines how the average implicit inflation target of the euro area central banks is computed before 1999 Q1. Namely, it assumes that the average inflation objective of the euro area central banks converged to the Bundesbank's inflation objective $(\pi_t^{obj,B})$ at a rate γ. Following GS, the Bundesbank's inflation objective was set equal to the Bundesbank's normative inflation assumption for its monetary targets. Unlike in GS, the inflation objective of the euro area (π_t^{obj}) since the start of Stage Three of EMU is assumed to be 1.5% in the QMA[41].

In the QMA, the estimated inflation equation is the reduced form of equations (8.27 to 8.29). In addition, the decomposition of the real money gap into the output gap[42], the overhang and the interest rate gap is used, following equation (8.23). The oil price in EUR was included as exogenous variable in the model. A parsimonious equation for the euro area for the period 1981 Q4-2006 Q2 can then be estimated as (standard errors in parenthesis, overhang derived for M3 corrected):

$$\pi_t - \pi_t^{obj} = \underset{(0.007)}{0.0019} + \underset{(0.08)}{0.3}(\pi_{t-3} - \pi_{t-3}^{obj}) + \underset{(0.05)}{0.34}YG_{t-4} + \underset{(0.04)}{0.1}OH_{t-4} + (\underset{(0.005)}{0.03} + \underset{(0.005)}{0.02}L + \underset{(0.005)}{0.01}L^3)\Delta oilp_t + u_t \quad (8.30)$$

The coefficients have the expected signs and the monetary overhang is significant in addition to the impact of the output gap measure. The real money gap thus contains additional useful information concerning future inflation as compared to the output gap. When forecasting inflation in the reduced form equation (8.30), it is necessary to supply the forecasts for the variables different from inflation. Assumptions and projections from the Broad Macroeconomic Projection exercise are used in the Quarterly Monetary Assessment to derive these forecasts. In order to illustrate the impact of excess liquidity on future inflation using the GS approach, the Quarterly Monetary Assessment presents inflation forecasts based on three scenarios: Scenario one assumes that excess liquidity impacts inflation in line with past regularities[43]. Scenario two assumes that the correction of the monetary overhang occurs slower than expected from past regularities, based on a possibly increased risk aversion of euro area economic agents after the prolonged period of stock market declines[44]. Finally, scenario three studies the impact of excess liquidity on inflation, assuming that

41 Gerlach and Svensson (2002) extend the series of the constant 1.5% inflation rate from the first quarter of 1999 onwards and then estimate the implicit inflation target of the euro area central banks as converging to this extended series.

42 This output gap is estimated by means of a multivariate unobservable components model (used to decompose the variables into a permanent and a cyclical component) implementing the production function approach, see Proietti, Musso, and Westermann (2002) for details.

43 Developments of the overhang are forecast with a money demand model estimated for the period 1980-2001 Q2.

44 Developments of the overhang are forecast with a money demand model estimated for the period 1980-2004 Q1.

past portfolio shifts between 2001 and 2003 do not impact inflation, as they are assumed not be used for spending. Overall, it has to be kept in mind that the inflation forecast equation presented above captures more the cyclical developments in inflation and money based measures. In that sense it does not use the full potential of the information contained in money concerning risks to future price stability, which is more geared towards the information contained in the longer-term trend components.

8.3.4 INFLATION FORECAST SCENARIOS

During 2000 and early 2001, money demand equations had been used in addition to simple bivariate forecasting models to derive forecasts for the GDP deflator, the HICP and for real GDP. The simultaneous determination of all model variables in the system money demand model (BC) (see Section 8.2.2) allows producing simultaneous predictions of all variables involved in the money demand framework, e.g. in this case short- and long-term interest rates, the GDP deflator, money and output. However, the experience with this framework was negative, mainly based on the fact that the empirical properties of inflation in the period 1980 to 1999, in particular due to the disinflation periods (inflation was integrated of order 1) weighted too much on the forecasts derived with such a system.

8.3.5 PARAMETER CONSTANCY

At the time of writing the QMA 2001 Q2, no signs of instability in the long-run or short-run relations of the workhorse money demand equation could be detected using conventional stability measures. Nevertheless, given the potential risks stemming from the extraordinary portfolio shifts triggered by heightened financial market and geopolitical uncertainties, at the end of 2001, it was decided to freeze the parameter estimates from the workhorse money demand models at their values estimated for the period 1980 to 2001 Q2. Such a measure was taken in order to protect against an assumed omitted variable problem that would otherwise affect the parameter values of the money demand equation, including the long-run parameter values and would at the same time signal instabilities. In addition to the above-described permanent measures that recognised in real-time the potential risks for the stability of the workhorse money demand specification, a number of parameter constancy tests have been applied regularly in order to monitor the progressive deterioration. It is important to note that those tests cannot answer the important question whether money demand instability is stemming from omitted variable problem, shifts in the demand and importance of certain sectors of money holders or from a general breakdown of the money demand relation. The test procedure relied heavily on the work by Bruggeman, Donati and Warne (2003) and can be separated in a number of steps:

Step 1:

Since the stability analysis is based on a given number of long-run relations, as a fist step, the long-run properties of the money demand systems need to be investigated. In particular, the results obtained from stability tests are conditional on the correct choice of the number of long-run relations. It is therefore crucial that a correct assessment on the number of these relations be made. In that respect it is important to estimate the probability that a sequence of tests for the number of long-run relations (based on critical values from the asymptotic distribution) incorrectly selects too few relations. This probability is zero for large samples, but it need not even be close to zero in smaller samples. Formally, the cointegration rank is analysed by studying the non-zero eigenvalues used in the cointegraion rank analysis, based on fluctuation tests as proposed by Hansen and Johansen (1999). In order to assess the properties of the stability tests in a small-sample setting with respect to test size and power, bootstrap-based distributions are generated. Bootstrapping is a method to construct artificial samples based on the estimated behaviour of the actual data. One benefit of applying bootstraps is that it allows accounting for the small-sample behaviour of the tests. While the theory on bootstrapping in a non-stationary framework, such as the cointegrated VAR, is still largely undiscovered, the usual theoretical properties form models with stationary variables seem to apply in this setting as well. Hence, the bootstrap distribution can be assumed to provide more reliable guidance for inference than when asymptotic distributions are used.

Step 2:

After studying the constancy of the cointegration rank, the parameter constancy of the long-run parameters is tested using the Nyblom type test (supremum and mean) (see Bruggeman, Donati and Warne (2003) for details).

Step 3:

In a third step, the constancy of the short-term parameters is studied based on fluctuation tests proposed by Ploberger, Kramer, and Kontrus (1999). It has to be noted that such formal tests can of course not answer the important questions on the sources of potential non-constancies in the parameter estimates and are in general not conclusive when non-constancy issues occur at the current end of the time series.

COMMENT

BY PHILIPP M. HILDEBRAND, VICE-CHAIRMAN OF THE GOVERNING BOARD OF THE SWISS NATIONAL BANK

1 INTRODUCTION[1]

Dear colleagues and friends. It is a pleasure to be here today. I am honored to have the opportunity to discuss *Money and monetary policy: The ECB experience 1999-2006* by B. Fischer, M. Lenza, H. Pill and L. Reichlin in front of such a distinguished audience. The paper presents an overview of the monetary analysis at the European Central Bank (ECB) since its inception. It provides market participants with detailed information on how the monetary analysis has been deployed by the ECB and how it has evolved over time.

A newly created currency presents formidable challenges to monetary policy. Arguably, this is particularly true for the monetary analysis. Two challenges strike me as being paramount: first, policy makers face a fundamentally rearranged financial environment and second, empirical estimates are difficult to come by due to the invariably short sample period. A new financial regime implies potentially unstable money demand equations; a short sample induces imprecise estimates. The presented paper makes a valuable contribution in documenting extensively how the ECB has been conducting its monetary analysis in such an environment.

It should be noted at the outset that the challenges addressed in the paper do not solely apply to a new currency area. A case in point is my own institution, the Swiss National Bank (SNB). The SNB will celebrate its 100th anniversary next year. The Swiss franc can therefore hardly be seen as a new currency. Nonetheless, in the late 1990s, the SNB encountered very similar challenges to those faced by the ECB and described in the paper. It had to cope with increasing instability in the demand for its targeted money aggregates. In light of these parallels, allow me to complement my comments on the presented paper by drawing on the SNB's experience with money and monetary policy. But before I do so, let me briefly highlight the two aspects of the paper that strike me as particularly relevant.

1 The author would like to thank Samuel Reynard and Marlene Amstad for their valuable input.

First, and arguably most importantly, the empirical results presented in the paper suggest that the information content of monetary aggregates improve the quality of inflation forecasts derived from other models. In light of these results, research efforts directed at combining forecasts based on different models and accounting for the additional information provided by monetary aggregates are clearly worth pursuing.

Second, the paper documents the thorough analysis done at the ECB to take money demand shifts into account when tracking M3. The result of this work is *M3 adjusted by portfolio shifts*, a new monetary aggregate. It accounts for changes in financial market conditions. At times, this new measure differs significantly from the traditional M3 measure. The paper shows that this new variable has valuable information content in inflation forecasting exercises.

In many ways, the empirical work presented in the paper speaks for itself. Nonetheless, it seems to me, there are at least two factors which limit the extent to which we can draw far-reaching conclusions from the work presented in the Fischer et al. paper.

First, the analysis covers the years from 1999 to 2006. This period is characterized by remarkably low and stable inflation. For a central banker, this is good news. Such prolonged periods of low and stable inflation can, however, give rise to distortions in econometric analyses. An accurate evaluation of the information content of a particular variable for future inflation becomes difficult when the volatility of inflation is low. In such a setting it comes as no surprise that the random walk is a hard to beat benchmark. Therefore, when inflation is low and stable for a protracted period, a low correlation between money and inflation should not automatically lead us to conclude that money no longer matters.

Second, the evaluation of the additional value of money in the paper is undertaken based on a forecast horizon of six quarters. As the authors recognize themselves and as I will point out later on, money appears to be particularly valuable to inflation dynamics of medium and long-term frequencies. A mere six quarters could therefore simply be too short a time horizon to allow for money to begin transmitting in any significant way its impact on inflation.

The Fischer et al. paper will prove to be particularly valuable if it encourages further research to investigate the relevance and stability of its findings under different inflation regimes, in different economies and over longer time horizons. In this context, let me now briefly turn to the Swiss experience with money and monetary policy.

3 SNB EXPERIENCE USING INFORMATION FROM MONETARY AGGREGATES

With the collapse of the Bretton Woods system, the SNB had to search for a new policy framework.[3] From 1974 until the end of the 1990s the SNB announced monetary targets; first for M1, and eventually for the monetary base. In 1978, the SNB abandoned its monetary target for a short period in favor of a nominal exchange rate target.[4] During the second half of the 1990s, the monetary base became instable. The SNB faced increasing difficulty using a money target for M0, let alone to communicate through them. Finally, the SNB decided to adopt an altogether new monetary framework in an effort to increase the clarity, transparency, and flexibility of the conduct of its monetary policy.

The new concept, introduced in January 2000, is based on three elements: an explicit definition of price stability, an inflation forecast as the main indicator for policy decisions, and a range for the 3-month LIBOR as the operative target. In contrast to the ECB's two-pillar strategy, the SNB decided at the time to adopt an integrated approach. For the purpose of today's discussion, I would like to highlight two important elements of the SNB's monetary framework.

First, communication considerations were an important element in the design of the new framework. Clearly inspired by the early inflation targeters, a definition of price stability and a quarterly inflation forecast became the primary communication tools with regard to monetary policy. These were considered to be clearer than the alternative of attributing a specific role to monetary aggregates. In other words, the two pillar model of the ECB was rejected primarily on the grounds of communication considerations.

Second, the new monetary framework was deliberately designed to allow sufficient room for judgment and flexibility in the conduct of policy. The inflation forecast as the main indicator for policy decisions is derived from a "portfolio" of models and indicators. Some of these models contain monetary aggregates; others don't. The weights assigned to different models and indicators are allowed to vary over time as their reliability and applicability may also vary across different economic situations. Empirical studies backed the "portfolio of models" approach. Empirical evidence drawing on six years of Swiss data suggests strongly that combining inflation forecasts from different models and specifications improve the forecasting accuracy of the SNB's inflation forecasts.[5]

3 As extensively documented in Nelson (2006), "the competition between monetary and non-monetary views of inflation" was "resolved earlier and more decisively in favor of the monetary view" in Switzerland than in other countries, with the close observed relationship between money growth and inflation playing a determinant role in shaping monetary policy since 1973.

4 The new regime was announced on October 1, 1978 and lasted until the end of 1979. It can be seen as an illustration of the fact that the SNB had traditionally employed money targets in a flexible way.

5 Jordan and Savioz (2003).

Of course, the SNB does not claim to have solved the fundamental problem of linking monetary and non-monetary analyses. The Governing Board feels strongly, however, that there are significant advantages in aggregating the information from our different models and indicators in an internal process and subsequently publish a single SNB inflation forecast. Let me simply mention the most obvious one. In the SNB's integrated approach, the Governing Board avoids the potential communication problem of conveying the impression that fixed weights are attached to the monetary and non-monetary analysis in the conduct of monetary policy. The biggest challenge the SNB Governing Board has so far faced with regard to the integration of both the monetary and non-monetary views was in 2003. While monetary aggregates rose significantly, negative output gap measures suggested a disinflationary risk. Similarly to what is described in the Fischer et al. paper, the monetary and non-monetary signals were reconciled through an analysis of portfolio shifts driven by the near-zero interest rate policy at that time.

Understandably, some of you might be concerned that not giving a prominent and distinct role to monetary aggregates could lead to relegating money to an insignificant role in the decision making process. This is not the case. To the contrary, I would argue that the SNB's "plurality of approaches" concept guarantees that money will retain an important role in policymaking, as long as money provides useful information for subsequent inflation fluctuations. There are theoretical as well as empirical studies which indeed suggest that money provides useful additional information for subsequent price developments.[6] Using Swiss data, empirical work conducted at the SNB shows that money growth rates and deviations from an estimated money demand equilibrium contain useful information for both short- and long-term Swiss inflation developments.[7] Similarly, a more recent study finds that money growth adjusted for changes in the equilibrium interest rate has a significant and proportional influence on subsequent inflation developments relative to information in output and interest rates.[8]

4 MONEY AND LONG-TERM FINANCIAL IMBALANCES

Let me conclude by stressing a final point, which strikes me as being worth emphasizing more prominently in the Fischer et al. paper: the role of money beyond a medium-term inflation forecast.

Clearly, the relevance of money extends beyond the medium-term. Several recent studies have discussed the relationship between monetary aggregates and

6 For example, Nelson (2003) argues that movements in monetary aggregates provide useful indications regarding different yields usually not incorporated in economic models.
7 Baltensperger, Jordan and Savioz (2001), Jordan, Peytrignet and Rich (2001).
8 Reynard (2006).

asset prices.[9] Today's economic models are unable to produce reliable inflation forecasts with a horizon beyond at most three years. I doubt this will change going forward. Nonetheless, developments in monetary aggregates can play a useful role in helping to identify potential imbalances in financial markets which could, in time, undermine economic and price stability.

According to a recent study, since 1980, the value of global financial assets excluding real estate has grown from an amount roughly equaling the global GDP to more than three times its size.[10] In light of the growing importance of financial assets, central bankers have an incentive to consider longer-term price risks more thoroughly. In a global economy increasingly affected by the effects of rising and falling asset prices, it seems to me that the role of money and credit aggregates in signaling potential long-term financial imbalances will become more important. Here I would like to refer to Mervyn King who recently said: "Monetary policy will, therefore, need to be alert to the information contained in a wide range of asset prices, to be forward-looking in its aim of maintaining low and stable inflation, and to be ready to respond to changes in the signposts."[11]

In practice, it is often difficult to consider money in the conduct of policy. Nonetheless, it allows us to address some of these important issues at least at first approximation. In that context, both the ECB and the SNB conduct a careful analysis of monetary aggregates partly in an effort to assess the risks of long-term financial imbalances. Moreover, acknowledging the monetary source of long-term inflation helps avoid the build-up of excess liquidity in the first place. In closing, let me therefore repeat that the Fischer et al. paper could benefit from focusing more extensively on the admittedly complex but nonetheless important link between money, asset prices and long-term inflation perspectives. In the case of the SNB, the flexible nature of the policy framework and the importance attached to money and credit variables means that in an effort to avoid potential long-term financial distortions from emerging, the Governing Board could conceivably tighten monetary policy even if our inflation forecast signals no imminent inflation threat.

9 For example, Issing (2002) provides evidence of a close relationship between excess money growth and real asset prices, a relationship that does not appear by looking at a standard Taylor rule as a measure of monetary policy stance. Similarly, Friedman (2005) showed that pre- and post-financial market crash evolutions of stock prices and gross domestic products were strongly related to the pre- and post-market crash evolutions of monetary aggregates. White (2006) pointed to the need of pushing further the frontiers of economic research in the direction of incorporating financial variables to assess longer-term macroeconomic developments.

10 McKinsey (2005, 2006).

11 King (2006).

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COMMENT

BY JORDI GALÍ, CREI AND UNIVERSITAT POMPEU FABRA

The paper by Fischer et al. provides a useful description of the tools and procedures used by the ECB as part of its monetary analysis, and how they have evolved over time. That analysis has, according to the ECB's strategy, a key role in assessing the outlook for price developments over the medium to longer term. It is also supposed to constitute an important input in its decision-making process, complementing the so-called economic analysis (which focuses more directly on measures of economic activity, prices and costs). Of course, the authors are better placed than anyone else to provide a descriptive account of the monetary analysis conducted at the ECB. The outcome of that exercise is a useful paper that should be welcome by all ECB watchers (I use the latter term in a broad sense) and a must-read for anyone interested in the workings of the monetary pillar in practice.

But the authors do not restrict themselves to a descriptive account. They also seek to provide, in their words, "a thorough ex-post evaluation of the information content and policy relevance of the monetary analysis," using a real-time data set constructed with that objective. In other words, the paper seeks to answer the following two questions: Has the monetary policy analysis been useful, in particular, in assessing the outlook for inflation? And, to what extent have Governing Council (GC) policy decisions been influenced by the monetary policy analysis? While, by their very nature, there cannot be a straightforward answer to the previous questions, the paper offers many insights that help the reader form a clear overall picture.

The paper touches upon a large number of issues, all of interest. My brief comments will focus on two of them. First, I will discuss the paper's account of the evolution of monetary analysis at the ECB, and the role that the stability of empirical money demand equations may have played in shaping that evolution. Secondly, I will offer a critical assessment of the reduced-form money-based inflation forecasts that appear to have become a centre-piece of the ECB's monetary analysis, and point to some shortcomings of the quantitative evaluation of those forecasts found in the paper.

THE EVOLUTION OF MONETARY ANALYSIS AT THE ECB: THE ROLE OF MONEY DEMAND EQUATIONS

Fischer at al. offer a detailed description of the use and performance of money demand equations as part of the ECB's monetary analysis. Their account reveals a dramatic change in their status over time. It is worth recalling here that, at the onset of EMU, the ECB viewed the existence of a stable money demand as a key condition for justifying the prominent role of money and the reference value for M3 growth established in the monetary policy strategy made public by the Governing Council in 1998. In explaining that strategy and its underpinnings, the ECB emphasized the strong evidence in support of such a stable money demand. Here is an illustration:

"The available empirical evidence suggests that broad monetary aggregates exhibit the properties required for the announcement of a reference value. … In the past the demand for euro area broad money has been stable over the long run … [that] empirical evidence has been judged strong and robust enough for a reference value to be announced …"[1]

At that time, many academic observers were much less sanguine about the prospects of a stable money demand for the euro area.[2] The search for a stable money demand relationship had proved elusive for many other countries. In the U.S., for instance, the observed instability of empirical money demand equations was interpreted as a natural consequence of financial innovation and changes in the patterns of liquidity management by households and firms. The likely though uncertain changes in behavior associated with the switch to a new policy regime in the euro area, it would seem, could only make matters worse.

Four years later, at the time of the self-evaluation of its strategy, the ECB largely re-affirmed the usefulness of existing money demand models, noticing however that those models were not able to explain the acceleration of M3 since mid-2001. The ECB also made clear that its monetary analysis had been extended beyond the assessment of M3 growth relative to its reference value, to include *"a comprehensive assessment of the liquidity situation based on information from the components and counterparts of M3, … and from various money gap measures and concepts of excess liquidity." That analysis "… [should] be helpful for extracting a signal for monetary developments that is relevant for identifying the longer-run trend in inflation.*[3]*"*

As the account in Fischer et al. makes clear, the ECB's initial hopes regarding the stability of money demand were not realized. The paper refers to as many as four different money demand models that have been used at different times as part of the ECB monetary analysis. Two of those models appear to have been discarded. The remaining two have been subject to numerous ad-hoc modifications, in order to improve their fit. As a result of that failure, the focus

1 ECB (1999).
2 See, e.g., Svensson (1999).
3 ECB (2003).

shifted gradually to the construction of "adjusted M3 measures," that sought to remove components that reflected shifts in money demand that would not be deemed a risk to price stability. In addition, and in order to supplement the reference value for M3 growth, a number of alternative monetary indicators started being used, including *money gap* measures.

The previous developments have represented a significant shift in the ECB's thinking on the importance of money demand stability as a foundation of the monetary pillar. In the words of Fischer et al.

"… money demand is no longer seen as the centre-piece of the framework for monetary policy analysis. Conducting a rich monetary analysis is thus not contingent on the stability or otherwise of any single specification of money demand for a particular monetary aggregate …"

That re-assessment, following the empirical failure of existing money demand models and the tools (e.g. excess liquidity measures) that relied on the stability of such models, has led to a growing emphasis on instruments that – at least apparently – do not hinge on the stability of money demand, and most prominently, reduced form, money-based forecasts of inflation.

But, in my opinion, the ECB's emphasis on the importance of a stable money demand was misguided from the beginning. The value of monitoring monetary aggregates or measures of excess liquidity as part of an assessment of the risks to price stability is questionable, *even in the presence of a stable money demand*.

In order to illustrate the previous point let me offer a simple example. For simplicity I normalize target inflation, π^*, and trend output growth, Δy_t^*, to zero. Assume that actual inflation is proportional to the log deviation between output, y_t, and its natural level, y_t^n:

$$\pi_t = \lambda\,(y_t - y_t^n)$$

The following stable money demand relationship is assumed to hold

$$m_t - p_t = \beta y_t$$

Note that, for simplicity, the demand for real balances is assumed to be independent of the interest rate, though that assumption is not critical for the argument below. Combined with the assumptions on target inflation and trend output growth, it is easy to check that the previous money demand schedule implies a reference value for money growth – as constructed by the ECB – equal to zero.

Note actual money growth is given by

$$\Delta m_t \simeq \pi_t + \beta \Delta y_t \qquad (1)$$

On the other hand, the measure of the real money gap, as constructed by the ECB is given by

$$RMG_t = (m_t - p_t) - \beta y^* \\ = \beta\,(y_t - y^*) \qquad (2)$$

Consider next the following hypothetical (but perfectly plausible) scenario. Suppose that the economy experiences a productivity boom, reflected in a persistent increase in the growth rate of natural output, Δy^n_t. Moreover, let us assume that the central bank succeeds in stabilizing inflation, by generating, through appropriate interest rate adjustments, an increase in output commensurate to the increase in the natural level. From (1) we see that money growth will show a persistent deviation from its reference value. That deviation would, however, be totally uninformative about future inflationary pressures, since inflation remains unchanged all along. Furthermore, the real money gap would show a permanent (and potentially large) increase, even though no rise in inflation would follow.

Alternatively, suppose that the central bank chooses to accommodate only gradually the increase in potential output, thus triggering a persistent deflationary episode. In that case, and as long λ is sufficiently small, we would observe a positive deviation of money growth from its reference value as well as a persistent increase in the real money gap. According to the ECB, those indicators should signal risks of inflation. But in our illustrative example they are followed by… deflation!. Furthermore, if the monetary signals were taken at face value, the central bank could be misled into pursuing a policy that would only reinforce the existing deflationary pressures.

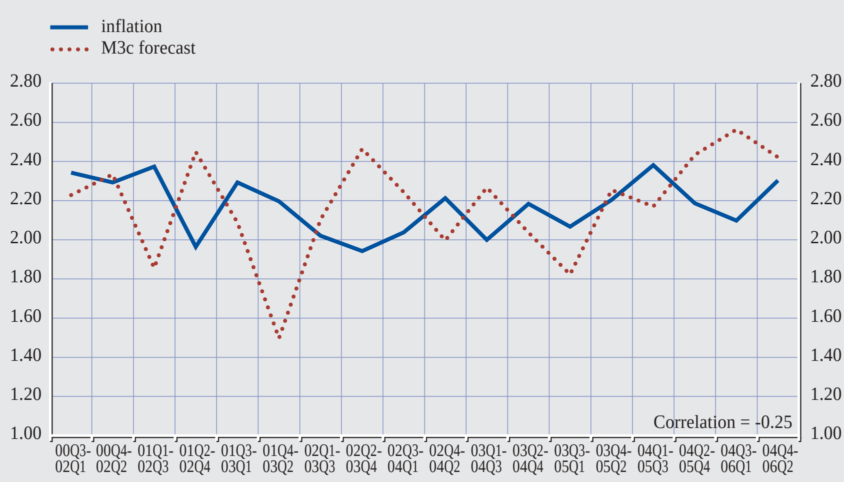
The previous example is meant to illustrate a more general proposition: the existence of a stable money demand relationship does not necessarily make monetary indicators useful in assessing the outlook for inflation and, hence, as guidelines for policy. In the example above, forecasting inflation must necessarily involve a forecast of the evolution of output relative to its natural level. It is hard to envision a scenario in which monetary aggregates could prove useful in that regard.

So, after all, perhaps we should welcome the fact that money demand in the euro area has turned out to be highly unstable, and that this is has been recognized by the ECB. Once the mirage of a stable money demand equation is gone, it is more likely that concepts like the reference value for M3 growth or measures of excess liquidity like the "real money gap" will be substantially downgraded or maybe even eliminated from the ECB's toolkit.

REDUCED FORM MONEY-BASED INFLATION FORECASTS

So what is the role left for monetary aggregates in that context? Fischer et al. point to a newfound role for monetary aggregates in the analysis of the ECB: as an explanatory variables in real-time, OLS based, reduced form forecasting equations.

Chart 1 Real time money-based inflation forecasts: 6 quarter horizon



Fischer at el. evaluate the out-of-sample performance of real time money-based inflation forecasts relative to a number of alternative forecasts. While the authors emphasize that it may be too early to draw definite conclusions from their exercise, the intended message seems clear: monetary aggregates seem to contain information about future inflation that is potentially relevant for monetary policy decisions.

How useful can these reduced-form money-based inflation forecasts be? Let me start with an observation. The authors present a range of indicators to evaluate the out-of-sample performance of the inflation forecasts based on the adjusted money series, and offer a favorable assessment of that performance. But, against convention, they do not present a graph plotting their forecast along the variable being forecast. Chart 1 displays such a graph. To go to the point: while the money-based forecast happens to get the mean more or less right, it fails miserably at tracking the movements in average 6-quarter ahead inflation: the correlation between the forecast and the realization is slightly negative![4]

A possible response to that observation could run as follows: money-based forecasts are not intended to anticipate small fluctuations in inflation around a constant mean, but instead persistent (even permanent) changes in that mean. Since we did not observe such an episode over the past six years, the fact that the forecast has remained close to the realized mean is good news. But given that evidence (or lack thereof), how should the ECB respond to an eventual persistent change in the mean of the forecast? This is not a hypothetical scenario: A rise in the money-based forecast of inflation has accompanied the accelerating trend in M3 growth over the past few years, which may have led to calls for higher interest rates.

4 Similar results obtain for the 12-quarter ahead forecasts, not shown here.

I would like to argue that putting much weight on such forecasts may not be warranted, and taking them seriously as an input for monetary policy decisions might be dangerous. To help me convey my argument, let me present my own estimates of a simple version of the bivariate forecasting equation for 6-quarter ahead used in the paper, covering the period 1980:I-2004:IV and using the corrected M3 growth measure:

$$\pi_{t,\,t+6} = \underset{(0.26)}{-0.25} + \underset{(0.05)}{0.52^{**}}\,\pi_t + \underset{(0.05)}{0.22^{**}}\,\Delta m_t + \varepsilon_t$$

Thus, we see that money growth is statistically significant, i.e. it has predictive power for future inflation, a property that could in principle be exploited in assessing the risks to price stability. Of course, other variables can also be shown to be significant, but that is not the issue, since the ECB does not deny the usefulness of other variables. In fact , money growth appears to be significant even after one controls for some other variables.

What are the problems with forecasting equations of this sort, and their potential use as a input to monetary policy? The first problem is related to the Lucas critique: reduced form forecasting equations involving inflation and money growth do not represent a structural relationship. As a result their coefficients are likely to vary over time as a result of structural changes in the economy, including changes in the monetary policy regime or as a result of the very instability of money demand equations reported by Fischer et al. Thus, money may have predictive power for inflation over a certain period, but may lose it after a while.

This is precisely what may have occurred in the euro area. The significance of adjusted M3 growth in bivariate inflation forecasting equations seems to emanate from similar (though slightly phased-out) low frequency movements in those two variables during the 80's, clearly identifiable in Chart 2. Such a

Chart 2 Euro area inflation and M3c growth

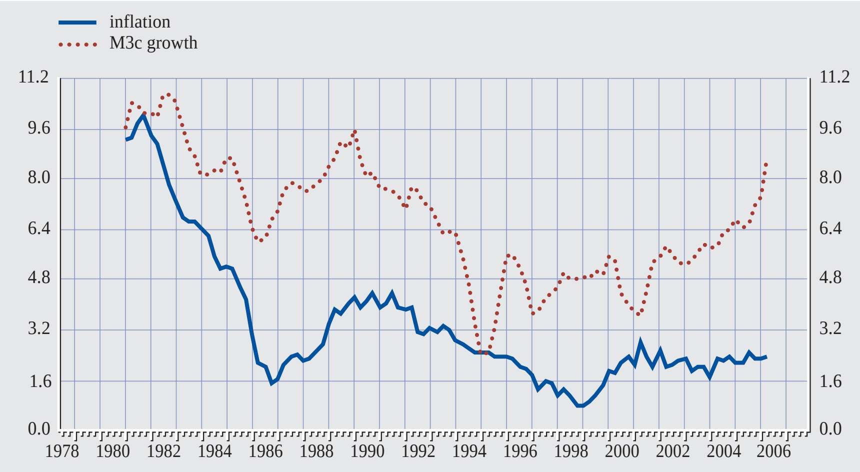
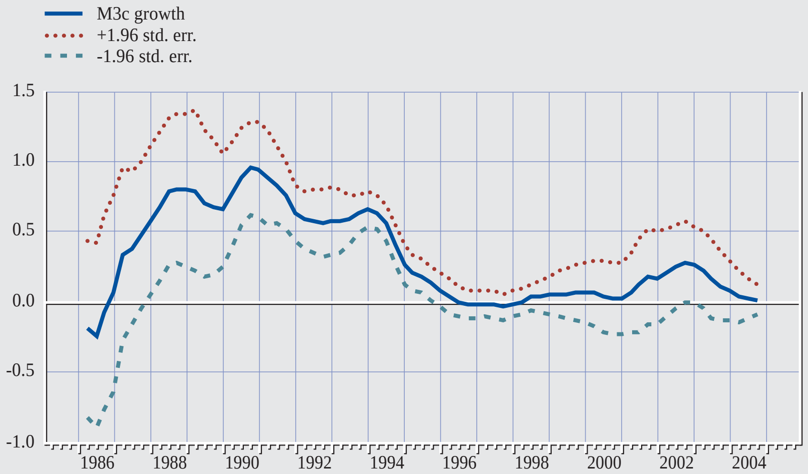


Chart 3 Recursive estimates of M3c growth

(using a moving window of width 24



low frequency comovement seems have been absent for the past 15 years. This suggests some instability in the dynamic relationship between inflation and adjusted M3 growth. That instability is reflected in the estimates of the above forecasting equation using data starting in 1998:I:

$$\pi_{t,\,t+6} = \underset{(0.47)}{1.22^{**}} + \underset{(0.11)}{0.26^{**}}\,\pi_t + \underset{(0.08)}{0.07}\,\Delta m_t + \varepsilon_t$$

That instability is also captured by rolling estimates of the coefficient of adjusted money growth in the above regression, as shown in Chart 3.[5]

A different perspective on the same issue can be given by looking at the evidence outside the euro area. If the ability of monetary aggregates to predict future inflation is an inherent feature of market economies (or at least of those with a level of development similar to the euro area), one should also find evidence of that predictive power for other countries. Yet, estimates of the baseline bivariate forecasting equation using U.S. data (covering the 1980:I-2004:IV period) show no evidence of predictive power of M3 growth for 6-quarter ahead inflation, as the following estimated equation makes clear.

$$\pi_{t,\,t+6} = \underset{(0.23)}{2.67^{**}} + \underset{(0.04)}{0.20^{**}}\,\pi_t - \underset{(0.03)}{0.03}\,\Delta m_t + \varepsilon_t$$

Given that *prima facie* disconnect between monetary aggregates and inflation, it is not surprising that the Federal Reserve has abandoned the use of monetary aggregates as a reference for their policy decisions.

5 Similar results emerge for unadjusted M3 growth.

CONCLUDING REMARKS

From the outset of EMU, a vast majority of academic economists have expressed their skepticism about the two-pillar structure of the ECB monetary policy strategy and, more specifically, about the usefulness of the monetary pillar.[6] That skepticism has been based on lessons drawn from modern monetary theory and the experience of other countries, rather than the actual workings or the practical implications of that ECB's monetary pillar. In fact, until now, little was known of the latter.

Fischer et al. have written a paper that sheds some needed light on the workings of the monetary pillar in practice. The paper brings together a wealth of information that was either dispersed or not public until now, and the ECB has to be commended for this additional step towards greater transparency. Many economists will find that information useful. But very little of it can be used in my opinion to change the minds of the critics.

On the contrary, the paper brings to the fore some of the strains that the implementation of the monetary pillar has generated.

Let me conclude with a prediction which, of course, is only modal: Ten years from now the current two pillar strategy of the ECB will have been revamped, and the so-called monetary analysis will have been "integrated" into the more general economic analysis. If that is the case, I conjecture that the paper by Fischer et al., and the reflections and discussions that it must have triggered within the ECB, will be seen as a significant mark on the road towards a more coherent and easier-to-communicate monetary policy strategy for the euro area.

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6 See, e.g., Svensson (1999) and Galí (2003).

Willem Buiter argued that in particular due to the communication challenges and the results of the inflation forecast combination exercises, a merger of the ECB's monetary analysis and economic analysis is more attractive than a separation. In addition, he argued that, in the case of unstable velocity or unstable money demand, a reduced form model of inflation and money growth can only work successfully if all shocks to velocity go into real output. Therefore, regarding the forecasting framework of each of the two pillars his recommendation was not to separate institutionally the two complementary approaches: "don't integrate – merge!"

In her reply, **Lucrezia Reichlin** expressed the view that is it encouraging to see other central banks looking more closely at monetary developments. She stressed that, as reflected in the paper, monetary analysis at the ECB is much broader than the characterisation typically made by ECB watchers. In particular, reliance on money demand equations and a mechanical interpretation of deviations from them was of much less importance than thought by observers outside the ECB. She argued that arguments based on the premise that "instabilities in specific money demand equations imply that money should play no role in monetary policy" are not well-founded. She noted that a large number of other economic relationships – for example, IS equations – are also unstable on the usual statistical criteria, but nonetheless these equations are still used to forecast the relevant variables.

In her experience, no central bank relies exclusively on structural models when forecasting inflation. Rather a suite of models is employed, including structural models, judgemental views and reduced form models. This set of frameworks constitutes the policy makers' tool box. Given the widespread occurrence of structural breaks in economic variables, Reichlin favoured multivariate rather than univariate forecasting models. That said, she took the view that money should definitely play a role in such multivariate models.

Huw Pill stressed that the ECB's monetary policy strategy was not aimed at producing the best possible inflation forecasts, but rather at creating a framework for the information and analysis that was conducive to decision-making that supports the maintenance of price stability. Staff provide economic and monetary analyses separately as policy inputs to the Governing Council. Policy makers at the ECB can then cross-check these sets of information in order to form a policy view. Thus characterisations of the monetary analysis as a mechanical assessment of and/or monetary policy response to deviations of M3 growth from the ECB's reference value (as implied by Galí's interpretation) were misplaced. This had never been the ECB's approach, as often expressed in the past (e.g. in the ECB Monthly Bulletin article describing its monetary policy strategy published in Janaury 1999 at the outset of Monetary Union). It was always important to identify the underlying causes of monetary developments and to identify the trend component of monetary dynamics that is relevant for the underlying trend in inflation. In this context, he stressed that the analysis of credit and other counterparts of M3 played a crucial role in the ECB's monetary analysis. Pill also disagreed with Galí's view that money did not play a role in the ECB's monetary policy in practice. As explained in the paper, there had certainly been situations in which the policy signal stemming from the monetary analysis was viewed as less reliable and thus appropriately played a less important role in decision-making. However, there were also occasions when the policy signal stemming from the economic analysis was blurred, but the monetary signal clear. In these circumstances, the monetary analysis had shaped monetary policy decisions.

Pill also took issue with how money demand instability had been defined in the preceding discussion. If it was defined very narrowly, as evidence of parameter instabilities in specific money demand equations estimated using data prior to 1999, then these specifications do show signs of instability. However, such a definition is too narrow. In its real-time policy analysis through 2004, the ECB had developed a structural explanation of monetary developments and their links to risks to price stability (based on portfolio shifts into money at a time of heightened economic and financial market uncertainties) that had proved to be robust.

Lucas Papademos

KEYNOTE SPEECH

THE ROLE OF MONEY IN THE CONDUCT OF MONETARY POLICY

BY LUCAS PAPADEMOS, VICE-PRESIDENT OF THE ECB

1 INTRODUCTION

The choice of the topic of this conference, "The role of money in monetary policy", may, at first sight, appear somewhat strange for a central banking conference, as it might suggest some uncertainty or even doubt about the role of money in monetary policy. But is it really possible for a policy described as "monetary" to be formulated and implemented without money playing a central role in it? Indeed, the suggestion that monetary policy can be conducted without assigning a prominent role to money seems like an oxymoron – a statement containing apparently contradictory terms, if not worse: for the literal meaning of the Greek word "oxymoron" is "pointedly foolish".

Yet in recent years, a large and influential body of academic work has disregarded or deemphasised the role of money as a determinant of inflation, even in the long run. The theory of monetary policy has often focused on the links between the policy-controlled interest rate and the paths of the price level and real output in theoretical frameworks, in which money plays no essential role, if any, in the transmission of the effects of policy and, consequently, in its conduct (see Woodford, (2008). The monetary policy reaction functions employed in theoretical analyses as e.g. in Clarida et al. (1999) do not typically involve measures of the quantity of money, either as an intermediate policy objective or as an indicator that may provide useful and timely information relevant for determining the appropriate policy stance.

Parallel to these theoretical developments, and in the environment of relatively low inflation that has prevailed over the past ten years, the role of money in the conduct of policy by many central banks has diminished or has even been ignored. Lawrence Meyer, a former member of the Board of Governors of the Federal Reserve System, summarised these developments in a speech in 2001 *"[…] money plays no role in today's consensus macro model, and it plays virtually no role in the conduct of monetary policy, at least in the United States."* Larry was careful to include this qualification at the end of his statement. For as you very well know, there is another major central bank that does assign a prominent role to money in its policy strategy. A role that, I will argue, is justified by both theory and empirical evidence, and which has served us very well in the conduct of our policy since the establishment of the ECB. On this last point, we have no doubt. In fact, we have organised this conference because we are interested in promoting scholarly debate on these important issues in an open and transparent manner. We believe that we can all benefit by sharing our experiences and learning from each other.

In my remarks, I would like to share with you some thoughts on four issues pertaining to the role of money in the design and implementation of monetary policy. These issues relate to the theoretical arguments, the empirical evidence, the uncertainty and practical considerations facing policy-makers that have a bearing on the role of money in the conduct of monetary policy. In addition, I will briefly address the role of money in performing the central banking task of safeguarding financial stability.

2 THEORETICAL ARGUMENTS

What are the basic principles and theoretical arguments supporting the view that money is the fundamental determinant of the price level over the medium and long term, and that money and its counterparts – notably credit – play a key role in the transmission of the effects of monetary policy to the economy? The essential role of money as the fundamental determinant of the price level can be established – and has been established – in the context of a microeconomic general market-equilibrium framework and a stylised consensus macroeconomic model. At a microeconomic level, and under certain plausible and rational assumptions concerning agents' preferences and optimising behaviour, the conditions for equilibrium in the product, services, labour and asset markets determine the relative prices of goods and services, the real wage (in terms of a general price index), and the spectrum of the relative real rates of return on all assets, including the associated risk premia. The determination of the general price level, and its rate of change, requires control of the nominal quantity of base money or of some other monetary aggregate that can be effectively controlled by the central bank (see e.g. Patinkin, 1966). This result reflects the role of money both as a medium of exchange and as a unit of account. Under price and wage flexibility, and in the absence of any nominal rigidities, the price level will promptly and fully respond to a change in the money stock. More generally, the determination of the price level by the nominal quantity of money will be established in the long-run equilibrium.

At an aggregate, macroeconomic level, the fundamental proposition concerning the link between the supply of money and the price level is captured by the quantity theory of money (see Friedman, 1956). In the context of this simple theory, the causality of the link is clear. The point that I would like to stress, however, is that the causal relationship between the stock of money and the price level is in principle also valid, at least in the long-run equilibrium, in more general and sophisticated macroeconomic frameworks, which incorporate alternative hypotheses concerning the factors and processes that determine the level and the dynamics of aggregate demand and supply and, consequently, the evolution of the price level over time.

One such general framework is what could be called the consensus macroeconomic model, which was developed in the 1980s (see e.g. Papademos and Modigliani, 1990) and has been widely accepted as a useful stylised framework for monetary analysis, at least until the late 1990s. It is useful to briefly discuss the role of money in the transmission of the effects of monetary policy in the context of this framework for three reasons: first, because it incorporates many of the advances in macroeconomic theory made over the past 20 years, reflecting different approaches to, or schools of thought on, the functioning of the macroeconomy; second, because in a general sense, it underpins most of the macroeconometric models currently used by many central banks; and, third, because it provides a benchmark for comparison with the latest generation of macroeconomic models developed in recent years for the analysis and assessment of monetary policy.

This consensus theoretical framework for monetary analysis is the outcome of a synthesis that combines three elements: first, the insights and basic characteristics of the New Classical models of Robert Lucas (1972, 1976) and the real-business-cycle models of Kydland and Prescott (1977, 1982) and others, including the emphasis placed on forward-looking "rational" expectations; second, the inclusion of institutional factors, staggered wage and price contracts and market imperfections, which have been associated with the work of Phelps (1967), Calvo (1983), Fischer (1977) and Taylor (1980), and which result in nominal rigidities in a Keynesian tradition that have important implications for the dynamic response of real output and the price level to shocks and to a change in the monetary policy stance; third, the elaboration, in certain extensions of this framework, of the economy's financial structure, which would allow for a richer representation of the potential channels through which monetary policy can affect economic activity and the price level, for example via wealth effects, variations in asset prices, credit and liquidity constraints and other "financial frictions".

In this general and eclectic theoretical framework, money plays an important role in the transmission of the effects of monetary policy, and in the conduct of policy. Aggregate demand, as determined by the conditions for simultaneous equilibrium in the product, money and financial markets, depends on the real value of the quantity of money, which influences aggregate spending both directly and indirectly via the level of real interest rates. In general, short-term and long-term market rates and bank lending rates need not move in parallel when monetary conditions change, differing only by constant risk premia and intermediation costs, but they may vary over time in response not only to transitory shocks but also to other factors, including changes in liquidity conditions. A change in the nominal quantity of money affects both real output and the price level over time, but progressively and ultimately it affects only the price level. Money is neutral and super-neutral in the longer run. The impact of money on real output and the price level over short-term and medium-term horizons, and the speed at which a change in money growth affects inflation, depend on behavioural and institutional factors and, most importantly, on the way inflation expectations are being formed and influenced. The extent to which expectations are formed "rationally" and the nature and modalities of the associated learning processes play a crucial role in determining the magnitude of, and the time lags in, the effects of a change in the monetary policy stance on the price level and aggregate output over time.

Two conclusions with implications for the conduct of monetary policy emerge from these theoretical considerations. The first relates to the central bank's strategy and policy implementation. Because expectations play an important role in the transmission of the effects of monetary policy and because expectations should, by and large, be formed "rationally", in the sense that they take into account all relevant available information concerning the factors and policies that may affect future price developments, the quantitative definition of the price stability objective of the central bank, the strategy it adopts in pursuing this objective, and the credibility with which policy is conducted all influence expectations and, thus, the effectiveness of the monetary policy itself (see Woodford, (2003). The ECB's quantitative definition of price stability and its commitment, in the context of its strategy, to achieving this objective are reflected in the effective anchoring of inflation expectations in the euro area at a level in line with our quantitative definition of price stability.

A second conclusion concerns our ability to capture empirically, and in a reliable manner, the role of money in the monetary transmission process, and the implication of this for the central bank's monetary policy strategy. The model I referred to implies that the long-term relationship between money growth and inflation is theoretically robust, that is, independent of, and consistent with, the model's behavioural or structural features that may reflect alternative hypotheses. However, over short and medium-term horizons, the effects on future price and output developments of a change in the monetary policy stance, and of monetary conditions in particular, cannot be settled *a priori* on theoretical grounds. The magnitude and time profile of these effects is an empirical issue that must be assessed on the basis of the evidence available. But as the response of the economy to a change in policy rates and/or the quantity of base money reflects the influence of various factors and past policy actions that may have varied over time, and are likely to differ across countries, the estimation of these effects is not straightforward, especially for relatively low rates of inflation. Indeed, the estimated parameters of traditional macroeconometric models cannot be expected to be invariant over time. This is not only because they will not be invariant to the central bank's strategy or policy rule, as Lucas (1976) has emphasised, but also because other factors and processes, such as technological advances, productivity gains, financial innovations and possibly changes in preferences reflecting demographic developments are likely to exert an ongoing, and difficult to precisely identify, influence over time on the dynamic response of the economy to a monetary policy change .

The latest generation of macroeconomic models for monetary analysis, developed in recent years and referred to as "new Keynesian" or "new neoclassical" models, can address some of these challenges, particularly those stressed by Robert Lucas. These models are conceptually appealing as they also emphasise the role of forward-looking rational expectations and nominal rigidities and, furthermore, are based on more rigorous microfoundations. The derived macroeconomic relations, linking policy objectives to instruments, reflect explicitly the optimal behaviour of economic agents and they can be considered truly structural in the sense that their parameters are invariant to monetary policy changes[1]. These types of models have been employed to argue, as Michael Woodford did forcefully this afternoon, that monetary policy can be effectively conducted to control price and output developments without any use or reference to monetary aggregates. For money plays no essential or active role in the monetary transmission mechanism, it reacts only passively to price developments – which are influenced directly only by the monetary policy interest rate – without any feedback effects on the economy. So money does not matter.

One feature of an analytical framework in which money plays no meaningful role and of a policy strategy in which the policy-rate is set without taking into account monetary developments is the possibility that the central bank may fail to anchor inflation expectations effectively. This is a troubling possibility, which would imply increased output and price volatility that would impair the central bank's ability to pin down the price level efficiently. Christiano and Rostagno (2001) gave a pertinent example. But the issue is more general and deserves further reflection.

The strong conclusions on the irrelevance of money in the conduct of monetary policy derived from the New Keynesian models are not a consequence of the key and attractive features of those models – the role of expectations and the more solid microfoundations – but they reflect underlying assumptions concerning the role of money and of financial intermediaries in the economy. One such simplifying but limiting assumption is that real money balances do not affect aggregate demand directly. Another is that financial intermediation, which is important for credit provision and liquidity creation, has no effects on economic activity and prices other than those resulting from changing lending rates which move in parallel with all market rates. In these markets, there are no informational asymmetries or liquidity and credit constraints affecting the behaviour of economic agents, which is not the case in the real world. And movements in asset prices, that in reality can be affected by liquidity conditions, do not affect directly or via wealth affects spending decisions. I am sure that as the new framework for monetary policy analysis is extended, to allow for a sufficient degree of realism on the role of money and its counterparts – notably credit – in the economy, the relevance of money in the conduct of monetary policy will be revealed and restored. Research carried out at the ECB and elsewhere aims at incorporating a richer financial sector into dynamic stochastic general equilibrium models, in order to study the role of financial variables in the conduct of monetary policy. And we should be looking forward to the findings of this research.

It is, of course, legitimate to ask whether these additional refinements that I am suggesting will turn out to be quantitatively significant. My expectation – and, I should say, my rational expectation based on the observation and assessment of economic reality – is that they are likely to be important. But the extent of their relevance in practice can only be judged on the basis of the available

1 They, of course, will not be invariant to changes in the economy's structure or agent's preferences.

evidence, which can perhaps be better assessed in the context of the new theoretical framework and the associated dynamic stochastic general equilibrium models being developed.

3 THE EMPIRICAL EVIDENCE

So far, I have argued that theory clearly suggests that money does play a role, but I have also pointed to potential challenges in identifying in practice and estimating with sufficient accuracy the effects of money on the economy over time. What does the empirical evidence available tell us? Is it robust and useful? What are the implications of this evidence, especially in the euro area, for policy?

A first and important finding is that there is strong and robust evidence concerning the long-term relationship between money and prices, based on data collected for many countries and over long periods of time. One such study, which estimates this relationship on the basis of a methodology that should make the estimates independent of country-specific events and of the sample period, finds that the correlation between inflation and the growth of money is close to 1, as suggested by theory. The existence of a strong and stable long-term relationship between inflation and money growth is documented by many other studies, including a number of major studies at the ECB based on euro area data. It is also interesting to note that the relationship between inflation and money growth is particularly close for high-inflation countries, as illustrated in a book co-authored by two of our distinguished guests, Chairman Bernanke and Professor Woodford (see Bernanke and Woodford, 2006). These findings are, of course, important and consistent with theory. But because robust correlations and long-term relationships need not imply causality, and because we are also interested in the links between money and prices over shorter time periods, we have to examine other types of evidence.

One approach employed in recent empirical studies to study the impact of monetary phenomena on the economy is based on vector autoregressions (VARs), which were pioneered by Sims (1972, 1980) and further developed and extensively applied by Professor Christiano and his colleagues (see e.g. Christiano, Eichenbaum and Evans, 2005). This approach has the merit that it is not constrained by a particular specification of the underlying structural relationships, and it provides evidence on the intertemporal response of the price level and output to a change in the monetary policy stance. Although the empirical results based on this approach are subject to several caveats, I would like to point to two findings from extensive research carried out at the ECB (see e.g. Angeloni et al. 2003). First, there are remarkable similarities in the price level and output responses of the euro area and the US economies to a change in the monetary policy stance, although the exact time profiles of the dynamic effects differ and cannot be estimated with great precision. Second, a reduction in the policy rate or an increase in the monetary base induces a very gradual positive adjustment of the price level that is long lasting, while it leads to a temporary increase in output which reaches a peak after a period of between one and two years, but eventually diminishes to zero. These time patterns of output and price responses are consistent with the theoretical paradigm of the monetary transmission mechanism that I previously reviewed, and with simulations of the effects of monetary policy based on highly stylised dynamic general equilibrium models calibrated for the euro area economy.

This brings us to the evidence available on the role of money, as captured by the macroeconometric models currently employed by many central banks, including the ECB. The pertinent evidence is not encouraging, but this is not entirely surprising in the light of the arguments previously made and the results of vector autoregressions. The relationship between monetary and price developments involves considerable time lags, which reflect the various channels of the transmission of the effects of monetary policy. The short to medium-term dynamics of inflation, which are captured by the existing structure of this type of model, tend to be dominated by the impact of economic factors and shocks, such as changes in the price of oil or indirect taxes, especially in a low-inflation environment. It could thus be argued that the success of past monetary policy in keeping trend inflation at a low level has made it more difficult to estimate, in the context of this type of model, the short-term links between money and price developments. At the same time, econometric models focusing on the medium to long-term links between money growth and inflation have been able to capture statistically significant empirical relationships that can help us to predict long-term inflation and assess the risks to price stability emanating from monetary developments.

4 THE CONDUCT OF MONETARY POLICY

What does all this imply for the ECB's choice of monetary policy strategy and the conduct of its single monetary policy? There is one logical conclusion, based on theoretical considerations, the empirical evidence and the current state of analytical tools: the sensible approach to assessing the outlook for and the risks to price stability over all pertinent horizons, but especially over the more policy-relevant medium term, is to analyse and combine all available information in a conceptually appropriate and consistent manner (see Gaspar et al. 2006). This conclusion is further supported by the nature and extent of the uncertainty faced by policy-makers:

(i) uncertainty about the impact of ongoing processes, such as technological advances and financial innovations, on the economic structure;

(ii) the associated uncertainty concerning the estimated values of key economic concepts, such as the economy's potential growth rate, the neutral real rate of interest or the non-inflationary rate of unemployment;

(iii) uncertainty about the way in which economic agents form expectations;

(iv) uncertainty relating to the robustness and completeness of the estimated quantitative approximations of the theoretical paradigms that may be employed in policy analysis; and

(v) uncertainty about the accuracy of data, especially on a real-time basis.

And needless to say, uncertainty was heightened – for the ECB – during the transition to the euro and the conduct of the single monetary policy. Taking all of this into account, the choice of our policy strategy – employing both economic analysis and monetary analysis, and using the latter to cross-check over the medium- and long-term the assessment resulting from the former – was the right one. It has served us well. My view on the assessment of the appropriateness and effectiveness of a monetary policy framework is summarised in the old saying that “the proof of the pudding is in the eating.” And I would contend that, over the past seven years, the pudding has been very satisfying. Otmar Issing, who played a central role in shaping this strategy, will elaborate on this tomorrow, and I should not say much more. I would, however, like to briefly make some points relating to the future.

As shown in the paper presented earlier today by my ECB colleagues (see Fischer, Lenza, Pill and Reichlin, 2008), the monetary analysis carried out at the ECB has evolved over time and is fairly comprehensive, going beyond the standard assessments based on the quantity theory of money and the stability of money demand. It employs a variety of tools in a manner that is not mechanical but combines judgement and analytical rigour in reaching a money-based assessment of the risks to price stability. The main conclusion from our experience with monetary analysis is that, on the whole, it helps us to extract useful information from monetary aggregates about the inflation outlook and the associated risks. This information has proven relevant and has made a decisive contribution to monetary policy decisions.

There is, however, more work to be done towards deepening and refining our monetary analysis. This will involve not only improving the pertinent analytical tools and examining more thoroughly developments in the components and counterparts of money, but also a more comprehensive use of the signals contained in money data to extract information on the current state of the economy, and which can be useful for forecasting inflation: money and credit aggregates can play an important role in providing timely information about variables which are measured with a lag, and about variables that are not observable, or shocks hitting the economy that may be correlated with monetary developments. Some work that has been done in this area is very promising. The general aim of this research agenda is to get more value from money.

At the same time, we will also enhance the tools employed in our economic analysis by introducing a new euro area-wide model (a state-of-the-art dynamic stochastic general equilibrium model of the euro area economy), which is based on more solid microfoundations, in line with the latest theoretical advances. This model has the potential to incorporate in a substantive way the role and effects of money and credit in the monetary transmission mechanism. Perhaps, in the future, we will be in a position to develop and reliably estimate a single empirical approximation of a general theoretical framework in which money is of central importance. When this is done, it may be possible to merge the two pillars of our analysis into a single one. But this will be a larger pillar in which money will continue to play a prominent role in guiding our monetary policy decision-making.

5 MONEY AND FINANCIAL STABILITY

A final issue that I would like to briefly address concerns the role of money and credit – the usefulness of monitoring and assessing monetary and credit developments – in the performance of another major central bank task, namely the safeguarding of financial stability. This issue is important in its own right, but it is also linked to the conduct of monetary policy, since price stability and financial stability are intertwined and should be mutually reinforcing. In recent years, extensive work has been undertaken at the BIS (see e.g. Borio, 2007), the ECB (see e.g. Adalid and Detken, 2007) and elsewhere that demonstrates that excessive monetary and credit growth can provide useful early signals concerning the potential emergence of asset price bubbles, and that excessive liquidity growth has been associated with asset price boom episodes that have sometimes been followed by post-boom recessions. These findings are obviously important for the role of money and credit in the monitoring and assessment of financial stability, but they are also relevant for the conduct of monetary policy.

A recently expressed view is that a narrow focus of monetary policy on price stability in the short term might pose risks to price stability in the longer run, if the potential consequences of financial instability for long-term price developments are overlooked. The ECB's monetary policy strategy, with its medium-term orientation and the important role it assigns to monetary analysis for assessing medium- to long-term price developments, allows us to address challenges that may arise from financial imbalances and potential instability in the financial markets. Monetary analysis can help us to identify distortions and imbalances in the financial system, and the implied potential risks to long-term price stability, in a timely manner. Moreover, market expectations of the monetary policy response to these long-term risks to price stability should help to contain evolving financial imbalances and thereby mitigate the vulnerability of the financial system. There is, therefore, no conflict between the conduct of a monetary policy focused on the preservation of price stability over the medium and longer term, and the safeguarding of financial stability. On the contrary, price stability and financial stability should be mutually reinforcing. And the monitoring and assessment of monetary and credit developments contribute to this, which reinforces what I said before: there is "value in money".

However, it is worth keeping in mind the implications of the rapidly changing global economy. Its structure and functioning is affected not only by *(i)* productivity developments related to technological advances; and *(ii)* the process of globalisation, but also by financial innovation and the increasing complexity of financial instruments. All these factors have a bearing on the dynamics of the inflationary process and the evolution and information content of monetary and credit aggregates. It is therefore essential that we continue to monitor these developments, and keep our antennas alert for monetary and financial signals that can be of use in assessing medium- to long-term trends in consumer and asset price developments and their potential interaction. Needless to say, it is not easy to interpret this information in the context of the ongoing structural changes in the real economy and financial markets that are difficult to identify and measure in real-time. But we have to. I am convinced that the information value that can be provided by money will remain important, but it also requires careful analysis and interpretation.

6 CONCLUDING REMARKS

According to an old saying, *"The best advice about money is not to talk about it"*. Well, I obviously did not heed this advice, as I have talked about money quite extensively. But I felt it necessary to treat "money" comprehensively in my remarks, because it is money – according to an ancient compatriot of mine – that "holds all things together". Around 330 B.C., Aristotle recognised that *"all goods must therefore be measured by some one thing […] that holds all things together."* He emphasised that *"Money has become a sort of representative of demand by convention; […] it exists not by nature, but by law. And it is in our power to change it and make it useless."* In modern democracies, the power – and the responsibility – to ensure that money retains its value is vested in independent central banks. And it is precisely because we take this responsibility very seriously that we want and need to talk about money, and the value we get out of money for our analysis, and for the pursuit of our price stability objective.

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Christian de Boissieu, Michael D. Bordo, Marc Flandreau and Lorenzo Bini Smaghi (from left to right)

SESSION 3

WHAT ARE THE BENEFITS OF RESPONDING TO MONETARY DEVELOPMENTS?

PILLARS OF GLOBALIZATION: A HISTORY OF MONETARY POLICY TARGETS, 1797-1997

BY MARC FLANDREAU, SCIENCES PO AND CEPR[1]

"To determine the pressure of steam, we do not take a popular vote: we consult a gauge. Concerning a patient's temperature, we do not ask for opinions: we read a thermometer. In economics, however, ... though the need for measurement is as great as in physics or in medicine, we have been guided in the past largely by opinions. In the future, we must substitute measurement. Toward this end, we must agree upon instruments of measurement".

William T. Foster, Foreword, in Fisher (1923).

"The advent of modern independent and anti-inflation-oriented central banks is one of the great success stories of modern economic science. But this story has been exaggerated. We should consider the possibility that the unprecedented pace of modern globalization, recently emphasized by Ben Bernanke, the Federal Reserve chairman, might also have played a role. If so, what will happen if the winds of globalization ever reverse course?"

Ken Rogoff "The myth of central banks and inflation",
Financial Time, 29/08/2006

The success met by central banks in bringing down inflation during the past quarter of a century is nearly universal, and in developed countries it is absolute. This constitutes perhaps one of the greatest transformations the global economy has experienced recently. What are the forces that brought about this change? According to some, theoretical advances in modern macroeconomics explain it: first, the identification of structural credibility problems in the conduct of monetary policy, known as the "time inconsistency problem"; second, the design of new tools to address this problem, namely independent statutes for the central bank and inflation targets. According to others, the opening up of domestic markets to the forces of international competition – "globalization" – is the invisible hand that subdued the inflation hydra (Rogoff 2006).

Within this grand debate, an admittedly more focused controversy has developed on the operational design of anti-inflationary rules. First, there is the issue of whether the inflation rate is a sufficiently comprehensive indicator for monitoring monetary developments. Perhaps central banks should also rely on other sources of information and criteria, such as variations of the money supply. Second, there is the related issue of whether central banks should be concerned with asset prices or instead ignore them altogether. Third, there is the issue of determining the adequate measure of inflation: "headline inflation" versus "core inflation"; the inclusion or exclusion of fuel prices; and the adequate measure

1 I am grateful to Béatrice Dedinger for research assistance and to Olivier Accominotti, Vincent Bignon, Mike Bordo, Willem Buiter, Forrest Capie, Alex Cukierman, Clemens Jobst, Pilar Nogues, Giuseppe Tullio and Geoffrey Wood for suggestions and discussions. Errors and misinterpretations are my own.

of monetary contributions to price variation given the structural changes brought about by globalization.

This paper intends to argue that such discussions have a long history, which may be useful in clarifying contemporary debates. Specifically, we discuss the evolution of monetary policy in the long run, focusing on the history of monetary targets. This perspective highlights major resemblances and differences between two "major eras of globalization", viz. the late 19th century and today. These two periods, generally described as displaying a high degree of commodity and capital markets integration, have been characterized by the adoption of transparent policy rules assigned to independent central banks.

On the other hand, the actual rule has changed dramatically. During the globalization of the 19th century central banks were assigned exchange-rate targets. They were supposed to peg the value of the currency to a certain amount of specie (Eichengreen and Flandreau 1997). The ability to maintain the parity of the currency has often been described by both contemporary and later commentators as a test of good behavior. Today by contrast, central banks are assigned inflation targets (Bernanke and Mishkin 1997). Observers often suggest that the capacity to keep the inflation rate within its assigned range (for instance, 0% to 2% in Europe) is as an indicator of the central bank's success.

In other words, the world has experienced a radical transformation in the definition of monetary targets between the two eras: External targets have given way to domestic ones. We intend to explain this transformation by taking a careful look at the emergence of institutions aimed at monitoring the quality and performance of monetary policy making. Toward this end, the remainder of the paper is organized as follows. Section 1 reviews conventional views on the history of monetary policy, and Section 2 provides a discussion of the epoch making bullion controversy of the early 18th century. Section 3 shows how concerns about discretionary actions led to the emergence of convertibility rules. Section 4 follows suit, showing how subsequent problems that emerged from the insufficiencies of the convertibility target led to the gradual takeover of monetary policy by more or less automatic rules. Finally, section 5 suggest that these rules backfired in the interwar years, leading to their eventual replacement by inflation targets, although the basic framework of assigning a target to an independent agency, has been kept essentially intact, or rather merely reinvented in the recent past.

1 MONETARY MANAGEMENT IN THE 19TH CENTURY: A NO BRAINER?

The conventional view is that monetary management is a recent thing, dating back to the interwar period at the earliest. Economists generally believe that in the 19th century the existence of strict monetary rules ensured that little leeway was left to monetary policy. Central banks, the conventional wisdom goes, did not develop their operating procedures by focusing on the formulation of monetary policy but instead gained their legitimacy by acting as lenders of last resort in the midst of financial crises. It is much later (following the massive deflation of the Great Depression) that central banks began conducting modern monetary management.

Thus the progenitors of modern monetary policy were keynesians and monetarists, who disagreed on the role of monetary policy yet agreed on the existence and relevance of monetary policy making. Keynesians recognized what monetary policy could do; monetarists emphasized what it could not. The reign of keynesianism was undisputed until it began to give way under the blows of monetarist critique and a rampant stagflation. During the 1970s, modern theory identified a contradiction between a central bank's capacity to boost the economy temporarily and its inability to achieve this on a permanent basis. This contradiction (known as the time inconsistency problem) arises because monetary policy can do something about output over the short run but nothing over the long run: the temptation to promote employment is irresistible but dangerous, for intelligent agents will simply adjust the price- and wage-setting process and so the economy ends up with higher inflation. This eventually wipes out the central bank's ability to achieve anything useful and leaves the economy worse off (Kydland and Prescott 1977; Barro and Gordon 1983). One solution is to have an independent central bank that is run by a conservative central banker (Rogoff 1985; Cukierman 1995). This reasoning paved the way for the two institutional revolutions that occurred in the 1980s and 1990s, whereby independent central bankers were entrusted with an explicit mandate of price stability known as "inflation targeting".

The period before the advent of the keynesian revolution is usually portrayed as one where monetary policy making did not have the scope it has today. Authors recognize that there were anticipations of modern debates but argue that they were confined to the abstract domain of ideas (Rist 1938; Schumpeter 1954; Laidler 1991). The fact is that, in general, countries sought to peg their currency to the price of some precious metal: Initially gold, silver, or a mix of the two called bimetallism (Flandreau 2003). Toward the end of the 19th century, gold became the only reference. This transformation placed a large fraction of the world on a common footing (Eichengreen and Flandreau 1997).

In practice, pegging to gold or silver was achieved through the agency of an institution known as *convertibility*: holders of banknotes could exchange them at the bullion window of the central bank against gold or silver coins and vice versa. But some countries whose finances were poorly run resorted to the seigniorage tax. Their inexhaustible thirst for funds, they drained the resources of the central banks, which eventually found themselves unable to maintain convertibility. Excessive paper issues to finance government expenditure inevitably led to runs on the bullion reserves of the central bank (Lévy 1911). As a result, sustained convertibility has come to be associated, in modern accounts, with sound monetary policy practice (see Bordo and Rockoff 1996).

The practical implications of convertibility are far reaching. Once in place, convertibility becomes a de facto monetary target, akin to a fixed exchange rate defended by foreign exchange intervention. The only difference is that, instead of buying and selling foreign exchange reserves against its own currency in the international foreign exchange market, the central bank buys and sells gold or silver coins against its own notes in the domestic bullion market. But the discipline it induces is essentially the same: in practice, the central bank must adjust the money supply to the imperative of convertibility. Using the price of bullion as a nominal anchor in turn renders the money supply and the general price level endogenous (Bordo et al. 2004). This explains the conventional view that pre-modern monetary policy making was essentially passive, being entirely subjected to the imperatives of convertibility.

This finding is related to an old-fashioned interpretation of the pre-1914 international gold standard that is surprisingly still popular despite it having been proven wrong long ago. This view argues that monetary policy was dictated by unwritten “rules of the game”. Supposedly, these rules specified that central banks facilitated the adjustment process by passing on or even amplifying (as opposed to sterilizing) the effect of losses or gains of gold reserves. Gold losses led to more than proportional monetary contraction by central bank ensuring a swift adjustment of the international economy to the new condition while gold gains led to more than proportional monetary expansion. This view explains that the gold standard collapsed between the wars after operating smoothly during the pre-1914 period by the fact that central banks obeyed the rules in the pre-WWI period but not thereafter. Yet Bloomfield (1959) demonstrated conclusively that such was not the case at all: in the pre-1914 period central banks sterilized much of the variation in their gold reserves.

Studies by Tullio and Wolters (2003a,b,c, 2004) identify the determinants of central bank discount rate changes relying on a homogenous German source that documents domestic and international variables at the date when central bank rate changes occurred. The countries considered are England, Germany, France,

Table 1 Central Banks Reaction Functions: Determinants of interest rate changes in four institutions (1876-1913)

Explanatory variables	Reichsbank	Banque de France	Öster.-Ung. Bank	Bank of England
Variations of notes cover	-0.035 (13.0)	-0.060 (6.6)	-0.049 (5.5)	-0.039 (16.3)
Var. of Reichsbank rate	--	--	0.129 (1.9)	0.172 (3.4)
Var. of BoF rate	--	--	--	0.270 (1.9)
Var. of Ö-UB rate		-0.469 (2.8)	--	
Var. of BoE rate	0.085 (1.8)	0.152 (2.8)	--	--
Exch.-rate depreciation with respect to parity	0.704 (4.6)	1.153 (6.2)	--	--
Constant	0.039 (1.0)	-0.150 (3.0)	0.028 (0.5)	0.086 (2.7)
Adj-R2	0.696	0.886	0.667	0.626
DW	2.35	1.80	2.44	1.82
Nobs.	136	35	50	221

Source: Tullio and Wolters (2003a,b,c, 2004).
Note: The nonsignificant effects of other central banks interest rate changes are omitted by the authors and cannot be reported here.

and Austria-Hungary for 1876-1913. They find that variation of central bank reserves and the interest rates of the most important foreign central banks (in particular, the Bank of England) were important drivers of actual decisions in monetary policy, explaining much of their variance.

In particular, the large and significant effects of variations of notes' cover on interest-rate changes reported in the first line of Table 1 suggests that one important motivation behind the central banks' policy action was the concern over convertibility. Although Banks were prepared to go to some length to avoid adjustments that might be painful for the economy, they surrendered to a decline of their cover ratio. This result is also supported by the significance of exchange rate variations. For example, a loss of reserves when the exchange rate was strong was not always met by interest rate increases since this signaled not an external drain, but rather an internal one, with specie more likely to eventually flow back toward the bank's coffers. Thus, the only rule that central banks recognized was a convertibility, or fixed, exchange-rate, rule.

The notion that monetary policy was a non (or a minor) issue, during the pre-modern period is further reinforced by the work of Goodhart (1988) who examines how private, profit making banks of issue transformed themselves into public institutions. He suggests that this was achieved during the 20th century. For the 19th century, he emphasizes the critical role of financial crises, information, and the need for a lender of last resort. According to Goodhart, central banks emerged when increasingly violent financial crises created the need for the emergency provision of liquidity. Institutions that had access to privileged information owing to their peculiar position within the financial system found themselves providing lending of last resort. This could be facilitated by the availability of government support through the granting of legal tender status for the notes of the bank of issue. Finally, a precondition for the transformation of central banks into their modern counterpart was that they move away from commercial banking and focus on their role as providers of liquidity, thereby neutralizing potential conflicts of interest between their mandate to serve the public and their essence to benefit shareholders. In the end, through an evolutionary process that saw the "public good" motive of financial stability taking precedence over the concern over private profits, modern central banks were born. More importantly, concerns over how should monetary policy be conducted played a minor role in this evolution:

"Until 1914 [monetary] management largely consisted of seeking to reconcile, as best as possible, the need to maintain the chosen metallic standard on the one hand with concern for the stability and well-being of the financial system, and beyond that of the economy more widely. Then, as various pressures of the twentieth century disrupted first the Gold Standard, and thereafter the Bretton Woods system of pegged exchange rates, the macro-economic objectives of monetary management were altered and adjusted. *Yet at all times, concern for the health of the financial system has remained paramount*" (our italics, Goodhart 1988, p. 5-6)

In this perspective, concerns over financial stability give continuity to the history of central banks.[2] But that does not explain why convertibility (as opposed to any other nominal anchor) emerged as a "first best" monetary policy rule with inconvertible paper currency a "second best". Nor does it tell why this has changed nowadays. Some authors have hypothesized that there was something special about gold adherence in that it may have conferred credibility benefits to those who used it as a monetary target (Bordo and Rockoff 1995). But empirical evidence suggests that the gold-standard convertibility rule did not improve significantly borrowing terms once other factors are controlled for (Flandreau and Zumer 2004). Finally, case studies show that some countries, such as Chile, performed extremely well in terms of growth and yet never adopted a gold anchor (Briones 2004). There is therefore nothing obvious in the reasons why, before the mid-20th century, central banks generally adopted the price of bullion as a target for the value of their notes and effective monetary policy rule.

2 MONITORING, TARGETS AND THE GOLD STANDARD, 1797-1821

2.1 THE "RESTRICTION PERIOD" AS A COUNTERFACTUAL

To understand why convertibility rules came to predominate, it is useful to think of plausible counterfactuals. The question we ask is the following: had specie convertibility not been adopted, what would have taken place? This leads us to examine how monetary targets are defined and implemented, and how the problem of definition and implementation makes a decisive contribution to the choice of what target is used.

So powerful is the reference to specie convertibility in the context of the 19th century that it seems difficult to imagine a world without it. This paper to deal with this by focusing on one episode in monetary history when an alternative to the specie convertibility rule was seriously considered in a leading country. This was the era of inconvertibility of the pound between 1797 (when the Bank of England was granted by parliament the right to suspend specie payments) and 1821 (when convertibility was resumed), known as the "Restriction period".

Modern students of the gold standard portray the episode as a parenthesis (Bordo and Schwartz 1984). But a quarter of a century is not an interregnum. During those years, people borrowed, reimbursed, purchased, sold, wrote contracts, financial markets expanded, and Britain was engaged in a major economic transformation, known as the Industrial Revolution, that saw its

2 It is beyond question that financial stability has been a chief concern among policy makers and designers of central banks statutes. Note however that Goodhart's account relies heavily on case studies laid out for the US Congress' National Monetary Commission of 1908. The commission had been set up following the financial crisis of 1907. Its mandate was to examine whether a central bank would be able to reduce the occurrence or severity of financial crises, and it led to the creation of the Federal Reserve System in 1913 (Timberlake 1993). It had no instruction to examine in details how monetary policy should be conducted in normal times. It is natural therefore that material from the National Monetary Commission displays an exclusive focus on financial stability and downplays the concerns about how to conduct monetary policy.

economic leadership durably established. Moreover, there were senior authorities and member of parliament who recommended that this regime should go on indefinitely. As argued by Fetter (1965), the episode and the controversy were critical for the making of "19th century monetary orthodoxy", i.e. the adoption of convertibility targets.[3]

One important aspect of the episode is that it had not been motivated by a credibility problem. The directors of the bank secured it as a preemptive measure in a period of military conflict with France. As emphasized by economist David Ricardo (although a fierce critic of the policies of the Bank of England), the monetary vicissitudes of the period did not derive from a "want of confidence in the Bank of England, or any doubts of their ability to fulfill their engagements" (Ricardo, 1810, Introduction). For the first time in modern history, a developed nation – the *most* developed one – experienced the effects of inconvertibility without this being associated with a major credibility crisis, such as when John Law infamously inflated away France's public debt (Faure 1977).

And thus it was that people debated the merits of the new regime. Some, such as the directors of the Bank of England supported the continuation of inconvertibility, and others such as Ricardo called for a swift resumption of specie payments. In 1809, as the pound sterling experienced a serious bout of depreciation, a parliamentary committee was set up. The committee comprised influential figures of the City such as Alexander Baring or Henry Thornton, author of a pamphlet on the effects of inconvertible paper currency (Thornton 1802). After extensive interviews with merchants, bankers, economists, and policy makers, the committee produced the celebrated *Bullion Report* (Parliamentary Papers, 1810). The *Report* recommended a gradual return to specie convertibility.

Yet, even after the *Report* was published, there was much delay in actual implementation. Parliament postponed publication of the report and the eventual vote rejected return to convertibility with a clear majority. Despite infuriated diatribes, a parliamentary decision was postponed until 1818. Convertibility itself had to wait until 1821. Thus the period of Restriction forced economists and authorities to confront the possibility of embracing a truly different monetary framework. It is therefore an excellent inspiration point from which to study policy making at the crossroads.

3 "In 1797 there was in England no generally accepted theory of a monetary and banking system. There were only laws and institutions, inadequate and in some cases inconsistent. The two decades before 1797, despite the economic growth of the country and the expansion of banking, had been almost devoid of any fundamental analysis of the monetary standard, of banking theory, or of the position of the Bank of England. The suspension of specie payments by the Bank of England on February 27, 1797, and similar action by the Bank of Ireland a few days later, precipitated a controversy that continued for over three quarters if a century. Out of this controversy developed most of the principles of monetary and banking orthodoxy, not only of England, but of virtually the entire Western world in the forty years before 1914". (Fetter 1965: 1).

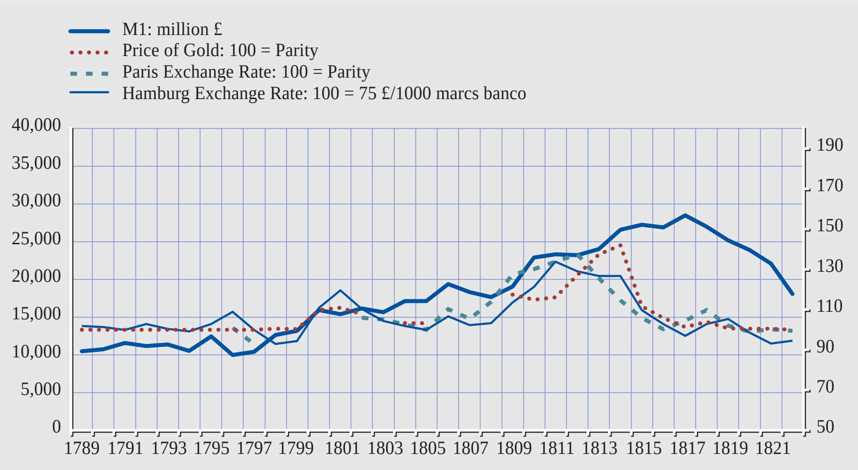
2.2 TOLERABLY ACCURATE CRITERIA

The controversy surrounding the restriction is widely credited as epoch making (Schumpeter 1954). Historians of economic thought usually interpret it as an intellectual fight between the real bills doctrine according to which the money supply does not drive prices because money is created passively as a counterpart to "real" credit (a view held by the bank's directors) and the quantity theory according to which monetary creation is inflationary (a view held by Ricardo and Thornton, and endorsed by the *Bullion Report* – hereafter "BR") (see Fetter 1965). In what follows we focus instead on the institutional aspects of that debate.

The controversy revolved on the effects of the restriction. People concurred that suspension of specie payment since 1797 had "enabled the conductors of [the Bank of England] to increase or decrease at pleasure the quantity and amount of their notes" (Ricardo, 1810), and available economic elements suggested that the restriction had increased rather than decreased the money supply. The next question was to determine whether the bank circulated the "right" amount of money, or whether the suspension had led to "over issues".

Chart 1 documents the information available to contemporaries.[4] As can be seen, they noted a continuous increase of the circulation of notes issued by the Bank of England. This had actually begun before the restriction but it accelerated markedly afterwards. A peak was reached when the debate erupted in 1809. Contemporaries also observed that the price of gold was going up and that foreign currencies were appreciating against sterling. After holding up well the

Chart 1 Economic elements of the bullion controversy



Sources: Exchange rates, price of gold: Lloyd's list; M1 is proxied with note circulation: Clapham 1944.

4 We take this series from Clapham (1944). Compare with *Bullion Report* and Ricardo (1810) for public information on these matters. A related series, known to the public, is the average amount of commercial bills under discount reproduced in Cannan (1919).

pound was now diving. This raised the possibility that the conductors of the bank had misused their new monetary prerogatives.

The directors of the bank insisted they were not "over-issuing". They challenged the notion that an increase in the supply of banknotes would depreciate them, arguing that they "could not see how the amount of Bank notes issued can operate upon the price of Bullion, or the state of the Exchanges" (BR: 34). On the empirical side, they emphasized that the course of the exchange and the amount of paper circulation "frequently have no connection" (BR: 33), a claim that was not unfounded empirically. On the theoretical side, they argued that they could never "over-issue" because they would "never force a Note in circulation" (BR: 47) and because they would only discount "legitimate mercantile paper" (BR: 47). On the practical side they claimed that, since they would never discount the bills of speculators concerned with shipping gold abroad, their monetary policy could not have any effect upon the exchanges (BR p. 32).

Ricardo (1810) and the authors of the *Bullion Report* disagreed. Building on the insights of the monetary approach to the balance of payments as developed by Hume (1752) that was then part of the conventional wisdom, they provided explicit predictions of what should be expected, ceteris paribus, from an increase in paper money in an inconvertible regime.[5] Their conclusion was that "a general rise of all prices, a rise in the market price of gold, and a fall of the foreign exchanges, will be the effect of an excessive quantity of circulating medium in a country which has adopted a currency … not convertible at will into a Coin which is exportable" (BR: 17). Because there was no consensus at the time on how to construct a price index, and because examining prices one after the other would prove tedious, the value of the pound in terms of other currencies was taken by the authors to be a "tolerably accurate criterion by which we may judge of the debasement of the currency proceeding from […] a depreciated paper-money" (Ricardo 1810: 12). In their hands, the evidence of a depreciated exchange rate and high price of gold became the basis of "two unerring tests" designed to reject the Bank of England's hypothesis that its paper issues had no effect on the value of the notes (Ricardo 1810: 13). Over-issuing notes implied depreciating the exchange rate or raising the gold premium – and such was precisely what had happened. In the more prudent language of the *Bullion Report*:

"Although, as Your Committee has already had the occasion to observe, no certain conclusion can be drawn from the numerical amount of paper in circulation, considered abstractly from all other circumstances, either as to such paper being in excess, or still less as to the proportion of such excess, yet they must remark, that the fact of any very great and rapid increase in that amount, when coupled and attended with all the indications of a depreciated circulation,

5 This suggests that Fetter exaggerated in arguing that there was no monetary doctrine available in 1797. As is obvious from both the *Bullion Report* and Ricardo (1810) both claiming to proceed from first principles, there was indeed an analytical doctrine which to fall upon.

does afford the strongest confirmatory evidence, that, from the want of some adequate check, the issues of such paper have not been restrained within their proper limits." (BR: 64).

2.3 THE PROBLEM OF DISCRETIONARY POLICY

Because the pound had depreciated one could not reject that there might have been over-issues. Consequently, one had to reject the view that the amount of notes provided by the Bank of England was always in proportion with the needs of the economy, as the directors maintained. However, there is a long way to go between this finding and the recommendation to return to gold convertibility. Strict monetarism does not mean a fixed exchange rate, but rather an explicit rule for monetary creation. But the *Report* explicitly objected to such rules and in several parts, which Fetter argues had been inspired by Henry Thornton, we even find anticipations of the benefits of active monetary management. For instance there were references to the problem of downward wage rigidity (BR: 7), and consequently, a discussion of the costs of deflationary adjustments that may result from monetary contraction (BR: 67-8). This seems to have led the *Report* to recommend a gradual return to convertibility, with advance warning to the market so that prices could adjust more swiftly (BR: 68).[6] In such a background, an inconvertible currency might have provided a more adequate framework.

Therefore, the reasons why the *Bullion Report* recommended a return to convertibility should not be confused with the monetarist arguments the *Report* contains. This paper claims that the reasons for recommending convertibility concern institutional issues pertaining to mechanism design. In several parts, the *Report* expresses reservations toward discretionary monetary policy. There was no rigorous, consensual, quantitative evidence that would relate prices and quantities and serve to measure the extent of the "excess issue". The alternative was to trust individuals. However, the authors of the *Report* were skeptical about the human ability to conduct discretionary monetary policy. Rules were better than discretion:

"The suspension of Cash payments has had the effect of committing into the hands of the Directors of the Bank of England, to be exercised by their sole discretion, the important charge of supplying the Country with that quantity of circulating medium which is exactly proportioned to the wants and occasions of the Public. *In the judgment of the Committee, that is a trust, which it is unreasonable to expect that the Directors of the Bank of England should ever be able to discharge. The most detailed knowledge of the actual trade of the Country, combined with the profound science in all the principles of Money and Circulation, would not enable every man or set of men to adjust, and keep always adjusted the right proportion of circulating medium in a country to the wants of trade*." (BR: 52, emphasis added)

6 Thornton (1802) is credited for having pioneered a statement of the short run expansionary effects of monetary policy, as well as a discussion of its long-run limitations.

The main advantage of the gold-standard rule, following this line of reasoning, was its legibility for a polity concerned with monitoring the actions of the bank. Convertibility was a completely transparent principle whose maintenance could be tested at any time by looking at the price of gold in newspapers.[7] In that respect, the convertibility advocated by the *Report* can be thought of as a second best arrangement. Other arrangements could certainly exist and could in time be even superior. But none was as simple and verifiable as the commitment to pay gold for the notes.

Thus, the real concern of the members of the bullion committee had been finding the official doctrine of the bank to be at odds with facts and its directors adamant in their insistence that they should be trusted. This was a much more serious problem than the depreciation of the pound sterling. Ships may travel North or South just as well, but their captains must be able to read a compass.[8] Hence, convertibility can be thought of as having truly solved a monitoring problem. The emergence of foreign exchange targets as a building block of "19th century monetary orthodoxy" resulted from governance problems. Apparently, the concerns of the policy makers of the 19th century were quite similar to those of their modern counterparts.

3 PRIVATE PROFIT, COLLECTIVE ENDS, AND POLICY RULES: WHAT DO CENTRAL BANKS MAXIMIZE?

3.1 INCONVERTIBILITY AND SHAREHOLDERS VALUE

Thus the bullionist controversy was really a debate on the institutional fabric of monetary policy. Consistently it raised the related problems of target selection and mechanism design. In modern macroeconomics, we derive monetary policy making from an optimization problem. Authorities set the inflation rate given preferences over price stability and output. The conflict between these two targets is at the origin of a suboptimal equilibrium, which is solved by the

7 In the words of Ricardo: "It will be a circumstance ever to be lamented, if this great country, having before its eyes the consequences of a forced paper circulation in America and France, should persevere in a system pregnant with so much disaster … The only legitimate security which the public can possess against the indiscretion of the Bank is to oblige them to pay their notes on demand in specie; and this can only be effected by diminishing the amount of bank-notes in circulation till the nominal price of gold be lowered to the mint price [thus adopt convertibility]."

8 When the directors of the bank declared that the monetary policy was guided by the solidity of the borrowers, so that they "could not materially err" and always provided the circulation with the right amount of banknotes, the committee confronted them with a thought experiment. The interest rate was 5% and they said they satisfied only legitimate needs. But, the Committee went on: "Is it your opinion that the same security would exist against any excess in the issues of the Bank, if the rate of the discount were reduced from £5 to £4 per cent ?" Answer. [by *Mr. Whitmore*]—"The security of an excess of issue would be, I conceive precisely the same." *Mr. Pearse*. – " I concur in that Answer." "If it were reduced to £3 per cent.?" – *Mr. Whitmore*, "I conceive there would be no difference, if our practice remained the same as now, of not forcing a note into circulation." *Mr. Pearse*. – "I concur in that Answer." (BR: 48)With these answers, the directors had unknowingly given the fort away, since they contained an implicit recognition that the directors' rule pointed to no single equilibrium. And the *Report* deemed the exchange a "very important part of the Evidence of these Gentlemen" (p. 48).

creation of a central bank with a mandate is to focus on inflation only. This outcome can be contracted out to an independent central banker whose compensation is a function of the success met (Walsh 1995a, 1995b, 2002).

In the late 18th century when there were "only laws and institutions" but no "generally accepted theory of monetary policy" (Fetter 1965) elements of private and public interests also intermingled. In the more advanced monetary systems of the time, such as those of Holland and Britain, a *private* central bank was in charge of fulfilling the *public* task of producing high-powered money (i.e. banknotes). This is critical element, for some contemporaries (such as David Ricardo) worried that the stock of the Bank of England had risen sharply following the restriction. Suspension of specie payment had put a private concern in the position to collect a revenue from paper issues and the price of its stock had reacted favorably: wasn't an abusive monopoly around the corner? Accusations were rampant and they prompted former governor of Whitmore and current vice governor Pearse to claim before the bullion committee that in setting the money supply they were "never induced, by a view to their own profit, to push their issues beyond what they deem consistent with the public interest" (BR, Minutes of evidence: 19).

To what extent did interactions between the suspension of convertibility and the private motive create pressures for excessive paper issues? This problem really has two facets, which must be dealt with separately. The first is straightforward: other things being equal, should a private central bank prefer convertibility of inconvertibility? The answer is obvious. Holding of specie reserves entails a deadweight loss. And inconvertibility enables one to reduce the cover ratio. To see this consider the case of a 100% cover ratio. The he asset side of the bank's balance sheet is entirely made of non-interest bearing gold, whose opportunity cost is equal to the revenue from lending. The bank borrows to buy a certain amount of gold and lends an equivalent amount of paper. On the other hand a 0% cover ratio maximizes profitability. This is because liabilities now comprise only non-interest bearing notes.

The implication is that the expansion of the *real* monetary base is wonderful news for shareholders in an inconvertible standard, leaves them unexcited in a one hundred percent cover system. Of course in the real world, things are and were slightly more complex. First, the Bank of England also took deposits, which were then lent out so that the profits from note issuing were combined with those of regular banking intermediation. Second, the bank did keep gold reserves during the inconvertibility period, and did not have a 100% cover system when convertibility was restored in 1821 but followed instead "Palmer's rule" according to which the ratio had to be of about one third.[9] However, since the expectation nonetheless is that less reserves will be needed under inconvertibility than under convertibility, one should expect the derivative of

9 The computations in Horsefield (1940) show bullion as a proportion of notes plus deposits at 20% in the 1800s and 10% between 1810 and 1815. For details on implicit cover rules during the restriction period see Horsefield (1940). For a discussion of Palmer's rule of 1832 prescribing a 1:3 cover ratio (between notes and bullion) and for the origins of the cover system prescribed in Peel's Act of 1844, see Horsefield (1944).

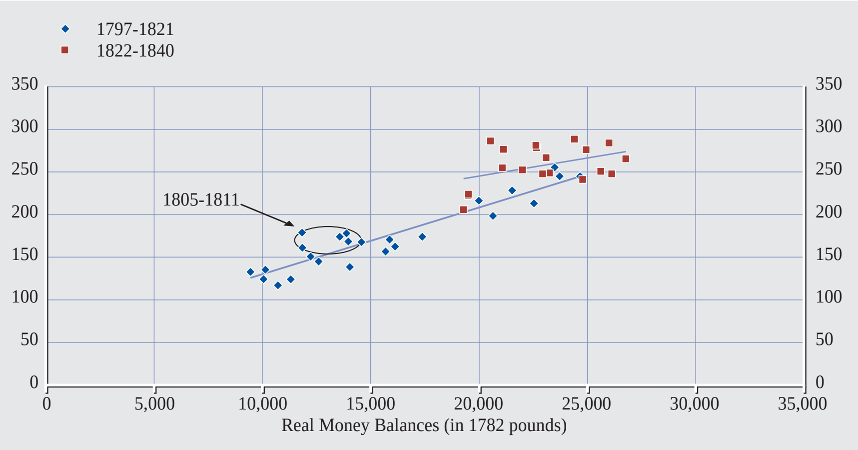
the price of the bank's stock with respect to an increase in real money balances to be greater in a regime of inconvertibility than in a convertible regime:[10]

$$\left.\frac{\partial P_{BoE}}{\partial (M/P)}\right|_{inconvertible} > \left.\frac{\partial P_{BoE}}{\partial (M/P)}\right|_{convertible} \qquad (1)$$

Chart 2 illustrates the relation between real money balances and the price of the Bank of England stock (measured in constant term) before and after the resumption of specie payments. As seen, it lends partial support to the view Equation (1) since the slope of the relation between real money balances and the price of the bank's stock shifts donwards. However, it does appear that the expected profitability of the bank (as reflected by the valuation of its stock) was not dramatically altered by the return to convertibility, suggesting that it may have been discounted, given the extensive debates that preceded it.

In any case, we can safely conclude that when the currency is nonconvertible and the central bank is privately owned, the shareholders of the bank and the economy at large have aligned interests: economic growth increases the demand for real money balances, which drives up the profits of the central bank. The *Bullion Report* recognized the situation. It emphasized that that it was "natural for the Bank Directors to believe, that nothing but benefit could accrue to the public at large [from the inconvertibility of the pound], *while they saw the*

Chart 2 Real Money Balances and the Bank of England Stock



Sources: Bank stock: Vitu (1867); Banknotes: Clapham (1944).

10 Note that the Bank was reluctant to be transparent on its bullion reserve. However, as described in Klein (2005) the reserve was communicated as an index from 1797 onwards and the relation between the index and absolute values was soon leaked. Moreover, the directors of the Bank knew the true figures from the start and were also who were also shareholders so that stock prices must have reflected their private information. They could obviously be inferred from available information: Horsefield (1940) reports evidence that investors inferred the actual cover ratio from knowledge of gross dividends and an assumption about returns.

growth of Bank profits go hand in hand with the accommodations granted to the Merchants" (Bullion Report, emphasis added). This explains why the Bank of England was a supporter of inconvertibility. Intriguingly, privately owned central banks must not have like the gold standard. This is interesting, especially since political scientists and historians often claim that the gold standard epitomized the age of laissez faire (see e.g. Gallarotti 1995). Had private interests got it the way they wanted, they would have rather floated.

3.2 PROFIT MOTIVES AND MONETARY RULES

The second matter that deserves to be examined is whether, as some feared, a private central bank seeking to maximize profits would adopt an inflationary stance. Ricardo was the first to articulate this concern that a central bank that would not follow convertibility rules would essentially behave like a seigniorage revenue maximizing government (Ricardo 1810). Yet a question is open as to whether the objective function of a private central bank and that of a seignorage collecting, money printing government are similar. We argue they're not. An early discussion of this matter can be found in Santoni (1984) who claims that the first order conditions for the private central bank and the government monopoly are not the same.

While the appendix derives steady state solutions, we discuss here the rationale underlying this result. In a continuous time framework, the key difference between the two entities is that the revenue function for the government is given by the real value of instantaneous monetary creation, while for the private central bank (assuming for simplicity a 0% cover ratio) it is the purchasing power (real value) of the interest earned on instantaneous lending against banknotes (i.e. zero cost resources). So the point is not that the zero cover central bank and the government have different budget constraints (both print free money), but that they have different objective functions. In effect, the bank gains from real lending, and real lending is maximized when the demand for money balances is maximized. This is in contrast with the government, who gains from forcing its notes into the circulation.

An interesting result that outlines the intuition concerns what happens when the elasticity of the demand for real money balances is large. In such a case, the seigniorage extraction capacity of the government is severely restricted. At the limit it cannot collect any real resources. However, as shown in the appendix, the private central bank reacts differently. Its best steady state policy converges towards Friedman's inflation rule, according to which the inflation rate is set equal to minus the real interest rate so that agents suffer no cost from holding non-interest bearing money. This result is normally derived by assuming a benevolent central planner in charge of setting the money growth rate (see Woodford (1990) for a comprehensive discussion). It arises naturally in a profit maximizing framework because a private central bank is concerned with minimizing the opportunity cost of holding money because this ensures that real money balances are maximized: The interests of a profit maximizing central banker issuing fiat currency and those of the public at large are in this case aligned with one another.

This result seems ironic. The bullionist controversy is conventionally remembered as having pitted the forerunners of monetarism (Ricardo and the authors of the *Bullion Report*) against supporters of the real bills doctrine (the directors of the Bank of England, among others) the former warning against the inflationary bias that may have arisen from a bank abiding exclusively by the profit motive. The analysis developed here shows that from a strictly monetarist point of view, it is not at all clear why profit maximization should have led to excessive inflation. In fact if agents are sufficiently averse to inflation then the profit seeking central bank will implement Friedman's rule. Consequently, inconvertibility per se cannot be seen to entail an inflationary bias.

The analysis is result is robust to a number of variants. Consider for instance the situation of classic Keynesian unemployment, where monetary expansion can promote output. Then a profit-maximizing central banker has an incentive to be accommodating as long as the expansion is non-inflationary. This is because, by propelling production, the banker can push the economy towards an equilibrium where output is bigger and thus the demand for real money balances is larger, which increases banker profits. Beyond this point however, money creation becomes inflationary and fails to boost output, thus reducing real profits. The banker will thus be induced to create money exactly up to the point where inflationary pressures set in.[11] Another way to look at the same thing is to focus on the effects of inflation surprises, once an economy is in equilibrium.[12] They give a transitory boost to output leading to one-off real output gains. But these gains are offset by real losses suffered through the depreciation of the bank's assets, since the bank is a creditor. There are also the long run costs associated with loss of credibility and higher nominal interest rate (expected inflation) in the future, leading to reduced real money holdings. Finally, because the bank is a chartered monopoly, it must take into account the risk of losing its privilege in the future because of inadequate monetary policy.

11 This situation was explicitly discussed by Thornton (1802).

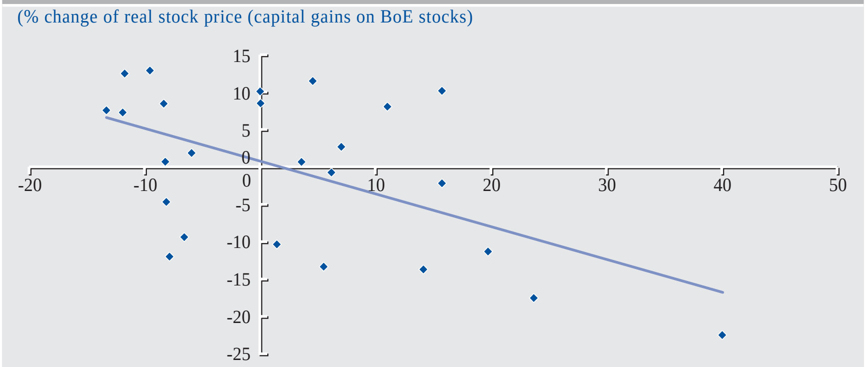
12 On inflation surprises and their effects, vide Ricardo (1810): "It is no dispute, that if the Bank were to bring a large additional sum of notes into the market, and offer them on loan, but that they would for a time affect the rate of interest. The same effects would follow from the discovery of a hidden treasure of gold and silver coin. If the amount were large, the Bank, or the owner of the Treasure, might not be able to lend the notes or the money at four, nor perhaps three per cent.; but having done so, neither the notes, nor the money, would be retained unemployed by the borrowers; they would be sent into every market, and would everywhere raise the price of commodities, till they were absorbed in the general circulation. It is only during the interval of the issues of the Bank, and their effect on prices, that we should be sensible of an abundance of money, interest would, during that interval, be under its natural level; but as soon as the additional sum of notes or of became absorbed in the general circulation, the rate of interest would be as high, and new loans would be demanded with as much eagerness as before the additional issues … To suppose than any increased issues of the Bank can have the effects of permanently lowering the rate of interest, and satisfying the demands of all borrowers, so that there will be none to apply for new loans, or that a productive gold or silver mine can have such an effect, is to attribute a power to the circulating medium which it can never possess. Banks would, if this were possible, become powerful engines indeed. […] No nation, but by similar means, could enter into competition with us, we should engross the trade of the world. To what absurdities would not such a theory lead us!"

This last channel may on the other hand provide a rationale for the concerns that contemporaries had regarding the behavior of the bank. As remarked by Ricardo, a portion of the circulation of the bank was used to finance government debt. If the government were able to force-feed the bank so that this fraction would rise, the bank might in effect become a printing machine in the hands of the Treasury. However, on this matter, the parliament, not the government, would have the final word. And this explains why the parliament became the natural home of the bullion debate.

The precise effect of these various factors on the conduct of monetary policy will depend on several variables and parameters and this is no place to develop all alternatives. But the basic element is that we cannot see why a profit-maximizing central bank should always over-issue. If, as monetarists believe, central banks have no influence over the long run on real values, and if a private central bank issuing an inconvertible currency maximizes its profit by ensuring that it produces a high quality instrument, thus maximizing demand, there is in effect little scope for permanent expansion. Thus, while the directors of the Bank may have erred in motivating their policies by reference to the real bills doctrine, their overarching concern with profits and retaining their charter must have acted as a powerful break on inflation. On this account we may remark that, after 1810, prices stopped rising and actually began a steady decline (Chart 1). Yet nothing had changed within the formal framework in which the Bank of England conducted policy.

To conclude, Chart 3 provides a test of the views developed here by examining whether shareholders of the Bank reacted favorably to inflation. Chart 3 gives empirical evidence that during the restriction period, the association between inflation and changes in bank stock prices was negative. Had the directors "over-expanded", the shareholders would have complained. That they did not complain suggests that over-expansion was not there. A consequence of this perhaps, was the directors' claim that they were "never induced, by a view to their own profit, to push their issues beyond what they deem consistent with the

Chart 3 Is inflation good for shareholders?



Source: Same as Chart 2, author's computations.

public interest". This could be the rationale behind the real bills doctrine – that the interests of a profit maximizing monopolistic bank of issue are aligned with those of the economy at large, as the bullion report itself had recognized, so that there may not be reasons to worry.[13]

3.3 CONVERTIBILITY AS THE INVISIBLE HAND OF MONETARY POLICY

Thus was the dilemma: On the one hand, British policy makers were uneasy with the assumption that maximization of shareholder value would always and everywhere generate good monetary policy decisions, for this was expecting a lot from a special interest. At the very least, they felt there was something unseemly in the private appropriation of the profits from circulating inconvertible notes. Ricardo (1819) claimed that the public was not getting a fair deal and made suggestions to share in the profits. In a tract published posthumously Ricardo (1824) explained that he wanted the Bank of England to be split in two parts, a government run currency board, and a privately owned commercial bank without a note issue privilege. A similar, though less extreme view was spelt out in the *Bullion Report* recommending that, if Parliament were not to decide a return to convertibility, then "some mode ought to be devised of enabling the State to participate much more largely in the profits accruing from the present system [of inconvertibility]".[14]

On the other hand, if this logic were pushed to its conclusion, and a rule were designed to share the profits between the bank and the state, there would be grounds for constant government interference in the conduct of monetary policy. And the authors of the Report hastened to state that the nationalization of profits was "by no means the policy they wish to recommend" (p. 65) adding a few pages later that the "compulsory limitation […] of the rate of the Bank profits and dividends by carrying the surplus of profits above that rate to the public account […] would be objectionable as a most hurtful and *improper interference with the rights of commercial property*" (BR: 68: emphasis added).

Thus the Smithian distrust of a merchant's ability to act willingly in the interest of the community at large was echoed by the equally Smithian pessimism regarding a government's ability to set adequate targets. The emergence of convertibility rules came to the rescue and helped solving the institutional conundrum. As long as there is convertibility, a privately owned bank is under a set of constraints that induce it to behave in the interest of the community at large even while pursuing its own interest. To see why, suppose it does over-issue. Then this is bound to lead to an increase in domestic prices. The resulting loss of competitiveness causes a trade deficit, which will manifest itself in a

13 "And it was very natural for [the Bank Directors] to pursue as before […] the same liberal and prudent system of commercial advances from which the prosperity of their own establishment had resulted, as well as in a great degree the commercial prosperity of the whole country" (BR, p. 49).

14 "If Your Committee could be of opinion that the wisdom of Parliament would not be directed to apply a proper remedy to a state of things so unnatural and teeming, if not corrected in time, with ultimate consequences so prejudicial to the public welfare; they would not hesitate to declare an opinion, that some mode ought to be devised of enabling the State to participate much more largely in the profits accruing from the present system". (BR, p. 65)

drain of the bullion reserve. This threatens the solidity of the bank, which consequently adjusts the circulation of notes (money supply) in order to defend its own credit. In the end, the bank creates exactly the "right" amount of money, and convertibility emerges as the invisible hand of monetary policy. As argued in the *Bullion Report*:

"So long as the paper of the Bank was convertible into specie at the will of the holder, it was enough, both for the safety of the Bank and for the public interest in what regarded its circulating medium, that the Directors attended only to the character and quality of the bills discounted as real ones and payable at fixed and short periods. They could not much exceed the proper bounds in respect of the quantity and amounts of Bills discounted, so as thereby to produce an excess of their paper in circulation, without quickly finding that the surplus returned upon to themselves in demand for specie. *The private interest of the Bank to guard themselves against a demand of that nature, was a sufficient protection for the public against any such excess of Bank paper*, as would occasion a material fall in the relative value of the circulating medium" (BR: 48-9, emphasis added).

This conclusion is important. As already indicated, previous students of the history of central banks have emphasized the role of financial crises and the need for a separation between commercial lending and lending of last resort in effect between private profit and collective ends as a preliminary stage in their evolution, which took place in the 20th century (Goodhart 1988). This paper's exploration of the making of convertibility rules in the early 19th century suggests a different chronology and a different focus. The need to address the conflict of interest between the private profit of the central bank and the general welfare of the economy manifested itself quite early, and was chiefly concerned with monetary policy, not crisis management.

4 MONEY AND CRISES

But convertibility did not fix everything. First, it implied that under some plausible circumstances such as a reduced production of bullion or a collapse of international monetary cooperation, the "right" amount of money would mean deflation. Combined with downward wage rigidity, this could turn out to be costly (Bordo et al. 2004). The problem would manifest itself in the most disastrous way during the interwar period when the gold standard became the "millstone around the neck of national economies, helping them to sink" (Eichengreen and Temin 2000). But there were difficulties over shorter horizons as well, and the "blind faith in convertibility as a panacea" (Horsefield 1944: p. 112) soon proved to be a delusion.

4.1 MONETARY RULES AND ASSET PRICE BUBBLES

By reference to the "right" amount of paper issues, contemporaries referred to both quantitative and prudential norms. The right amount of money was one that would neither encourage a depreciation of the currency nor generate asset price bubbles. The one instrument could meet two targets, people believed, because they coincided. This view is evidenced by the recurrent insistence on the need to discount "real" bills only, by which it was understood bills issued as part of a genuine commercial transaction, as opposed to "speculative" operations. In this logic, the blame for the financial crisis of 1812-1814 was assigned to the excesses of paper money. The notion prevailed in some circles that a money supply subjected to the convertibility rule would render the currency more "elastic", a wording that meant essentially "automatic". Technically, it was thought that the bank's ability to set an adequate money supply would work through the banking system via the operation of the multiplier, ensuring that speculative manias would never be encouraged.

This was optimistic, as became evident in 1848. A few years after the aforementioned ideas crystallized in the Bank Act of 1844, a massive crisis took place that triggered a run on the reserves of the bank. Despite its quasi currency-board features (apart from a free circulation of £14 million notes had to be backed one-for-one by reserves), the bank was forced to seek the protection of inconvertibility from the government. Technically, banking failures resulting from commercial liquidations had led to a scramble for gold. Depositors of the bank joined with holders of banknotes to demand that their balances be paid in gold; since deposits were not part of the formula that tied note issues to gold reserves, the bank was caught wrong footed.

The episode forced everyone to recognize that the convertibility target was not a magic bullet ensuring that financial crises would be kept at bay.[15] It came to be understood that financial emergencies created a need for central bank discretionary action above and beyond the automatic stipulations of a convertible currency. But then again policy faced the same dilemma that had been at the heart of the bullionist controversy. Again, there could be conflicts of interest in the exercise of discretionary action, and boundaries had to be set that would ensure the political acceptability of emergency liquidity provisions.

In 1860, this became the center of a European wide debate when Juglar, a French economist, published a pioneering study of this problem (Juglar 1889). Juglar was interested in describing the features of what he called "periodical commercial crises", which he found to be recurrent, international, and always financial in nature. One of his major findings was the identification of early warning indicators in the behavior of macroeconomic banking series and in particular in the central bank balance sheet. Three phases, he argued, could be identified. During expansion, the first period, credit was easy and the central bank was happy to accommodate. However, as a result, bullion reserves were depleted to the point where the central bank became cautious in extending credit. But this was calling off the punch bowl when people were already drunk. Such bank

15 Clapham (1944) reported that the directors of the bank had themselves contributed to drafting the Act of 1844. This suggests that the bank understood before their opponents that the convertibility rule would not discourage crises and that it was better to comply to an automatic rule, which would bear the brunt of criticism in case of problem, than to adopt a discretionary policy and become the target of attacks. This strategy also protected the privilege and indeed, Fetter (1965) reported that the price of the bank stock rose when the Act was drafted.

actions only increased alarm, causing more agents to seek support from the bank and more to be turned down. The second phase – the crisis properly speaking – was in full swell by then. Then began liquidation, the third and last phase. Businesses went bankrupt. The demand for liquidity was raised because borrowers now needed more cash in hand to convince lenders of their creditworthiness. Then, as the economy languished and the velocity of money declined, the central bank began rebuilding its bullion reserve. A low point was reached and the cycle could start again.

Did the central bank have a responsibility in the process? Shouldn't it have acted earlier? Wasn't the strict implementation of the convertibility rule pro-cyclical and thus detrimental? Juglar's analysis raised questions that are surprisingly modern. In implying that, along the business cycle, there were other targets that the Bank might want to consider, he anticipated the modern debate on monetary policy and asset price bubbles (see e.g. Adalid and Detken 2007, Borio 2006 for recent discussions).

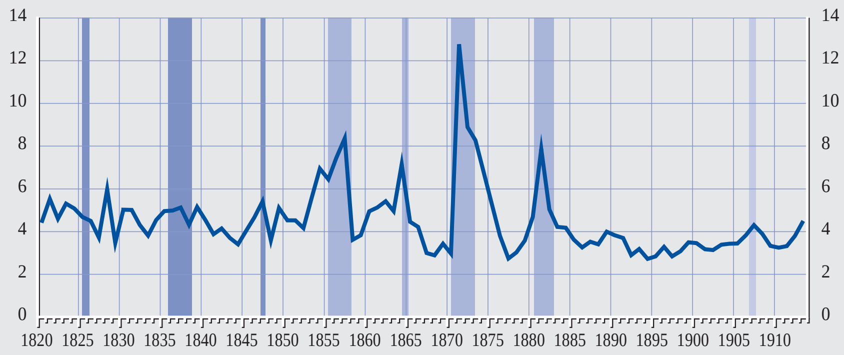
4.2 LIKE DOCTORS IN A PLAGUE: A CASE STUDY

In France, the controversy took the shape of a fierce policy debate on the consequences of discretionary interest-rate management by the Bank of France. The reason was that the bank had recently transformed itself into a genuine central bank. Following the Revolution of 1848, it had received the monopoly of issue over the entire country. Moreover, the suppression in 1857 of an usury law that set a ceiling on interest at 6% enabled the bank to manage the interest rate, especially in periods of crises. This permitted it to do away with older policies of credit rationing and to become a genuine lender of last resort for the economy at large. The extension of the powers of the Bank was politically contentious. The Bank was being criticized as being owned by a banking establishment that used it against new entrants. When Savoie was annexed to France in 1860, the Pereire brothers took advantage of the existence of a bank of issue to try and set up a competing bank. A major commission, reminiscent of the bullion committee, was created to discuss the conduct of monetary policy.[16] A recurrent theme was that the central bank was setting a policy that maximized its profits at the expense of the economy's welfare. The concern, consistent with the theoretical elements sketched previously was that the Bank of France was too restrictive. This feeling was motivated by the observation that it distributed record dividends in years of crises. As seen in Chart 4 there was a perfect overlap between years of crisis and years of high dividends, when the Bank of France was both a genuine central bank and also a private company too (1848-1897).

An outcome such as that shown in Chart 4 is perfectly normal. A crisis implies, following Bagehot's rule of lending of last resort, that the central banks discount record volumes (because there is a need for liquidity) at record rates (Bagehot's expression was "penal" interest rates): both prices and quantities are maximized, and so revenues peak while costs are essentially identical from one year to the next. From a political point of view, however, the matter is more complex, just

16 See Flandreau 2003.

Chart 4 The Bank of France dividend and financial crises



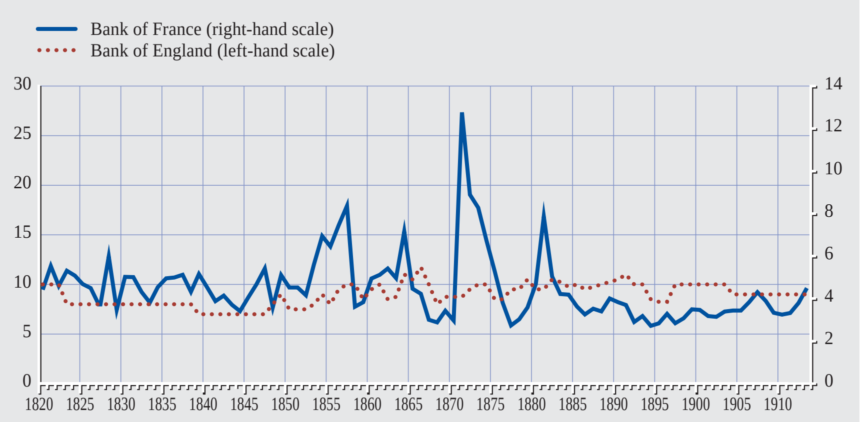
Source: Author's computations. Dividend calculated from data in Bouvier et al. (1965); chronology of crises from Juglar (1889).
Note: We added the crisis of 1907.

as the setting of monetary targets by a private company had been at the time of the bullion controversy. The bank, some observers remarked, was very much like a doctor who becomes rich in the midst of a plague. The situation opened the door to conspiracy theories. The bank, accused of fueling speculation in order to generate a profitable crisis, was caught in a quandary: It was blamed for what it was doing but would have been blamed just as well if it weren't. If it had instead sought to fine-tune the economy, tightening credit before "excessive expansion" occurred, it would have met just as much criticism.[17] Given the set of constraints under which the bank found itself, there was little it could do, but passively follow the cycle. Any deviation from this course – any attempt at active monetary management – would be criticized as self-serving.

With the same causes producing the same effects, the eventual solution to this dilemma was reminiscent of the *Bullion Report* recommendation that "some mode ought to be devised of enabling the State to participate much more largely in the profits" of the bank. In 1897, when the bank's charter was renewed after nationalization had been considered, several provisions ensured that a larger share of the bank's profits in emergencies would go to the state (Blancheton 2001). Any revenue arising from a discount rate above 5% could not be paid to the shareholders. It had to be distributed equally between the government and a special reserve.[18] The bank could no longer be blamed for raising interest rates to increase its profits; indeed, as seen in Chart 4, the crisis of 1907 had only a modest impact on dividends.

17 The Péreire brothers motivated their campaign against the bank by pre-keynesian calls for easy credit that would help mobilize unused capacities.
18 The extension of the privilege of the Bank of France in 1857 had specified (art. 8) that it would be enabled to increase its discount rate above 6%, but that profits above this level would be deducted from the amounts distributed annually to the shareholders and incorporated in a special account. The privilege of 1897 lowered the ceiling to 5%; this time, three fourths of the surplus was to be paid to the government (art. 12). Anonymous (1931:141).

Chart 5 Dividends paid by Bank of France and Bank of England



Sources: Clapham (1944); Bouvier et al. (1965)

Further evidence of the effect of regulation on dividends can be garnered by comparing the evolution of the dividend paid by the Bank of France to that paid by the Bank of England, where profits arising from suspending the Act of Peel were integrally paid to the government and where strict limits on the issue of notes ensured that credit expansion would immediately be checked (Lévy 1911: 288). Chart 5 shows that, during the period 1848-1897 the volatility of the Bank of France's dividend is substantially higher and the effect of crises quite considerable, although the effect of the crises of 1848, 1866, 1873, and 1890 (but not 1907) on the Bank of England's dividend are still visible on the chart.[19]

France's evolution wasn't isolated (Canovai 1911). Everywhere it was found necessary to separate policy making from the profit motive and toward the end of the 19th century, the charters of leading central banks were modified in a direction that effectively separated monetary policy decisions from profit motives.[20] This took a variety of regulatory forms with three main arrangements (not mutually exclusive) dominating.

One was the introduction of a curb on the dividend that was paid to shareholders. For instance the 1899 renewal of the charter of the Reichsbank substantially

19 Of note is that, prior to the Act of Peel, the Bank of England seems not to have taken advantage of crises to distribute higher dividends. This may have reflected the fierce controversy that was surrounding its role then, a controversy that perhaps led the bank to anticipate the effects of subsequent legislation (see Clapham 1944 on the climate surrounding the adoption of Peel's Act, and Horsefield 1944 on the bank's role in supporting it).

20 It is interesting that "elasticity" was the term used by Canovai (1911) to designate the property of the money supply that such institutional mechanisms were supposed to deliver. We measure the distance traveled since the early 19th century when elasticity was a property that stood at the antipode of discretion, a kind of miraculous effect of monetary policy rules that, if faithfully adhered to, would ensure that things would work smoothly.

reduced the part of profits that could be appropriated by shareholders, setting a de facto cap on dividends. This transformed the Reichsbank's stock into a kind of bond: a minimal return was easily achieved, thanks to the privilege of note issues, while it was quite implausible to go much beyond this level. Consequently, shareholders' votes no longer influenced profitability, although their role as an external supervisory body still had value for transparency and accountability. The Reichsbank, as result, was a quasi-state bank (Canovai 1911, Levy, 1911). A second type of regulation was the introduction of a ceiling on non-backed issues with a stipulation that issues beyond this threshold would be entirely transferred to the state (United Kingdom), or heavily taxed (Germany, Austria). This ensured that emergency liquidity provision would be mainly guided by considerations of financial stability. Finally, there were also explicit formulas, such as the one just described for the case of France, whereby profits were confiscated if they originated from high interest rates (France, Belgium). Table 2 summarizes the evidence, for a selection of European banks.

The precise effects of such a complex set of regulations on central bank incentives regarding policy making have never been studied and are still not

Table 2 Central Banks' Profits and Incentives After 1848: A Selection of Leading Institutions

	Reichsbank	Banque de France	Öster.-Ung. Bank	Bank of England	Banque de Belgique
Statutes	1875	1801	1816/1878	1696	1850
Rule	– Convertibility – Proportion – Contingent	– Convertibility – Ceiling on circulation	– Convertibility – Proportion – Contingent	– Convertibility – Million £14 unbacked circulation – Issues beyond this backed 1 for 1	– Convertibility – Ceiling on circulation
Excess or emergency issues	– Yes	– Yes	– Yes	– Yes	– Yes
Taxes on profits from emergency issues	– 5% of excess issues	– No	– 5% of excess issues	– Entirely taxed	– Partly taxed (after 1872)
Tax on profits	1875: dividend between 4.5% and 8%; beyond 8%, 3/4th go to Government 1890: dividend between 3.5% and 6%,; beyond 6%, 3/4th go to Government 1900: idem	1848: Tax on circulation (0.5%) 1878: Lower tax on unbacked circulation 1897: Tax equal to 1/8th of revenue from unbacked circulation	1878: dividend between 5% and 7%; beyond 7% profits shared with government.	– Fixed annual fee	1850: 1/6th of profits when dividend > 6% 1872: 1/4th of profits when dividend > 6% 1900: 1/4th profits when dividend > 4%
Tax on high discount rate	– No	– 1857: Tax on discount profits when interest beyond 6% – 1897: Tax on discount profits when interest beyond 5%	– No	– No	1872 : No discount profits when interest > 5% 1900: No discount profits when interest > 3.5%

Source: Constructed from information in Lévy (1911).

understood. They should be the topic of future research. The French example suggests that they may not always have created more room for cyclical management. The increased predation of central bank's profits by the government led the Bank to seek profits where they were less heavily taxed. The result was a massive increase of direct lending in regional centers where the Bank of France competed for primary customers against the local branches of leading commercial banks (Gonjo 2003). In so doing it moved away from rediscounting and liquidity provision, as a "bank of banks" is expected to behave, and "regressing" into straight credit to local customers. This evolution created pressures for minimizing the frequency and size of interest-rate changes because dealing with a local clientele implied developing stable relations. This pushed the Bank of France away from modern monetary management for "modern" monetary management became more costly. In effect, the bank adhered to a 3% interest-rate target. The connection between the removal of the profit motive and the emergence of modern monetary policy is loose and long.

4.3 WHY CENTRAL BANK INDEPENDENCE?

On the surface, this evolution runs counter another concomitant one. Between 1870 and 1914, leading economists (Conant 1895; Lévy 1911) achieved critical advances in central banking theory. Relying on extensive historical evidence on the effects of central bank independence on monetary performance and exchange rate-stability, they concluded in favor of a strict separation between monetary policy and government action (Flandreau et al. 1998).[21] On the practical side, the period saw numerous institutional changes aimed at reinforcing the operational independence of central banks. Lévy recommended the creation of a European central bank that would set monetary policy for a number of participating countries, and thus facilitate cooperation. He imagined it would de located in Switzerland so as to escape governmental and diplomatic pressure. Independence had come to be a central element of institutional orthodoxy (Flandreau et al. 1998), and would later become a building block of the reconstruction programs implemented under the auspices of the Geneva-based League of Nations (Flandreau 2003).

The two seemingly conflicting evolutions – of new regulations aimed at removing financial incentives from monetary policy management and of the consolidation of operational independence within those regulations – actually operated on different levels. Everything happened as if there were a gradual replacement of the profit motive by a set of publicly set targets. The reduced concern of shareholders over monetary policy as such (since the links between monetary policy decisions and dividends had been severed) created a policy vacuum, which called for more explicit prescriptions of monetary policy. On the other hand, this heightened the danger of government intervention in the actual conduct of monetary policy. With fewer interest in the behavior of the bank, shareholders may have failed to care about misbehavior. Consequently, it

21 Flandreau et al. (1998) provide evidence of a remarkably modern command of the time consistency problem as early as 1873 when French premier Adolphe Thiers resisted parliamentary pressures to nationalize the Bank of France in the aftermath of the Franco-Prussia war of 1870-1, arguing that the Bank could only help the government "if it were not a state bank".

was necessary to consolidate both the theory and practice of central bank independence. The combination of these forces ensured that central banks were left with essentially one concern – retaining their charters and the accruing benefits – and a simple target that was the sine qua non for the charter to be retained: specie convertibility. This transformed the central banks into servants of the convertibility rule.

5 TARGETS, MONETARY POLICY AND GLOBALIZATION

This paper has explored the foundations of monetary policy targets in the 19th century. The resulting *tour d'horizon* would not be complete however, if we did not explain how this better knowledge of an earlier regime sheds light on the current system. There are three interesting issues to discuss. The first issue is the question of understanding the relation between the monetary policy rules that emerged from the late 19th century and the collapse of globalization that occurred in the 1930s. The second issue is the question of understanding the differences and resemblances between 19th century monetary policy rules and the modern rules that re-emerged in the past quarter of a century. The third issue is to speculate on the challenges that modern rules are likely to meet. Given space constraints, our discussion remains tentative, and yet a few salient points emerge.

Our study of the making of convertibility rules and of the gradual separation, on the eve of the 20th century, between monetary policy decisions and the profit motive may explain why historians of the 19th century are always struck to discover the very ideological tone of monetary authorities' defense of the gold standard in the 1920s, compared to the language used in earlier times. In fact, through a number of decisive institutional transformations, gold convertibility was now valued for its own sake and quite independently of welfare or growth considerations. Building on this insight, we can further speculate on whether the different levels of commitment to the defense of convertibility displayed by different central banks was a function of the value their shareholders placed on retaining the charter. In this regard, Chart 5 shows that for each stock whose nominal price was 100, the dividend of the Bank of England was on average 2.5-3 times larger than that paid by the Bank of France.[22] Therefore, the privilege paid almost twice as well for every franc or pound invested in England than in France. Such occurrences must have influenced the determination displayed by alternative institutions that defended of the status quo. Whether or not similar incentives explain the Bank of England commitment during the 1920s to return to the older parity is still a long shot, but the subject is worthy of future research.

22 Interestingly, the Price Earning Ratio (PER) of the Bank of England was always above that of its French counterpart, during the period 1820-1914. This may have reflected the greater risk that investors placed on an eventual change in the charter of the Bank of France in a direction that would be harmful for shareholders.

In any case, there are reasons to believe that through the agency of the convertibility principle a certain conception of what monetary policy "ought to be" crystallized and became a holy principle as opposed to the pragmatic criterion it had been in the past. Consequently, the discussion in previous sections sheds light on the dynamics of the interwar period when central banks desperately clung to convertibility even when this meant imposing major costs on the economy. They did so until the costs of convertibility were too large and the goal became self-defeating. As a result, the resilience of monetary policy institutions became a major factor in deglobalization (Eichengreen 1992, James 2001). The relations between institutions, monetary stability and globalization is thus more complex than is implied by current debate: History shows that forces that lead to the creation of monetary institutions capable of delivering a high-quality output are the same that bring international integration. From that respect the question of determining whether low inflation results from globalization or inflation targeting by independent central banks is a rhetorical one. However, the extent to which specific institutions, created at a given time and in a given environment to address specific monitoring problems, remain optimal when the environment does change is a different matter.

The second issue worthy of a discussion is that of the relation between current practices and historical trends. The history that has been told can be understood as that of the serendipitous discovery of principles that foreshadow current practices. Just as today, monetary stability was seen as resulting from the pursuit of formal targets that had been assigned to the central bank. Just as today, the success in reaching these targets was associated with central bank independence. Just as today, central bankers were faithfully committed to reaching these targets because they derived benefits from fulfilling their mandate.

A natural interpretation of the reasons why the history of central banks repeats itself may be found in their agency nature. As agents in charge of implementing monetary policy for the benefit of society, central banks are expected to produce a currency with certain attributes deemed useful by using a number of instruments considered as legitimate. To determine whether they are successful or not, it is simpler to ask them to achieve certain goals that can be used to monitor their performance. In this context, targeting (the exchange rate as in the 19th century or the inflation rate as today) is a particularly relevant framework. The legitimacy of the central bank is tightly related to its ability to achieve the objective it has been assigned and, because this objective is simple and transparent, the legitimacy is itself simple and transparent.

As a result, changes in the targets assigned to monetary policy can be traced to changes in the way society defines and measures the "quality" of money. In this regard two major factors explain the shift that has occurred in the definition of monetary targets between the periods under consideration. The first is the emergence of a consensus over price indices as adequate tools for tracking inflation. Our discussion of the bullionist controversy revealed that such instruments were entirely lacking then, leading the authors of the *Bullion Report* to focus on the exchange rate and the price of gold. Ironically, there was less correlation between exchange-rate variations and the money supply than between the money supply and the price level as it has been reconstructed later. But there was just no consensus on how to measure prices and hence there was too much discretion for monetary policy, which had thus to be subjected to strict convertibility rules. Following this line of analysis, it is no surprise that Fisher, one of the founding fathers of modern macroeconomics, devoted an entire chapter of his early treatise and later a full book to the issue of measuring price variations (Fisher 1907, 1930) before becoming a proponent of price stabilization schemes as opposed to exchange stabilization (Fisher 1907, 1930, Jonung 1979, Bordo et al. 2003).

The second and perhaps less important factor is a residual from the Keynesian view that inflation is good while deflation is bad. This once predominant notion (we saw it was part of the intellectual background of the *Bullion Report*), which became a building block of orthodox theory in the midst of the interwar collapse survives today in the form of inflation targets that are low but above zero. Some economists have sought to motivate this number by emphasizing the existence of downward adjustment costs when inflation is close to or below zero. Reference to the work of Akerlof et al. (1996) establishing this theoretical result is now conventional (see e.g. the survey in Bernanke and Mishkin 1997, Bernanke 1998). Yet in the perspective developed here – that political acceptability is a crucial aspect of a successful delegation scheme – we may understand why a range that neither displeases monetarists nor alienates moderate Keynesians was eventually chosen. Polities must in cases agree on things they do not understand.

Finally, before concluding, we should like to say a word on current discussions. A bird's eye view of the evolution of central bank institutions suggests that there has been a definite trend toward a greater contribution of "scientific" ingredients in the conduct of monetary policy. This grew naturally from the dilemma of discretionary monetary policy, which early 19th century British monetary authorities were the first to meet. The more monetary policy becomes a science – as opposed to being an "art" – the greater the leeway that society will be able to grant to policy makers, because the monitoring problem will be reduced. For example, the availability of objective, agreed-upon measures of inflation permitted the emergence of inflation targeting when 19th century monetary authorities were instructed to peg their currency to gold. To the extent that this rules out deflation and to the extent that deflation is a bad thing, this development constituted an improvement.

Our discussion provides historical significance to the current debates over alternative ways to measure inflation, since these different measures correspond to alternative assessments of the outcome of monetary policy. This also explains the concerns over the significance of evolution of the money supply, a debate that really began with the bullion controversy when observers suggested that the increase in the supply of banknotes, even when it was not met with exchange-rate depreciation was only a debasement time bomb. Finally, this explains the concerns of modern policy makers regarding whether or not they should respond to asset price bubbles. Although some have argued that monetary policy is turning into a "science" (Clarida et al. 1999), it is likely that these issues will remain controversial for some time.

6 CONCLUSIONS

This paper has provided an overview of the making of modern monetary policy rules. It argued that the reason why exchange-rate targets emerged in the 19th century as criteria for sound policy is not that there was no alternative. The possibility of a managed currency had been effectively considered. Nor is it because the management of this currency by a private institution would have been necessarily inflationary, although this is what Ricardo and others feared. We saw that there was no necessary conflict of interest between the pursuit of private ends by a profit-seeking bank of issue and the fulfilling of collective goals normally associated with the conduct of monetary policy. The reason why convertibility emerged, we argued, was the concern that delegating monetary authority to a private concern might turn out to involve too much discretionary action. In order to rule this out, a strict target was thus assigned to central banks.

Moreover, as the century progressed, concerns about the effect of the profit motive on the way central banks dealt with crises led to increased regulation whereby exceptional profits accruing – for instance, from the bank's function as lender of last resort – would automatically be confiscated by government authorities. As a result, the actions of central banks had to take place in the narrow space left between a convertibility target that ensured they would not expand too much and a profit appropriation rule that ensured they would not contract too much. By then, central banks, though still nominally private companies, had really become monetary bureaucracies.

This evolution paved the way for subsequent transformations in the interwar period. We argued that, because of earlier transformations, central banks could now take actions that were detrimental to the welfare of the economy without having to support the effects of such decisions, since the link between the prosperity of the economy and their own welfare had been severed. Central banks could continue to target the exchange-rate because they were protected from government interference by a complex institutional coating. The existence and design of the convertibility targets go a long way toward explaining the persistence of restrictive policies despite worldwide deflation during the 1930s. Just as they may have promoted globalization before WWI convertibility rules contributed to the collapse of globalization after that conflict. In this light, the terms of the ongoing debate about whether central bank independence and inflation targeting or rather globalization caused the recent disinflation are missing the point.

Historians like to emphasize persistence. Economists have a soft spot for novelty. As an essay in economic history, this paper was about both. It was about persistence because it sought to show that the dilemmas faced by modern monetary policy makers have counterparts in previous centuries. It is about novelty because current issues incorporate new elements in a way that makes them both distinctive and unique. By combining historical and contemporary insights, it is hoped that we have achieved two things. First, our historical perspective on the use of monetary policy targets found modern policy makers in the good company of their forerunners, facing pretty much the same structural objectives, challenges, and constraints. This may be cold comfort, but it is one kind of comfort. Second, and possibly more importantly, it has helped to identify which resources and constraints are available to modern policy makers that were not available to previous ones. As Schumpeter stated in Business cycles (Schumpeter 1933), we learn economic history to know "why we are as far as we are" but also "why we are not further".

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7 APPENDIX

We develop here a simple theoretical analysis of the difference between seigniorage collection by a government and an independent monetary institution. Let:

M: nominal quantity of money
P: price level
M = M/P: real money balances
Y: nominal income
y = Y/P: real income
$g_x = d(\log x)/dt = (1/x)(dx/dt)$: percentage rate of growth of variable x (e.g. g_p : inflation)
$m^D = f(y,g_p)$: demand for real money balances; and
$i = r+g_p$: the nominal interest rate, equal to the sum of the exogenous real interest rate and the inflation rate.

Consider first the steady-state revenue ΦG collected by a government seeking to maximize seigniorage (see e.g. Friedman 1971 for a classic treatment) conventionally given by:

$$\Phi^G = \frac{1}{P}\frac{dM}{dt} = \frac{M}{P} \cdot g_M \tag{1}$$

Inflation is constant along the steady state and since (by assumption) real income is also constant (positive growth could be handled without loss of generality), we have:

$$g_P = g_M \tag{2}$$

Moreover, equilibrium between money demand and money supply requires that:

$$m^D = m \tag{3}$$

It is then possible to compute the derivative of the government revenue function with respect to g_p in order to obtain a first order condition for the revenue maximizing steady state inflation rate. Formally, substituting (2) and (3) into (1) and taking the derivative yields:

$$\begin{aligned} \frac{d\Phi^G}{dg_P} &= \frac{M}{P} + g_P \frac{df(y,g_P)}{dg_P} \\ &= \frac{M}{P} + \frac{M}{P} \cdot \frac{1}{f(y,g_P)} g_P \frac{df(y,g_P)}{dg_P} \\ &= \frac{M}{P}\left(1 + g_P \frac{d\log m^D}{dg_P}\right) = 0 \end{aligned} \tag{4}$$

From which we obtain the usual solution:

$$g_P \frac{d\log m^D}{dg_P} = -1 \tag{5}$$

To simplify things further, we consider the following money demand function:

$$m^D = l(y)e^{-bg_P} \tag{6}$$

In this case we have:

$$\frac{d\log m^D}{dg_P} = -b \tag{7}$$

So that:

$$g_P^* = g_M^* = \frac{1}{b} \tag{8}$$

Consider now the situation of a revenue maximizing central bank. The revenue function is not given by the real value of instantaneous monetary creation, as in the government case, but by the purchasing power of the interest earned on lending against banknotes (i.e. zero-cost resources). Formally:

$$\Phi^B = i \cdot \frac{M}{P} = (r + g_P)\frac{M}{P} \tag{9}$$

Taking derivatives with respect to the inflation rate and then setting the expression equal to zero yields:

$$\begin{aligned}
\frac{d\Phi^B}{dg_P} &= \frac{M}{P} + (r+g_P)\frac{df(y,g_P)}{dg_P} \\
&= \frac{M}{P} + \frac{M}{P}\cdot\frac{1}{f(y,g_P)}(r+g_P)\frac{df(y,g_P)}{dg_P} \\
&= \frac{M}{P}\left(1 + (r+g_P)\frac{d\log m^D}{dg_P}\right) = 0
\end{aligned} \tag{10}$$

From which it follows that:

$$(r+g_P)\frac{d\log m^D}{dg_P} = -1 \tag{11}$$

Substituting (7) into (11) gives the formula for the steady state optimal inflation rate:

$$g_P^{**} = g_M^{**} = \frac{1}{b} - r \tag{12}$$

Which is strictly smaller than the optimal inflation and money creation rate for the seigniorage maximizing government. Interestingly, for reasonable parameters of interest rate elasticity of real money demand, which are typically set between

0.2 and 0.4 (Knell and Stix 2004), and a real interest rate of (say) 3%, we get a target inflation range of -0.5 to 2%.

Finally, as indicated in the text, it is interesting to look at what happens when the interest rate elasticity is very large ($b \rightarrow \infty$). Then we have:

$$g_P^{**} = -r \tag{13}$$

Where we recognize Friedman's inflation rule, which is normally derived by assuming a benevolent central planner in charge of setting the money growth rate (see Woodford 1990).

COMMENT

BY MICHAEL D. BORDO, KINGS COLLEGE, CAMBRIDGE, RUTGERS UNIVERSITY AND NBER

In this very interesting and provocative paper Marc Flandreau reinterprets the evolution of central bank monetary targeting over the past two centuries. He compares two eras, the period from 1797 until World War II, when the monetary target was gold convertibility (a fixed price of national currency in terms of a weight of gold), and the present where the monetary target is low inflation. The story he tells about the evolution between the two targets is based on changing institutions (especially their incentives) and the constraints facing central banks, and changes in information technology. I very much like his focus on the lessons for policy makers of today from the lessons of history and I find much of his analysis to be of considerable interest.

As Marc points out, there are many similarities between today's issues and those of 100 years ago. These include: the choice between rules and discretion, central bank independence and the choice of nominal anchor. There are also some important differences, especially the fact that today's central banks are not private profit maximizing entities and the fact that we no longer adhere to gold (specie) convertibility rules.

Flandreau's main thesis is that the roles of the Bank of England and other European central banks as private (monopoly) banks of issue with public responsibilities were the object of public concern over their governance, i.e. concern over the tension between their responsibility to earn profits for their shareholders and their responsibility to provide the public goods of monetary and financial stability. This according to Flandreau explains the advent of the gold convertibility rule in the early nineteenth century and also the evolution of central banks as lenders of last resort and as being granted operational independence. Moreover concern over the profits central banks earned during financial crises (when they followed Bagehot's stricture to lend freely at a penalty rate) led to ever expanding restrictions on their profits, until by the end of the nineteenth century, central banks emerged as monetary bureaucracies with operational independence geared to maintaining gold convertibility.

Gold convertibility targets, according to Flandreau, backfired in the interwar because gold convertibility was divorced from private incentives. In turn gold adherence became ideology and represented "golden fetters". True monetary management was a product of the Keynesian and Monetarist debate of the 1960s. Finally the development of good price indexes and advances in monetary theory made the case for the development of a monetary target superior to gold convertibility, to be based on low inflation or price stability.

Flandreau takes issue with Charles Goodhart's (1988) view, which he calls the consensus view, on the evolution of central banks. The Goodhart thesis is that central banks evolved in the nineteenth century because of financial stability concerns. Their special privilege as governments banker, their large size and role as depository of official gold reserves, led to the transformation of these banks into lenders of last resort which in turn required that their private profit making be curtailed. Flandreau argues that true central banking emerged earlier – during the Suspension period 1797-1821 in British history. This was the era of the famous Bullionist debate over the quantity theory of money, the monetary standard, and rules versus discretion. He argues that the paper money regime, which prevailed during that period, represented a clear alternative to the gold standard as a regime to deliver price stability. It was not so chosen because of issues of governance and monitoring.

My comments first focus on some general issues raised by the paper, second on Flandreau's interpretation of the Suspension period and the Bullionist Controversy and third some other issues.

GENERAL ISSUES / THE ORIGINS OF CENTRAL BANKS

The view that the true origins of monetary policy can be traced back to the early nineteenth century controversies and not to Charles Goodhart is not novel. In fact that was the view of earlier writers including: Ashton, Clapham, Viner and Schumpeter. The lender of last resort principle of central banking was not the core emphasis of these writers. Monetary developments according to them proceeded on two tracks. On the first track, innovations in the creation of money made possible monetary expansion. The second track was devising the ways in which to restrain overissue that produced inflation. The key objective central banks were expected to achieve throughout history was to provide stable purchasing power of the national currency. That objective was achieved by linking the currency to a weight of metal, holding gold reserves, and having gold cover ratios.

Moreover monetary management didn't begin with the Monetarist Keynesian debate. Virtually all of the principles were worked out by Hume, Thornton, Ricardo, Marshall, Fisher and Hawtrey. Some of these writers are mentioned in this paper.

THE SUSPENSION PERIOD AND THE BULLIONIST CONTROVERSY

Flandreau argues that the Suspension period 1797-1821 represents a good natural experiment to examine the perennial issues of: specie versus fiat monetary standards, fixed versus floating. It is also the period when modern central banking and modern monetary policy began.

His story is that the Bank of England, a private bank of issue with public privileges and responsibilities, was forced to suspend convertibility in February 1797 "as a preemptive measure in a period of military conflict with France". It was not forced to suspend because of an attack on its credibility, as was usually the case with suspensions. There followed a twenty-four year period in which Bank of England notes ceased to be convertible – the famous "paper pound". The episode was associated with significant inflation, 5% per year during the war and up to 10% in 1810 (see Chart 1). It was also characterized by a vociferous debate between the Bullionists (Ricardo, Thornton, Baring and other authors of the 1810 Bullion Report) on the one hand, who attributed the inflation to the Bank's note issue and on the other hand, the Anti Bullionists, (the Bank's directors and their allies), who attributed it to nonmonetary forces and, who proferred the real bills doctrine view that as long as the Bank lent on the basis of real commercial bills there could not possibly be overissue. The Bullion Report recommended a gradual return to gold convertibility, which was achieved in 1821, 6 years after the end of hostilities.

According to Flandreau, although the Bullion report made a strong case for the Quantity Theory of Money, it did not make the case for a return to the gold standard and it could even be interpreted as making the case for a permanent paper money standard. He argues that there was very strong contemporary support for permanent suspension and moreover that a paper monetary standard operated by a private Bank of England might have been a superior outcome compared to the gold standard.

His argument is that the Bank as a private, profit maximizing central bank would have no incentive to inflate once its gold constraint was removed and even in the limit would provide very low inflation or even Friedman's (1969) optimum quantity of money with a rate of deflation equal to the real interest rate. This he argues would hold when the interest elasticity of the demand for money infinite in the highly unlikely case of the liquidity trap.

The reason why Flandreau doesn't get the standard Bailey (1956) result that a government controlled central bank maximizing segniorage revenue would operate at the point where the expected inflation elasticity of the demand for money was equal to minus one (and an inflation in the range of 25 to 50%, Friedman 1971), is that the private central bank is not concerned with maximizing seigniorage revenue from money issue but instead is concerned over the purchasing power of the interest earned on the loans backing its note issue. (Incidentally, a similar point was made over 20 years ago Santoni, 1984). Hence a private central bank could deliver low inflation minus the resource costs of having a gold standard. Moreover the reason Flandreau argues why the paper pound standard was not adopted was because of the concern by Ricardo and the others that the Directors of the Bank would not use their discretion wisely and that adhering to gold convertibility was a transparent way to monitor their performance. Thus according to him, issues of governance explain the origin of the convertibility rule.

I have a number of concerns with this interpretation.

First, there was virtually no contemporary support for a permanent suspension of specie convertibility. The only visible advocate for a permanent suspension was Thomas Attwood in 1819 representing the interests of the Birmingham manufacturers, who advocated a continuation of the depreciated pound as a form of tariff protection (see Bordo and Kydland 1995 and Laidler 1987). My alternative view to explain why the Suspension was credible is that people viewed it as temporary, necessitated by the wartime emergency, and that once hostilities ceased, with a suitable delay period, that the gold standard would be restored at the original pre war parity. That the temporary suspension was credible can be seen in the low nominal yields on consols recorded, well below the rate of inflation. As Kydland and I argued 10 years ago, the gold standard was a contingent rule and agents understood this. Moreover people at the time viewed money and specie as synonymous. Money evolved from the precious metals and convertible notes were in turn based on the long run purchasing power of specie based on the commodity theory of money. Indeed gold convertibility was a credible nominal anchor based on the special properties of gold and the market forces, which anchored its value. The likelihood that in 1821, the Bank of England, absent convertibility, would have been considered as able to provide a credible nominal anchor seems to me to be remote.

Secondly, the Bank of England during the Suspension period did not operate like a private profit maximizing central bank, it operated like a de facto Martin Bailey (1956) government central bank maximizing its revenue from the inflation tax. The way this operated is discussed in Bordo and White 1990. The reason for the Suspension in 1797 was because the Bank of England was pressured into helping the British government finance its war against France. Beginning in 1793 the Bank was pressed to accept short-term government paper, referred to as Exchequer bills (which the government was having difficulty rolling over in the market). The Bank consequently had difficulty in both satisfying its private borrowers and at the same time maintaining the reserves needed to preserve gold convertibility. Hence it requested the government to relieve it of its gold constraint. Thereafter, by absorbing government paper as well as accepting private discounts secured by government paper at the fixed usury ceiling rate of 5%, (which at inflation rates near 10% was well below the shadow market interest rate), the Bank became an engine of inflation just as it was to become in World War I and World War II. Thornton (1802) nicely described how this indirect method of war finance worked.

The Bank's contribution to the war effort was not as large as the revenues collected by direct and indirect taxes and bond sales (consoles) to the public but at the peak of hostilities in 1810 it reached 3% of total war revenue and 17% of the fiscal deficit (Bordo and White 1990 Table 3) (see Chart 2, log of money supply, Chart 3, log of real money balances, Chart 4, fiscal deficit). Thus the real concern that Ricardo and the others had with the Bank was over its role as the inflationary agent of the British government.

OTHER COMMENTS

Flandreau makes two assertions about the operation of the classical gold standard that are not quite correct. First he states that "the rules of the game" were not followed. Second he asserts that adherence to the gold standard was not a “good housekeeping seal of approval”. In the first case, the answer depends on how you define the “rules”. If you use the Bloomfield (1959) definition of a positive correlation between international reserves and domestic credit, then with the principal exception of Great Britain, he is correct. If you follow the more sophisticated definitions used in the vast literature on the subject, such as the absence of sterilization, or the lack of attention paid to domestic objectives, then the answer is mixed. In the second case, there is again an ongoing debate in the literature on whether adherents to gold were rewarded in the international bond markets by a lower spread than non-adherents. The outcome of that debate is still in play as can be seen in a recent, highly acclaimed study by Obstfeld and Taylor (2004), which in critique of Flandreau’s position, strongly suggests that the markets paid a significant premium for gold adherence.

Flandreau posits the view that gold convertibility backfired as a monetary target during the interwar and became an engine of deflation because it was no longer lined up with central bank incentives and moreover it had become like a religion. This view is close to the gold standard mentality view expressed by Eichengreen and Temin (2000).

An alternative interpretation is that it wasn’t the gold standard per se that was the problem but the conditions under which it was restored in the 1920s and the way in which central banks operated under it. The fact that Britain went back to gold in 1925 at an overvalued parity while France and Germany went back at greatly undervalued parities and moreover these countries and the United States sterilized gold inflows meant that the basic adjustment mechanism of the gold standard was not allowed to work the way it did before 1914.

This and the other well-known flaws of the interwar gold standard and the Great Depression itself, which ended the gold standard, were not brought about by central banks constrained from maximizing profits. The gold exchange standard largely reflected the post war political economy. The Great Depression which ended the gold exchange standard was brought about by a massive failure of monetary policy by the Federal Reserve, in turn the product of adherence to a flawed theory (real bills) and a flawed institutional design.

Finally, Flandreau is correct in stating that it was in the absence of good price indices that the Bullion Report focussed on the price of gold as its indicator of overissue and that the price of gold is a less informative target than a general price index. Irving Fisher, Marshall, Wicksell and others over a century ago criticized targeting the price of gold and advocated price level targets.

In sum, this paper makes a nice contribution to our understanding of the evolution of monetary policy. It does so by its novel focus on the interaction between the incentives and the constraints faced by central banks in the past two centuries.

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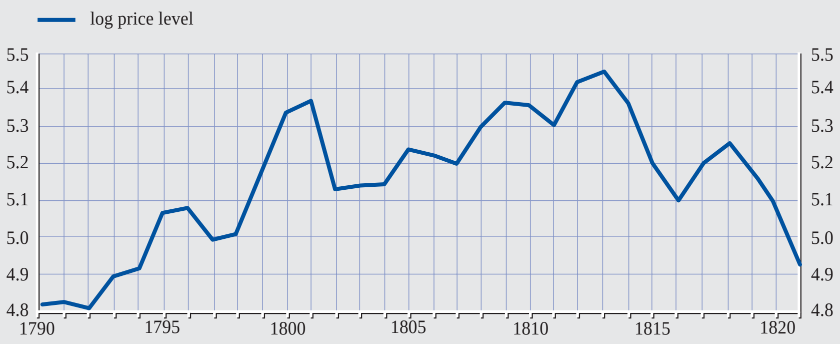
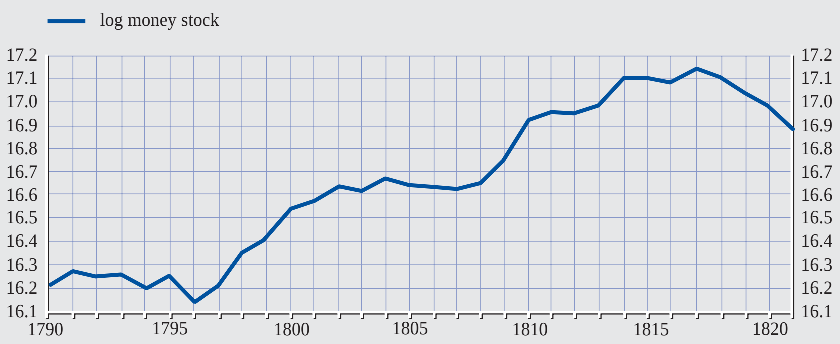
Chart 1 Great Britain, log of the price level



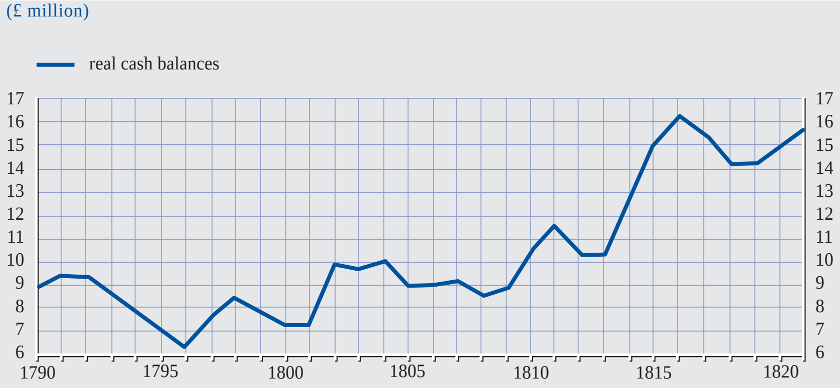
Source: Bordo and White (1991).

Chart 2 Great Britain, log of money stock



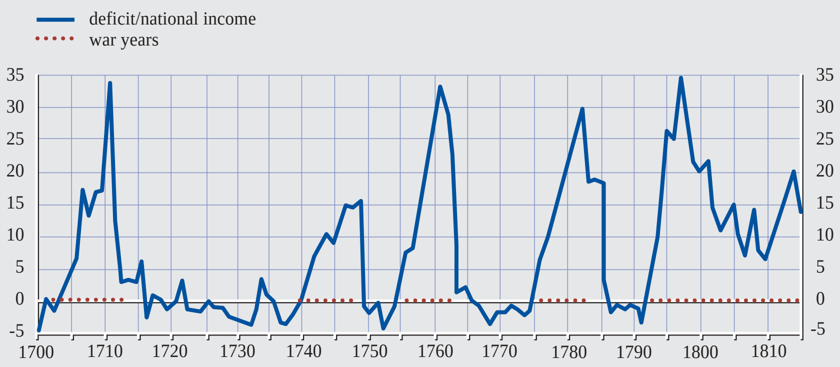
Source: Bordo and White (1991).

Chart 3 Great Britain, real cash balances



Source: Bordo and White (1991).

Chart 4 Great Britain, deficit as a percentage of national income



Source: Bordo and White (1991).

COMMENT

BY CHRISTIAN DE BOISSIEU, UNIVERSITY OF PARIS AND CHAIRMAN CONSEIL D'ANALYSE ECONOMIQUE

1 INTRODUCTION

Flandreau's article is a well-documented and somewhat provocative contribution to the history of monetary policy and central banking. Contrasting the 19th century with the 20th century, it shows that the main difference regarding the conduct of monetary policy has to do with the rules vs. discretion debate and the various implications derived from it. Monetary policy during the 19th century (which really ended with WWI or even slightly after) was characterised by monetary convertibility and exchange-rate targeting (pegging the currency to gold). Therefore monetary rules were prevailing, "to limit the discretionary power of central banks" (Flandreau). Modern monetary policy and central banking rely on discretion (even the so-called Taylor rule is a way to understand and possibly forecast the actual implementation of this discretionary power) and inflation targeting. From this point of view, the interpretation by Flandreau of the "Restriction period" (suspension of specie convertibility) in Great-Britain during the period 1797-1821 is fascinating. All the subsequent important debates concerning monetary policy and central bank were already embedded in the Bullion Report and the discussion thereafter. An important conclusion of Flandreau's analysis is that during the 19th century there was no conflict of interest between a profit seeking central bank and the conduct of monetary policy (or, at least, possible trade-offs remain within narrow limits).

I had myself the opportunity to discuss some aspects of the "Restriction period" and the rise of the banking/currency principle controversy[1]. However, adhering to most of Flandreau's historical interpretation, I am going to pick up a few aspects of the monetary debate raised over the last two centuries and still very topical today.

2 GLOBALISATION AND THE FIGHT AGAINST INFLATION

Flandreau compares the conduct of monetary policy during the two waves of globalisation, the "first" globalisation according to Suzanne Berger (was it realy the first? A very long-term perspective would lead to a more cautious wording) which covers the period 1880-1914, and the current one. He supports correlation rather than causation between globalisation and disinflation: "History suggests that the forces that lead to the creation of monetary institutions capable of delivering a high quality output are the same that bring international integration". Focusing on the current globalisation process, I want to stress

1 See my foreword to the new printing of the classical book by Charles Rist, *Histoires des doctrines relatives au crédit et à la monnaie*, Dalloz, Paris, 2002

some casual links. Globalisation has become supportive of monetary policy, and up to a certain point a partial substitute for interest rate tightening, since it generates disinflation or even deflation forces through several channels: (i) an acute competition in all sectors and for all firms. (ii) productivity gains. As regards the impact of new technologies on productivity and prices, the historical perspective put forward by Paul David has been very influential on Alan Greenspan and the conduct of monetary policy in the US since the mid 1990's. (iii) the rise of overcapacity in many sectors (computers, automobile industry, banking …) with effects on prices and margins.

During the past three years, inflation rates have exhibited a relatively low sensitivity to the energy shock. Without this shock the current debate would focus on the risk of an excessive drop in some prices. To claim that globalisation and competition act as a support to monetary policy does not suggest at all that this policy has become superfluous. On the contrary it has to be adjusted to the new competitive environment. Whether the effect of globalisation on prices and inflation is a transitory or a permanent phenomenon is more debatable. Beside the necessary distinction between the price level and the rate of inflation it has to be kept in mind that in the very long-run, despite the technological changes which are irreversible, globalisation itself could be reversed due to major geopolitical shocks (e.g. WWI), systemic financial crises (e.g. 1929), etc. Therefore we cannot extrapolate the anti-inflation support of globalisation in the long term.

3 MONETARY TARGETING

The long-run transition from exchange-rate to inflation targeting is well explained and documented in the paper. Specie convertibility meant exchange-rate targeting. Regarding inflation goals, Flandreau shows that during most of the period under scrutiny there was no significant trade-off between the profit maximisation behaviour of a private central bank and the fight against inflation. This conclusion challenges a part of the conventional historical wisdom.

As far as inflation targeting is concerned, two aspects are rightly underlined. First, the index problem is recurrent. The current debate about the measurement of inflation and the best price indexes is relevant for central banks all over the world, in both developed and developing countries. Second, how to articulate goods and services prices with asset prices (financial assets, real estate…)? This debate has become topical for the conduct of monetary policy in general and inflation targeting in particular since Alan Greenpan acknowledged the possible "irrational exuberance" of asset markets in December 1996. My view is that, from both the theoretical and statistical view point, it would be premature to aggregate flows prices and stocks (i.e. financial assets, real estate…) prices. As Paul Samuelson put it, if we have two eyes, it is to look at two indicators at least. Central banks have less (indirect) controlability over assets prices than over goods and services prices. However they will have to closely monitor the former prices since they generate positive or negative wealth effects which are more decisive for private consumption, growth, employment and prices in the new context than the canonical income effects.

4 THE ELASTICITY OF THE FINANCIAL SYSTEM AND THE INTERPLAY OF FEED-BACK EFFECTS

Flandreau points out that in the early 19th century "elasticity" meant "automaticity" of the adjustement. In that respect the full convertibility regime was "elastic". This approach underlines the link between the elasticity of the monetary and financial system and the rules vs. discretion debate. But this definition of elasticity is rather counterintuitive. During the "Restriction period" Henry Thornton was crucial by focusing on the various feed-back effects and the management of financial crises. Much ahead of Bagehot he analysed lender-of-last resort interventions. With the gradual transition to a more flexible interpretation of specie convertibility, more elasticity (then the contrary of automaticity) was introduced in the financial system and in the financing of firms, households, etc. This other concept of elasticity (the exact contrary of the former one) refers to the capacity of the central bank and financial intermediaries to satisfy the needs of producers and consumers. It is explicity in line with the "Real Bills" doctrine and the banking school. Thornton was important, but Knut Wicksell still more at the very heart of the "first" globalisation (Interest and Prices, 1898). Focusing less on convertibility and more on the critical gap between the natural rate of interest and banking lending rates (themselves directly influenced by central bank's rate), Wicksell has proposed a new vision of the dynamic path of any monetary economy and of its potential instability. He was the key thinker at the turning point between the 19th and the 20th century.

5 INDEPENDENCE AND ACCOUNTABILITY

The debate about the independence of the central bank, even when it was a private body, was already raised during the 19th century. The delegation model of central banking was partially or totally effective much ahead of the invention of the agency theory and its side challenges (optimum incentives, information structures…). In effect accountability must have developed parallel with the growing power and independence of central banks over the years. Here we must acknowledge the existence of a structural gap in all countries, accountability procedures and effectiveness lagging much behind the trend towards more independent central banks. My view is that this gap is less warranted than it is commonly and very often implicitly argued by conventional wisdom, since the efficacy of monetary policy could improve with more transparency and better communication from central bankers. Accountability vis-à-vis whom? Here the capitalistic structure of the central bank and corporate governance considerations have to be taken into account. Regarding the long period of privately-owned central banks, the main accountability requirement was vis-à-vis their shareholders. Nowadays, the most important "principal" is the public opinion in general, the set of economic agents in particular.

6 TOWARDS A "QUALITY" THEORY OF MONEY

The quality of credit is at the heart of the "Real Bills" doctrine. The quality of money was more recently put forward by Hayek especially in his book Denationalisation of money. I do not accept the policy conclusions of Hayek's analysis in favour of free banking. However, he was right when focusing on some ingredients of the quality of money: 1) the degree of stability of its value; 2) its area of acceptance and circulation. Other factors have to be considered when explaining the competition among currencies, such as the depth and liquidity of capital markets behind each reserve currency. Flandreau touches upon the quality of money at the end of his contribution. My own interpretation is the following. The 20th century monetary thought has deepened and refined the quantity theory of money, with evident and powerful implications for the conduct of monetary policy (the new quantity of money introduced by Milton Friedman and the Monetarist School, what I would call the $(new)^2$ quantity of money developed by the New Monetarism and the Rational Expectations School, etc.). To be sure, the quantity of money is one important dimension of its overall quality, not the only one. I hope that the 21th century monetary thought is going to develop a true quality theory of money, focusing on the main determinants of the competition among currencies (the dollar, the euro, the yen, the yuan in the future,…) and elaborating on the relevant Hayekian intuitive lines. This would be very useful for both economists and central bankers, even if I do not "buy" at all the Hayekian promotion of the free banking regime.

Willem Buiter expressed the view that the distinction between the revenue maximising central bank and the seignorage maximising government disappears when taking a proper intertemporal perspective as the present discounted value of seignorage – which is the future monetary base issuance – equals the present discounted value of central bank revenues. What is remarkable historically in the eyes of Buiter is that throughout the fiat money area, neither governments nor central banks to his knowledge actually got close to maximising seignorage. Although there were often temptations to do so they instead exercised remarkable self-restraint. **Roger Farmer** asked whether and to what extend the lack of crises in France in the second half of the 18th century might be a consequence of the changes in regulations about dividends that have been described by Flandreau. **Charles Goodhart** stressed the importance of the question: what exactly was money. He was reminded of the dispute between the banking and currency schools. The latter assumed to know what money was, whereas the former saw the definition of monetary aggregates as changing over time due to financial innovation. For the suspension period in the UK, he stressed that he did not see the suspension of convertibility as driven by high inflation nor as pre-emptive actions of the Bank of England, but rather as a decision triggered by a crises and by panic reaction due to exaggerated media reports on the landing of French troops in Wales. **Lars Svensson** expressed his view that for a historical analysis, it is important not to forget Knut Wicksell, who already back in 1898 gave an operational targeting rule to stabilise the price level. In his book “Interest Rates and Prices” he laid out that when prices are rising interest rates should be raised. If prices fall, interest rates should be lowered and should be kept at the new level, until news on price changes would call for changing interest rates in one or the other direction. **Gianni Toniolo** remarked that the gold standard in less financially developed countries seems to have been a good tool for maximising the target of having a clear and understandable communication of the central bank to the public. He reminded conference participants that Lord Norman thought the gold standard would protect central banks’ independence and would put monetary policy on more scientific grounds. However, this has “backfired” within the great depression, when central banks took all the blame and eventually their popularity decreased over time. In addition, governments took over the control of money supply. After this experience, central banks today know that they should not tie their hands with precise policy rules.

In his reply **Marc Flandreau** answered that he focussed in his paper on the long-run evolution of institutions running monetary policy. He does not see this evolution as a constant evolution towards independence but rather as a more complex process. In particular, progress towards central banks’ independence has not been linear. Two main moves could be observed, namely a gradual separation of the monetary policy and the profit maximising motive. Up to the first world war, the money making motive seems to have been the main motive. In addition there was a gradual increment of operational procedures and rules that filled the vacuum that had been created by the removal of the profit making motives. In the inter-war regime, the setup of private institutions and the convertibility created a number of shortcomings and there was not enough thinking about the mandate, full transparency and concrete rules. The importance of academic input in the policy process came only after the interwar period.

Otmar Issing

HONORARY ADDRESS

THE ECB'S MONETARY POLICY STRATEGY: WHY DID WE CHOOSE A TWO PILLAR APPROACH?[1]

BY OTMAR ISSING, CFS AND FORMER MEMBER OF THE EXECUTIVE BOARD OF THE ECB

1 THE TRUTH ABOUT THE TERM

The title of my paper makes it perfectly clear: we are talking about history. This emphasis is appropriate. Otherwise colleagues at the ECB might have told me: Otmar, you are history. This reminds of the dictum that progress in science comes funeral by funeral or in institutions fortunately rather retirement by retirement.

Nevertheless, nobody will protest if I place the decision of 1998 on the strategy of the ECB into a broader context. Therefore, I will comment – with different emphasis – on three questions.

1) What were the reasons for this decision, and was the choice of strategy appropriate at that time?

2) Has the strategy served the ECB well since?

3) Is the strategy robust and flexible enough to fit a changing economy and progress in research?

Before I come back to these questions, let me be precise on history. To be frank, at first in our communication we did not exactly speak of a "two pillar approach". (In internal discussions we had already used the term "pillar". We had initially identified three pillars, the third one being the quantitative definition of price stability.) The public use of this term goes back to the press conference of 13 October 1998 in which the president communicated the adoption of "A stability-oriented monetary policy strategy for the ESCB" by the Governing Council. Then a journalist asked:" I have a question about your monetary policy strategy regarding the *dual pillars of the strategy* the monetary element and the inflation forecast or real economy element. Will they carry approximately equal weights or will you decide the relative weighting between the two pillars on a case by case basis?" (By the way this is not only evidence for the intelligence of the journalist but also for the successful communication of the ECB right from the beginning.) Wim Duisenberg answered: "… it is not a coincidence that I have used the words that money will play a prominent role. So if you call it the *two pillars*, one pillar is thicker than the other is, or stronger than the other, but how much I couldn't tell you."

1 I would like to thank M. Bluhm, G. Fagan, V. Gaspar, B. Hofmann, K. Masuch, L. Reichlin, F. Smets, and R. Strauch for valuable comments.

When I discussed this wording with my experts a few days later the opinions were split if we should adopt it or not. The arguments brought forward reflected already the experience we made later. On the one hand, the notion of "two pillars" could give the impression of a split of analysis and arguments thereby contributing to confusion. On the other hand this term makes not only clear that the ECB's approach has a characteristic which is specific, it has also the charm of signalling, in a shortcut, a rock solid approach. So, it is not surprising that soon it became a kind of trademark notwithstanding the fact that the initial disadvantages of the term remained valid for some time to come.

2 A SITUATION OF EXTREME UNCERTAINTY

After the establishment of the ECB on 1 June 1998, only 7 months were left to prepare for the beginning of monetary policy for the euro area. As a result of long discussions among the experts from the EMI two options had "survived," namely monetary targeting and inflation targeting. Years before – during my term at the Bundesbank – I had initially argued in favour of the ECB adopting monetary targeting but had at a later stage already signalled reservations (Issing, 1998b).

But now we had to come to a final conclusion and decision. Monetary policy always has to be conducted under uncertainty, but it was obvious that we were confronted with a situation of extreme uncertainty. It is instructive to review all the elements of uncertainty in some detail (see also Issing, 2002).

– First, there was uncertainty about the state of the economy. Needless to say that the data situation around the start in January 1999 – and, though gradually improving, for years to come – was very worrisome. This was true for simple data but even more for unobservable indicators like the output gap etc. In this context it would also be extremely difficult to identify the nature and persistence of potential shocks.

– Secondly, uncertainty concerned the structure and functioning of the economy. This uncertainty has two sources. First, there is a fundamental uncertainty as to which models provide the most reasonable description of the functioning of the economy – and how they relate to each other. Second, this uncertainty depends on the strength and stability of the structural relationships, the so-called parameter uncertainty. Here, the famous Lucas Critique was especially relevant, as all countries preparing for participation in EMU underwent a deep structural change which might even intensify after entry into the regime of a single currency.

– Finally, we faced a situation of strategic uncertainty, i.e. uncertainty over our own interaction with private agents. The impact of monetary policy on the economy depends to a large extent on the formation of expectations by private agents. How would markets, investors and consumers/savers react to the disappearance of the familiar national currencies and the introduction of a new one, the euro? This kind of uncertainty has an endogenous character insofar as its degree would very much depend on the way the new central bank would be able to master the situation. Strategic uncertainty highlights the need to anchor expectations quickly. From this it is evident that continuity with the best performers of national central banks participating in monetary union and especially with the Bundesbank had to be given high priority.

3 THE CHOICE OF A STRATEGY

After the thorough assessment of the situation the challenge was how to deal with this historically unique situation. (On the issue of monetary policy in uncharted territory see Issing, 2003b, and Issing et al. 2006). In the spirit of full transparency should the ECB not just start in a process of trial and error under the motto: trust us, we will do our best to fulfil our mandate of maintaining price stability?

Spelling out this option means already to discard it. How could a brand new institution like the ECB convince the public of its determination to maintain price stability just by announcing a "let's do it approach"? Such an option is only viable ex post, when credibility derives from a solid track record. Therefore this option was not available for the ECB before and at the start. Such an approach would have also missed the chance to transfer credibility from the "old" national central banks to the new one, the ECB.

A strategy was needed! But, what kind of strategy? Would it not be advisable just to emulate the example of the Bundesbank and adopt a strategy of monetary targeting? For me the arguments against such a choice were straightforward. I had experience of rather wild volatility of M3 in the nineties and I knew how difficult it was to explain to the public – and sometimes even to the Zentralbankrat – that we should nevertheless stick to our strategy of monetary targeting? I also knew that aggregate euro area M3 could display a similar degree of volatility. How could we hope to explain convincingly to the public that this should be interpreted as a temporary phenomenon? Wasn't the disappearance of long established currencies and central banks and the arrival of a new money and a new institution responsible for it a regime shift of extreme dimension – with a very high risk of structural breaks in the meaning of the Lucas critique? Under those circumstances, how could we maintain consensus among the members of the Governing Council, who anyway had different priors as to the role of money?

In case the ECB would have to abandon a strategy soon after the start this would cause an almost deadly blow to the credibility of the new institution from which it would not recover for years.

So, monetary targeting was excluded as an option. However, rejecting monetary targeting as a strategy for the ECB did of course not imply neglecting the overwhelming evidence for the long-run relation between money and prices and the undeniable fact that monetary policy has somewhat to do with "money".

Inflation targeting could also not cope with the challenges we were confronted with. There has been and there is still some confusion on the terminology. The ECB has quantified its target for maintaining price stability and made it public. If a quantified target for keeping inflation low is the relevant criterion, the ECB is indeed an inflation targeter (Issing 2003c). However, the relevant interpretation of this monetary policy strategy here is that of inflation *forecast* targeting. It is obvious that the "beauty" of this approach fully depends on the reliability of the inflation forecast as *the* fundament for the conduct of monetary policy. But no forecast is a sufficient summary of information. And in the specific case of the start of monetary union none of the supporters of the option of inflation targeting ever tried to explain how we could rely on any inflation forecast considering the uncertainties mentioned before. (I am still puzzled by the way how e.g. the rather extreme divergencies of estimates for the output gap by different institutions and later revisions are just ignored.) Above all, it is obvious that an inflation forecast targeting approach would not be able to integrate the information stemming from monetary developments to identify risks to price stability over the medium- to long-term. Adopting inflation targeting would therefore have unduly shortened the horizon of monetary policy to the conventional forecast horizon of one to two years.

To cut a long story short the starting point for me was: we needed a strategy, and money should be given a "prominent" role within such a strategy. The challenge now was how to create an all-encompassing strategy so that no relevant information was lost and which at the same time would structure all incoming data in a way that we would be able to identify risks to price stability in a timely and consistent manner. Transparency about our strategy was also an important element which guided our deliberations. As a consequence the ECB made its strategy public already before the start. The first Monthly Bulletin of the ECB included an article on the strategy (ECB 1999).

May I also mention in this context that hardly any other central bank has documented the process of creating a strategy in almost real time (Issing et al., 2001). It might be interesting to quote: "To summarise, no simple and unique indicator has proven sufficient for central banks to motivate and explain their policy decisions. In spite of the rigidity of theoretical monetary targeting and inflation targeting, judgment has been a crucial element of both monetary policy strategies.

Taking stock of these experiences, one of the key characteristics of the ECB's new monetary policy strategy – conceived in order to cope with the particularly high degree of uncertainty and imperfect knowledge at the beginning of Stage Three of EMU – is to acknowledge explicitly the lack of satisfactory models suitable for policy analysis" (p.104/5).

Finally, an explicit strategy was also needed for a reason which is mostly overlooked in public. The responsibility for the conduct of monetary policy would be transferred to the Governing Council, a complex committee of highly qualified persons, 11 governors coming from longstanding central banks. How to prepare these meetings, how to guarantee that all deliberations would be concentrated on the euro area, on the risks to price stability for the single currency?

Already the internal discussion before the start demonstrated that an explicit strategy was needed to structure the documents preparing the meetings and to organise the discussions. Experience soon has shown that the chosen strategy has worked extremely well also in this respect. It has facilitated an open and frank exchange of views with a strong focus on the final goal, namely the ECB's mandate to maintain price stability in the euro area as a whole over the medium term.

4 THE TWO PILLARS

In October 1998, the Governing Council adopted its stability oriented monetary policy strategy with three elements namely

– a quantitative definition of price stability;

– a prominent role for money;

– a broadly based assessment of the outlook for future price developments.

In its first Monthly Bulletin of January 1999 (ECB, 1999), the ECB published an article explaining its strategy in detail. By the way, in this publication the ECB also adopted officially the term of "two pillars". (See also ECB, 2000.) "Inflation is ultimately a monetary phenomenon" – this is the starting point why money should be given a prominent role. To establish a kind of quantitative benchmark for identifying longer-term risks to price stability the ECB derived a reference value but made immediately clear that any deviation of M3 growth would not trigger a mechanistic monetary policy reaction but would prompt further analysis to identify the reasons behind such developments. The ECB already made clear that other monetary aggregates etc. would also have to be assessed thoroughly.

To quote from the Bulletin (p. 49): "Although the monetary data contain information vital to informed monetary policy-making, on their own they will not constitute a complete summary of all the information about the economy required to set an appropriate monetary policy for the maintenance of price stability. Therefore, in parallel with the analysis of money growth in relation to the reference value, a broadly based assessment of the outlook for price developments and the risks to price stability in the euro area will play a major role in the Eurosystem's strategy. This assessment will be made using a wide range of economic indicators".

It was clear from the beginning that risks to price stability identified under the two pillars referred to different time horizons. The relation between "money" and prices is a long run phenomenon and short-term movements in monetary data do not necessarily give an indication on the need for policy actions. On the other hand, limiting the horizon of monetary policy to the information coming from the economic analysis would run the risk of conducting a short term oriented and "activist" monetary policy loosing side of trend developments. Money is therefore a kind of "natural" anchor for the longer term orientation of monetary policy.

This choice of two pillars was seen as a device to structure the information coming from a host of data which would be conducive for the internal discussion as well as for the communication (Issing, 2003a).

Monetary policy has its full impact on the economy only with long time lags. The Governing Council as the decision making body has to take into account all information when coming to its policy decisions, thereby ensuring that the long- to medium-term orientation does not get out of sight. The monetary pillar should help to look beyond the transient impact of various shocks, protecting against the temptation of fine-tuning the economy and maintaining a firm medium- to long-term orientation.

The two pillars serve the purpose of organising the incoming data in a structured way basically under the aspect of the relevant time horizon. The cross-checking is a means of reconciling the shorter-term analysis with the longer-term perspective leading to a consistent, "unified" overall assessment. "Two pillars, a single framework" a headline in our book of 2001 captures the message we wanted to give and the reasoning behind it.

5 REAL-TIME ASSESSMENT VERSUS EX-POST RATIONALISATION

In the press release of 8 May 2003 on the result of the evaluation of the strategy the Governing Council stated: "More than four years of implementation have worked quite successfully". I would be surprised if nowadays i.e. eight years after the adoption of the strategy an assessment would sound differently.

This and the fact that the monetary policy of the ECB in general gets high marks can be seen as evidence that the Governing Council back in 1998 took the right decision when choosing its stability oriented monetary policy strategy. Of course, one could still argue that another strategy would have delivered the same – or even better? – results. I leave this counterfactual thought-experiment to others.

It is, however much more convenient to argue on the basis of success and I cannot hide satisfaction against the background of so much criticism especially around the start of our policy. There is no need – and even no chance – of ex-post rationalisation of our decision of 1998 as we have been so transparent on the concept as such as well on the details. Considering J. M. Keynes' observation that "worldly wisdom teaches us that it is better for reputation to fail conventionally than to succeed unconventionally" (Keynes, 1936, Chapter 12, V) the ECB took a high risk not joining the then dominant approach of inflation targeting.

This is not the place to analyse the monetary policy of the ECB since the start until to-day (see e.g. Issing, 2005). The interpretation of information from the monetary pillar sometimes has been anything but simple not least because of substantial portfolio shifts (for a thorough analysis, see Fischer et al., 2008). But, this is not to say that economic analysis on balance "did better" or even "standing alone" could have given complete and consistent guidance to the ECB for maintaining price stability over the medium-term. Overall, the strategy with its two pillars and appropriate cross-checking provided a robust approach on the basis of which the ECB could –considering major shocks during this period- conduct a surprisingly smooth and successful monetary policy (Gaspar and Kashyap, 2006). (On the role of crosschecking see also a recent paper by Beck and Wieland, 2006.)

6 FUTURE PROSPECTS?

The most remarkable element of the ECB's strategy which makes it unique was the importance given to "money". I have already provided the arguments for this decision. At that time, perhaps neglect of money was at its peak not only in central banking. "Money" had almost disappeared from macroeconomics. This is not a new phenomenon. The fifties of the last century were dominated by the view "that money doesn't matter" before the world in the great inflation of the seventies had to learn that neglect of money might not be a wise choice. (For evidence that taking monetary developments serious helps to avoid high inflation see Issing, 2005a). The monetarist revolution was very much supported by this experience.

It is not surprising that in a world of low inflation the interest in "money" in central banks as well as in academia has declined, if not disappeared. I do, however hope that the world does not have to go through the same process of pathological learning as at the end of the last century. From an intellectual point of view I would like to ask those who disregard money if it is not premature –or should we say just arrogant–to claim that all this evidence collected over many centuries and across numerous countries has lost any meaning for the present and the future? Can one really expect that models without an explicit, well developed financial sector can explain an economic world in which financial markets play an ever increasing role? And, how could a central bank which conducts a monetary policy in which these financial markets are essential for the transmission mechanism rely on such models?

We do not know what will happen in the future. Will financial innovations, new financial institutions, cashless payments, electronic money dominate in a way that any experience from the past as to the relation between present monetary aggregates and prices will become obsolete? Nobody knows. But, it may be worthwhile remembering that in the 19th century we saw a comparable development in practice and an accompanying discussion between representatives of Banking and Currency Schools.

A central bank should also in this respect be on the side of caution. I wonder if the figure of the "conservative central banker" used in the economic literature should not be accompanied by an element of intellectual conservatism. This is not an argument in favour of ignoring new research and discussions in academia. Not at all! But, we have also seen a kind of renaissance of the role of money as was demonstrated e.g. by a number of contributions at the ECB's Colloquium in March this year.

From this perspective one might argue that the ECB with its choice of strategy was ahead of developments – a notion of which I was convinced from the start. I would also like to refer to a speech given by the governor of the Bank of England Mervyn King with the title "No money, no inflation" which gave a clear message (King, 2002).

In the meantime the importance of money (and credit) has been (re-)discovered in an already impressive number of contributions. One strand of research focuses on the global dimension (Bordo and Filardo, 2006; Ciccarelli and Mojon, 2006: Mumtaz and Surico, 2006). Another important field of research analyses the relation between money and credit and asset prices (Adalid and Detken, 2007; Detken and Smets, 2004, and a number of studies at the BIS by Claudio Borio and others). Finally, I would also like to draw the attention to the contributions by Larry Christiano in cooperation with Roberto Motto and Massimo Rostagno (Christiano et al., 2003, 2008).

This leaves open the question if a separate monetary pillar is the definitive answer to these challenges. But, as long as we lack a model which encompasses both dimensions, the economic or real and the monetary, in a consistent manner, I am not aware of a superior approach. We might have to wait still quite some time before this task of – if you wish – establishing the conceptual and empirical background for a "one-pillar-approach" is achieved. Nobody would be happier than me if we could celebrate success in this endeavour rather sooner than later (see Issing, 2006).

It is hard to believe that any central bank would totally ignore the information coming from "money" although it is sometimes difficult to discover how this information enters the process of analysis and decision. Establishing a monetary pillar means creating a strong barrier against the risk of just "forgetting" money. To say it in a phrase coined by Larry Christiano at this conference it guarantees that money has always a seat at the table. Looking back into 1998 the monetary pillar can be seen as a lighthouse signalling that money should never be ignored – neither in monetary policy nor in research. This conference confirms that the ECB has transferred this awareness into the twenty-first century.

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Hyun Song Shin, Mark Gertler, Jean-Pierre Danthine, Ricardo J. Caballero and Volker Wieland (from left to right)

SESSION 4

PANEL: MONEY AND MONETARY POLICY – ACADEMIC VIEWS

ON THE MACROECONOMICS OF ASSET SHORTAGES

BY RICARDO J. CABALLERO[1], MIT AND NBER

The world has a shortage of financial assets. *Asset supply* is having a hard time keeping up with the global demand for store of value and collateral by households, corporations, governments, insurance companies, and financial intermediaries more broadly. In equilibrium, the value of the (relatively) few existing assets must rise, which has important global macroeconomic implications.

These shortages have been a perennial problem in emerging markets, where many of their economic perils and idiosyncrasies stem from this feature. But we are now seeing a shortage on a global scale. It probably began with the meltdown of a substantial share of Japanese assets in the early 1990s, it was exacerbated by European stagnation and the collective emerging market crises of the late 1990s, and it consolidated in the new millennium by the fast income growth of China and commodity countries, most of which have substantial asset demand needs but are not natural asset producers. In addition to these macroeconomic factors, there are microeconomic factors contributing to these shortages. In particular, the recent rapid pace of financial development has facilitated restructuring, innovation and economic growth, but because of their margin requirements they may well have been a net collateral consuming activity, at least in the short run.

The equilibrium response of asset prices and valuations to these shortages has played a central role in global economic developments over the last twenty years. The so-called "global imbalances", the recurrent emergence of speculative bubbles (which recently have transited from emerging markets, to the dot-coms, to real estate, to gold...), the historically low real interest rates and associated "interest-rate conundrum", and even the widespread low inflation environment and deflationary episodes in parts of the world, all fall into place once one adopts this asset shortage perspective.

Understanding the source of these developments as asset supply shortages informs optimal policy responses. The policy prescriptions that follow from this view are a mixture of conventional advice, with an emphasis on financial development and incentive preservation in capital markets, and more adventurous recommendations. In particular, since speculative bubbles are a necessary evil in this environment, it is important to learn to manage their risks rather than to obsess over choking them. By extension, the same recommendations apply to concerns about global imbalances and over the excess-liquidity consequences of low interest rate policies.

1 I thank George-Marios Angeletos, Olivier Blanchard, Arvind Krishnamurthy and conference participants for their comments.

In these notes I sketch the essence of this view and of the main policy recommendations that follow from it. However, these are largely uncharted waters. My discussion has plenty of conjectures anchored by spotty academic work. Much of the research needed to understand what got us to this point, how to manage a global economy of this nature, and ultimately how to grow out it, if this is perceived to be necessary, lies ahead.

This introduction is followed by four short sections. Section 1 sketches the macroeconomic consequences and policy lessons of endemic asset shortages in emerging market economies. Section 2 discusses the global counterpart, where equilibrium considerations play a central role, and argues that low interest rates and inflation rates, as well as high (speculative) valuations, are all market-based mechanism to rebuild asset supply. It also warns on the deflationary consequences of chasing bubbles, and proposes instead to focus on the risk management of high valuation equilibria. Section 3 discusses the role of a lender of last resort in reducing net collateral demand. Section 4 concludes and is followed by a short appendix.

1 EMERGING MARKETS

It is useful to start the discussion with emerging markets for three reasons. First, their experience informs the issue since their chronic asset shortage is an integral component of their macroeconomic performance and management. Second, there is a tendency to extrapolate directly these countries' lessons to the current global imbalances. While this is sound in some dimensions, it is not in others. It is important to understand which one is which. Third, the coordinated crises of emerging markets in the late 1990s, as well as their fast growth in recent years, have played a central role in generating the current worldwide shortage of assets, and hence are at the core of understanding world equilibrium.

1.1 ASSET SHORTAGES AND BUBBLES

If we could ignore capital market frictions of all sorts, emerging market economies would borrow massive amounts from the rest of the world, both to build the stock of capital required to catch up with developed economies and to smooth consumption intertemporally. However, this description does not fit these economies' reality. Not only is their international borrowing limited, but they also experience chronic capital outflows from residents, ranging from households to central banks, seeking to store value in safer locations. In short, emerging market economies are not able to produce the financial assets demanded by local agents to store value.

The reasons for asset supply shortages in these economies come from a variety of microeconomic, macroeconomic, and political deficiencies. Weak bankruptcy procedures, chronic macroeconomic volatility, and sheer expropriation risk reduce the value and safety of local assets.

However, there is a latent tension between the potentially high marginal product of physical investment in these economies and the relatively low returns obtained from safer external assets. This gap creates *both* a natural source of speculative bubbles (by which I mean assets held primarily for their potential capital gains rather than for their dividends) and a potentially useful role for them. There is a sort of dynamic inefficiency. If domestic agents succeed in coordinating their investments in some local assets, their capital repatriation can lead to higher returns to those that choose to store value in local assets. This path is rational (potentially sustainable) because of the gap in returns. In turn, these additional resources relax financial constraints and facilitate domestic growth. Again, it is the gap in returns that makes this strategy potentially welfare improving.

Real estate, and land in particular, are among the assets with best defined property rights in many of these economies and therefore become the initial focus of attention. Corporate assets from the bellwether companies of the country follow behind. Eventually, the large asset appreciations attract foreign investors who further fuel local speculation.

Not all is virtuous in the bubbly equilibrium, however. There is an inherent macroeconomic fragility in coordination-dependent speculative booms. In the same way as these start, investors' moods can change rapidly, causing an implosion in local asset values and widespread international liquidity scarcity as the savings that once were stored in safe heavens are now deployed in riskier local assets, and there is a surge in capital outflows for thosethat can still do it.

1.2 POLICY CONSIDERATIONS

What should the local authorities do in dealing with such an environment? In particular, should they prevent the emergence of local bubbles altogether, or should they, on the contrary, wait until after a crash has taken place to intervene? These are the questions we address in Caballero and Krishnamurthy (2001, 2006a).

It turns out that the same financial underdevelopment that limits the number of assets produced by the economy and gives value to bubbles, biases the private sector incentive toward undertaking an excessive number of risky investments.[2] In this context, once domestic bubbles develop, the private sector reallocates too many resources toward them, overexposing the economy toadeep crash.

2 When a domestic investor decides to bring back some of its resources stored abroad (or borrow from foreigners) to speculate in local markets, it increases the systemic risk in the event of a crash. If domestic financial markets are well developed, and hence borrowers can credibly pledge much of their future earnings to lenders and investors, the investor internalizes the value of hoarding safe resources for a potential crash. In contrast, if domestic financial markets are underdeveloped, the ex-post arbitrage opportunities are limited since existing assets can only capitalize a small share of the return from the additional resources.

This excessive risk taking justifies intervention. An important question is whether policies should focus on preventing excessive risk taking or on improving the handling of a crisis should one occur. While optimal policy typically involves elements of both, the optimal package overweights prevention in emerging markets (relative to developed economies) since the government has limited options once in a crisis, as it often finds itself involved in the turmoil and deprived of credit.[3]

There are two broad categories of potential policy interventions. Those that address the excessive risk taking but not the underlying shortage of sound assets, and those that address the shortage itself. Among the former are measures such as imposing liquidity ratios on financial intermediaries or sterilizing capital inflows. However, these are not free of their own limitations. The former policy requires the ability to monitor financial intermediaries, whose individual incentives to go around the system and take excessive risks rise as competitors are bound by regulation. The latter policy is costly for the government and requires that it has sufficient credibility to create a large amount of financial assets, which is often a constraint. More importantly, neither of these policies addresses the fundamental shortage of assets and, worse, they risk exacerbating the problem if overdone.

Monetary policy can also be used as an incentive (rather than as a palliative) mechanism. In Caballero and Krishnamurthy (2005), we show that by modifying the inflation targeting rule so that it automatically rewards prudent behavior in the event of a crash, monetary policy improves private sector risk management practices. This can be done, for example, by having an explicit rule that overweights nontradables, so that the private sector anticipates that the central bank will let the exchange rate fluctuate more freely in the event of a crisis, and hence discourages excessive reallocation from dollar-assets to speculative peso assets. However, this strategy may also backfire if domestic derivative markets are limited, and the additional exchange rate volatility depresses non-speculative investment and domestic intermediation. Moreover, there is some circularity in the problem, since well-functioning derivative markets require collateral assets, but it is their scarcity that is the root problem behind the fragility monetary policy is seeking to alleviate.

Ultimately, the long term solution to the problem is financial development, as sound assets crowd out the reason for the emergence of speculative bubbles. If the government has enough taxation credibility, then it should begin by developing the domestic public bond market. Absent this credibility, public debt is just another speculative bubble.

3 A theme I do not develop here is what should the government do with the resources it chooses to store for precautionary reasons (see e.g. Caballero and Panageas (2005)).

2 THE WORLD ECONOMY

For a variety of reasons, many of which I mentioned in the introduction, as of late the world has been experiencing a situation in which assets are in

short supply. In essence, globalization spreads the shortages from specific regions to the world at large. While many of the elements of the analysis in the previous section extend to this context, there are two key di_erences and considerations. First, not all regions of the world are equal in their ability to supply financial assets, and hence the global shortage of assets leads to large capital gains and flows toward the asset-producing regions of the world. Second, an important factor behind the significant potential for crises in emerging markets is the existence of a large number of assets that can substitute for local assets at a moment's notice. This is not the case for the world as a whole or for a large economy like the US. These are the themes we develop in Caballero *et al* (2006a) and, in particular, in Caballero *et al* (2006b).

2.1 GLOBAL IMBALANCES AND LOW INTEREST RATES

The starting point of the analysis is the observation, already present in the previous section, that capital's ability to produce output is only imperfectly linked to its ability to generate assets. A higher capacity to produce output makes the underlying capital more valuable, but the possibility to sell the rights over that output in advance, and hence to create an asset from it, depends on a series of institutional factors that vary widely across the world.

On one end, developed Anglo-Saxon economies, and the US in particular, have managed to combine good growth conditions with an unmatched ability to generate sound and liquid financial assets appealing to global investors and savers. On the other end, emerging market and oil-producing economies have seen large increases in their disposable income, but remain largely unable to generate an adequate supply of good quality assets. Lastly, continental Europe and Japan have been hampered by limited growth and by lagging behind the Anglo-Saxon economies in terms of their ability to produce financial assets.

Other things equal, such configuration leads naturally to the so-called "global imbalances", as the Anglo-Saxons supply financial assets to the rest of the world and experience current account deficits as an unavoidable counterpart. These "imbalances" can go on for a long time and are exacerbated by the rapid growth of China and emerging markets more broadly. Moreover, it turns out that "other things" are not equal, and they tend to reinforce the direction of flows, as a series of demographic and precautionary motives have increased the demand for assets in the global economy.

Much has been said about China's policy of international reserves accumulation and its responsibility for global imbalances. Some of this concern may be justified, but I believe this to be a second-order issue. Ultimately, China is a fast-growing economy with ever-increasing demand for store of value instruments, which its economy is largely unable to generate at the moment. If China had an open capital account, its citizens would seek these assets abroad directly. Since it does not, it is the government that accumulates the international assets and instead issues implicitly collateralized sterilization bonds to its citizens. Unlike the typical sterilization episode, these bonds yield very low returns, which simply reflects the excess demand for store of value they partially satisfy.

The shortage of assets also helps explain the secular decline in long-run real interest rates over the last decade, despite occasional efforts from central banks around the world to raise them (recall the interest rate conundrum). While central banks may be able to control short rates, the long rates are kept low by the high valuation of scarce assets.

These secular forces behind low real interest rates and large net capital flows toward the Anglo-Saxon economies are occasionally interrupted by speculative episodes which raise local asset values in emerging markets. This is the mechanism described in the previous section. The emerging market crises of the late 1990s corresponded to an abrupt and systemic end of one such episode. The result was a massive rise in capital flows to the US and a sharp decline in safe interest rates. In fact it does not seem unreasonable to conjecture that some of the dot-coms bubble in the US resulted from that rapid reallocation. By the same token, the crash in the real estate and stock markets in Japan in the late 1980s was probably an important factor behind the US current account deficits that began to build in the early 1990s.

In summary, endogenous real interest rate drops are market-mechanisms to raise the value of existing assets and therefore replace some of the lost assets after a crash, and to cover part of the asset shortage created by secular forces.

2.2 SPECULATIVE BUBBLES AND LOW INFLATION

The emergence of speculative bubbles and a drop in inflation (perhaps into adeflation), are yet two other market mechanisms to bridge the asset gap.

For reasons similar to those discussed in the emerging markets section, in a world with substantial asset shortages speculative bubbles are not only likely to arise, but also provide an important service to those seeking to store value. In fact, in Caballero *et al* (2006a), we show that under certain conditions, bubbles *must* exist.[4] That is, in the absence of a speculative bubble, there is an excess demand for financial assets and a corresponding excess supply of goods (see the appendix).

The conditions for the must-have-bubbles result are natural within an environment in which assets are in short supply. All that is needed is that the rents accruing to assets currently traded are expected to decline over time

4 Note that this is never the case for a single emerging market economy, since in that case there are many substitute assets.

relative to the size of the economy (but not too fast).[5] For example, it seems sensible to expect that rents from currently owned land are not likely to keep up with the economy's rate of growth for the indefinite future. Note that these are conditions for fully rational bubbles to exist. It is not that I beleive that speculative bubbles are always of this nature. The point is that if the world is in a situation where even fully rational bubbles could be justified (or nearly so), we should not be at all surprised that speculative bubbles (rational or not) take hold so easily.

In reality, agents' portfolios also contain nominal assets issued by the government. This addition gives the economy another adjustment mechanism, since a change in the price level affects the real value of these assets. On the face of an asset shortage, a drop in inflation or an outright deflation when the shortage is due to a crash in asset values, is a market mechanism to revalue nominal assets and help covering the asset-gap.

2.3 POLICY IMPLICATIONS

Theway out of the current juncture is ultimately one of financial development in the regions of the world that have limited capacity to generate store-of-value instruments relative to their demands.[6] Financial development also reduces the incentive and space for inefficient risk-shifting in emerging markets.

But this process of financial development is slow. In the meantime, the world must learn to operate in a high-valuations environment. Failing to understand that some of the observed "anomalies" are symptoms and marketbased solutions can have dire consequences if policymakers start chasing bubbles, "global imbalances" and low real interest rates.

For instance, if the government attempts to and succeeds at bursting an equilibrium bubble, the immediate impact of destroying these assets is to create an excess demand for financial assets and a corresponding excess supply of goods. In the short run, the real interest may drop to zero if the economy comes to a halt, but the relief from this adjustment is minor if capitalizable dividends are small relative to the bubble they are supposed to replace. The rest of the adjustment falls on the real value of nominal assets. However, in reality the value of these assets is too small to offset a significant crash in asset values. For example, even a relatively minor correction such as that experienced by the US

5 The reason these conditions ensure a bubble is that they put an upper bound on the present value of fundamentals (rents), which under the right assumptions is not enough to satisfy the demand for assets in the economy. The gap must be filled by a speculative bubble. The question arises of why can't the interest rate drop as much as it needs to make the present value of fundamentals as large as is needed to satisfy asset demand. The answer is again in the excess demand for store of value. As the economy grows, so does its demand for assets, which ensures capital gains from selling assets in the future. These capital gains mean that the rate of growth of the economy is a lower bound for equilibrium interest rates, from which the upper bound on the present value of fundamentals follows since rents are growing at a rate lower than the economy.

6 Financial development is likely to operate on both ends, by increasing the supply of assets and by reducing the demand for assets (precautionary savings).

stock market at the beginning of the millennia is about twice the size of all the nominal liabilities issued by the U.S. government and held by the private sector. Reasonable increases in the supply of these assets will not suffice, and a sharp decline in the price level becomes the main escape valve of the economy. Complementing this environment with price inertia and a Phillips curve naturally yields a protracted and costly deflationary episode while the economy waits for the Pigou-mechanism to make up for the lost assets.[7]

Instead, policies should focus on managing the risks associated to high valuation equilibria. There are two main dimensions along which speculative equilibria bring about risks: Aggregate and location. The former refers to the size of the collection of all speculative valuations in the economy. It turns out that inflation targeting should suffice to control excessive bubbles at the aggregate level. If valuations grow too much, then the economy enters a region of excess supply of assets and excess demand for goods; inflationary pressures build and hence automatically trigger monetary policy tightening. Unfortunately, as mentioned earlier, the same argument does not apply for deflationary pressures as crashes are often more abrupt than booms. The good news is that if speculative valuations are the result of a shortage of assets, then they are likely to be less prone to crashes absent some strange shock or misguided policy intervention.

Note, however, that while the value of the aggregate bubble is pinned down, there is nothing that determines its location. This observation hints at several policy conclusions: First, chasing a bubble in an asset-shortage environment is likely to move it around rather than eliminate it in the aggregate. This can be costly, as it forces the economy to experience crashes and disruptive reallocations without the reward of a more stable bubbleless economy. Second, monetary policy is not a good instrument to address location problems. These must be dealt with more sector/investment specific instruments, perhaps in the form of a combination of policy induced caps and backing. Third, since high valuations must develop, it is better that they take place in non-resource consuming activities. In this sense, bubbles on land and gold are better than a speculative boom on some industrial activity.[8] Although the ideal is probably that the bubble spreads across a wide variety of assets, thus reducing the cost-impact on sectors that use land, commodities, etc., as inputs of production. Fourth, taking the previous argument to the limit, the impact of loose monetary policy on intermediaries' lending practices has the virtue of creating multiple bubbly assets and hence preventing excessive concentration of bubbles. Of course this effect must be traded off against the more conventional risk-shifting concern. But the point is that there is a trade-off, rather than just a bad effect, as it would be in an environment without an asset shortage.

In summary, the policy conclusion is that in an environment with asset shortages, it is important to recognize that speculative valuations are part of the equilibrium.

7 Moreover, the sharp contraction associated to this mechanism is likely to reduce the value of real assets, exacerbating the required reflation of nominal assets.

8 I hesitate to describe the dot.com bubble as such, since in that case there were plenty of technological externalities which may have offset the privately wasted physical investment.

In this context, the best policy is to minimize the resource misallocation they may cause and to protect their stability. The latter can be achieved by fostering the spreading of the aggregate bubble across many assets (i.e., foster an extensive rather than an intensive margin), by not chasing them indiscriminately, and by providing some sort of implicit or explicit backing to some of the speculative assets. The good news is that in a world of low interest rates, even a pledge of a small share of the tax receipts can back a large amount of assets, as long as the total revenue from these taxes grows in tandem with the economy.

3 ECONOMIZING ASSETS: A LENDER OF LAST RESORT

Financial intermediaries have significant demands for store of value. However, in a world with limited asset supply, hoarding collateral assets is expensive. This encourages intermediaries to take larger risks by trimming the backing of their financial obligations.

There are limits on how much collateral-trimming is feasible and desirable. If excessive, the risk of a systemic crisis rises and may trigger panics, especially when agents are confused by Knightian uncertainty (which is often the case during financial turmoil). Facing this risk, it is tempting for a regulator to force financial intermediaries to increase their collateral position. But this regulation can be costly if imposed in response to a situation created by widespread scarcity of collateral assets. Of course this consideration must be traded off against the standard risk-shifting and moral hazard concerns. But the point is, again, that the scarcity of collateral assets establishes a meaningful trade-off and mechanically applying rules suitable for other environments can be counterproductive.

The question arises whether there are more efficient means of intervention in this environment. This is the issue we address in Caballero and Krishnamurthy (2006b).

We show that when Knightian uncertainty is a concern and a source of collateral freezing, a lender of last (not intermediate!) resort (LLR) can play an effective role even if it is less informed than the private sector. Moreover, very little of the gain needs to come from the direct intervention of the LLR, as the benefit of the policy derives primarily from improved efficiency in the use of private collateral.

The reason the LLR has this power is that it exploits a *collective bias* in the implicit assessment of the probability of extreme aggregate events by private agents. We show this result in a context where financial intermediaries understand the risks of their own market, but are uncertain about the risks in other markets. In particular, they fear not being able to collect on their claims if other markets are hit before theirs. In response to this uncertainty, intermediaries demand for other intermediaries to fully collateralize their contingent liabilities, which inefficiently locks scarce collateral assets.

The LLR may know less about each market than do intermediaries, but it does know that it is impossible for all intermediaries to come out second in the event of acrisis. This knowledge is enough toleverage the value of a LLR facility, as for any given level of resources pledged by the LLR, intermediaries collectively magnify its value and free collateral accordingly.

4 FINAL REMARKS

In these notes I have argued that many of the main macroeconomic events of the last two decades, both for developing and developed economies, can be understood by recognizing a powerful, yet largely ignored ingredient in the analysis of these events: the world seems to have a severe shortage of assets.

This ingredient has positive and normative implications. Among the former, emerging market boom-bust cycles, global imbalances, low real interest rates, deflationary episodes, recurrent bubbles, and financial panics, all follow naturally from this view.

As for policy, perhaps the main advice is the importance of recognizing the source of these symptoms and the fact that some of them are simply the market's attempt to fill the asset gap. In this context, knee-jerk reactions to the emergence of speculative bubbles and global imbalances can be counterproductive.

5 APPENDIX

The following model illustrates a situation in which the economy must have a bubble. Suppose that the financial wealth of a country, W, is composed of the present value of rents, F, and a bubble, B. The flow counterpart of F is a dividend f. Total output in the economy is made of these rents and some endowment, totalling y and growing at a rate g. These goods are non-storable and consumption is proportional to financial wealth (hence, there is a non-ricardian feature): $c_t = \theta W_t$.

Equilibrium in the goods market requires that:

$$\theta W_t = y_t$$

Now suppose that dividends grow a rate $g - \rho < g$, then, for a given sequence of real interest rates $\{r_t\}$,we have:

$$F_t = f_t \int_t^{\infty} e^{\int_t^s (r_\tau + p - g) d\tau} ds < \frac{f_t}{p}$$

where the last inequality follows from the fact that in this economy the interest rate converges to g from above. To see this, note that the standard arbitrage equation is:

$$r_t W_t = f_t + \dot{W}_t$$

Replacing W by y/θ and rearranging, yields:

$$r_t = \theta \frac{f_t}{y_t} + g > g.$$

Replacing W by its components and dividing by the propensity to consume, we find that:

$$F_t + B_t = \frac{y_t}{\theta}$$

to imply:

$$B_t \geq \max\left\{ \frac{y_t}{\theta} - \frac{f_t}{p}, 0 \right\}$$

It follows that if the share of income from rents is not too large, the economy must have a bubble in equilibrium.

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IDENTIFYING A BUBBLE: NEWS FROM THE REAL SIDE!

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1 INTRODUCTION

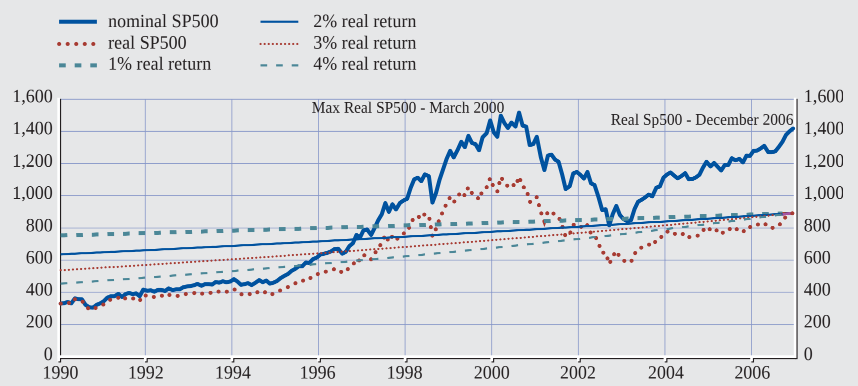
Can broad monetary and credit aggregates help identify a bubble and select an appropriate monetary policy stance? Christiano, Motto & Rostagno provide an innovative first answer and thus open a road that deserves to be explored systematically in the future. Their context is very specific, however. A broader reading of the recent literature calls for prudence. In this short note, I first draw some lessons for bubble identification from the recent market experience. I then review recent advances of the literature that shed new light on the difficult challenge of recognizing a bubble.

2 THE "GREAT BUBBLE" IN RETROSPECT

The equity markets peaked in March 2000 and then fell until 2003 before starting a phase of strong expansion that is still on at the time of this writing. The peak of 2000 is now almost uniformly considered as the manifestation of a bubble and the market valuations of the time viewed as unwarranted. Today, equity markets are high but the assessment of the near future is positive: few would characterize current valuations as obviously excessive or irrational. This situation provides us with an interesting benchmark for reviewing the experience of the end of the 1990's: if the valuations of December 2006 are rational what can be said on the size and the timing of the 2000 bubble and what insight can one obtain on the monetary policy of the end of the 1990's?

Chart 1 reports the evolution of the S&P500 from 1990 to December 2006 in nominal terms (thick blue line) and deflated by the CPI. In nominal terms, the S&P500 is within 100 points of its all-time high and the trough of 2003 has been erased, but clearly this is not the appropriate vantage point. Despite moderate inflation, dollars of 2006 do not have the same purchasing power as dollars of 2000. In constant dollars, the S&P500 still is some 20% below its peak of 2000. Accepting the hypothesis that today's valuations are warranted gives us some indication as to when the bubble might have started. Thus, while the December 1996 "rational exuberance" statement of Alan Greenspan might indeed have signalled the starting point of excessive valuations, the lower thin teal green dashed line in Chart 1 indicates that an investor entering the market at the time of Greenspan's speech would have made a nice 4% real annual return on a buy-and-hold investment liquidated ten years later in December 2006. Exuberance perhaps, but with hindsight very rational! A more prudent circumscribing of the bubble, given by the top thick teal green dashed line in Chart 1, would date the

Chart 1 SP500 and SP500 deflated using CPI



start of excessive valuations close to two years later, that is, in September 1998. A buy-and-hold investor entering the market at that time would have made a positive but more modest 1% real annual return on a buy-and-hold strategy pursued until December 2006. In that view, the bubble itself would have lasted some 34 months until July 2001 and the window of intervention for the Fed would have been 18 month long, that is, between September 1998 and March 2000.

While this discussion does not invalidate the view that the episode is a manifestation of a bubble, the date at which the Fed should have initiated interventions is clearly difficult to ascertain, even with hindsight. So is the extent of the real costs the Fed should have been prepared to impose on the economy.

3 A BETTER PERSPECTIVE: THE LUCAS TREE ECONOMY

The factual discussion of the preceding section is partly misleading: the inflation correction applied to nominal market valuations is insufficient. This is because the capital stock which one is valuing on the stock market has grown in volume and productivity over the period and it is producing an output of goods and services that is significantly larger than at the beginning of the 1990s. This remark is even more striking as one adopts a longer period of observation. Chart 2 displays the constant dollar S&P500 since 1870. This is a very popular representation from which the hypothesis of a 2000 bubble has received its most spectacular support. Yet the message drawn from this picture is profoundly distorted since the capital stock valued in the S&P500 is an order of magnitude larger in 2000 than it was in 1870.

A good way of correcting the distortion, while also avoiding statistical controversies linked with estimates of the capital stock and of Tobin's Q and simultaneously taking inflation into account, is to relate the total market capitalization (rather than the value of an index such as the S&P500) to nominal

Chart 2 SP500 deflated using CPI – 1870-2007

Source: R. Shiller, http://www.econ.yale.edu/~shiller/data.htm.

Gross Domestic Product (GDP). Such a ratio is reported in Chart 3 for the period 1960-2001. Here the thick blue line displays the total value of US corporations (including debt) divided by nominal GDP while the red dotted line reports the value of corporate equity relative to nominal GDP. For most of the period there is little difference between the two views as the net indebtedness of the corporate sector is close to zero. Unfortunately the sample is shorter than the remarkably long stretch of data used in Chart 2 but the point can be made nevertheless. One observes in particular that, while in Chart 2 the early 1980's display valuation levels comparable to those of 1960, taking account of economic growth leads one, on the contrary, to view the early 1980's as a period of low valuations relative to the early 1960's. This being said, Chart 3 does not invalidate the view that market valuations at the end of the 1990's were historically very high.

The message from Chart 3 is more encompassing, however. The perspective is one where the capital valued in the stock market is presented in relation with what it is producing. It is in the spirit of price-earnings ratios except that it adopts a more global macroeconomic viewpoint: the economy is a machine using capital and labor to produce output. The value of capital as measured by the stock market depends on the amount of capital – which has grown over time – and on its per unit price. The price of capital depends on the value that it permits to create, that is, on its productivity which has grown even faster than sheer volume. Importantly it also depends on the fraction of the value created that ends up in the hands of capital owners.

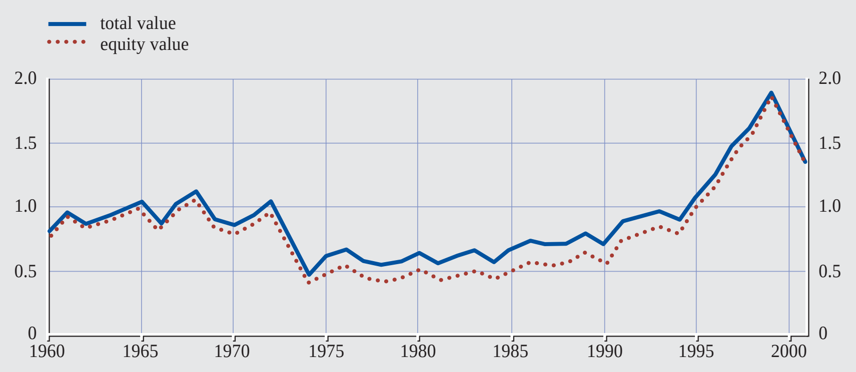
The macroeconomic perspective requires exercising caution, for one because the share of the capital of an economy represented by *publicly traded firms* may vary over time – the trend towards private equity is, conceptually, a case in point although it is likely to be of limited importance quantitatively. But this perspective has also tremendous advantages, in particular when one adopts the long view. Except for well-defined special circumstances, one would expect the ratio represented in Chart 3 to be stationary or mean-reverting (this does not mean, of course, that it is constant). Looking at the value of the corporate sector relative to GDP also has the advantage that it draws the attention to potential mis-measurements that are hard to pinpoint when focusing on purely financial ratios. Indeed the link between the macroeconomic and the financial sides of the economy suggests taking a hard look at how one measures the capital that is being priced on the stock market, how value added is shared between capital and labor, and how the owners of equity may be affected by taxation issues. Recent research has contributed along these 3 dimensions underlining considerations that are rarely taken into account in financial circles.

First, in order to produce modern goods and services, bricks and machines have increasingly been supplemented by what is often subsumed under the term of intangible capital: ideas, patents, social capital, goodwill, etc., all items that are known to be poorly measured in the accounts of the corporate sector as well as in national income accounts. By some estimates, in the case of the US economy the value of mis-measured capital amounts to one time yearly GDP (McGrattan and Prescott, 2005) or more (Corrado, Hulten and Sichel, 2005). Hall (2001) had suggested that e-capital could explain a good deal of the rise in stock market values in the 1990's. Danthine and Jin (2007, forthcoming) argue that the process of accumulating intangible capital is very different in nature from the accumulation of physical capital. Assuming intangible investment is akin to R&D investment helps explain observed (high) volatility of aggregate returns, market capitalization to GDP ratio, and price to earnings ratios.

Second, the sharing of value added between capital and labor, while recognized to follow a stationary process, accepts persistent deviations from the mean which represents a significant risk factor. Current concerns over the decreasing share of labor in GDP are a case in point. From the viewpoint of capital owners, these variations are a major source of risk: the share of value created ending up in the hands of capital owners may be linked with global social and economic factors on which they have little control, that is, which from their perspective are stochastic and likely to be uninsurable. Danthine and Donaldson (2007) show that taking distribution risk – persistent, idiosyncratic, priced risk – into account explains significant movements in equity prices that cannot be explained if one adopts a purely financial viewpoint.

Third, taxation of capital income has undergone substantial variations which interestingly are left totally unrecognized by focusing on price to earnings ratio. Thus Ellen McGrattan and the 2004 Nobel Prize winner Ed Prescott (MGP hereafter) estimate that changes in the legal and regulatory system have led to a dramatic increase in the share of corporate equity held by entities (pension funds, individual retirement accounts, and non-profit organizations) that pay no tax on dividends or capital gains income. That share moved from 4% in 1960 to 51% in 2000. Coupled with reductions in marginal income tax rates and the elimination of capital investment subsidies, these changes imply that effective marginal tax rates on distribution have fallen by more than a factor of two. While it can be argued that these are one-off, low frequency, events, MGP show that existing constraints on individuals shifting savings from non-retirement accounts to retirement accounts plausibly result in long adjustments (15-year transition period). These changes are of first-order importance. MGP in fact estimate that once one takes into account changes in taxes and regulatory

Chart 3 Value of US corporations relative to GDP (1960-2001)



Source: McGrattan and Prescott, 2005.

system, puzzling changes in the ratio Market Cap /GDP (increases in the 1980's and 1990's) with little changes in the capital to output ratio or earnings share of output can be accounted for by an otherwise standard stochastic growth model. In other words, the underlying structural changes are important enough – when viewed through the prism of dynamic general equilibrium theory – to lead them to think that market valuations as reported in Chart 3 for the year 2000 were not less economically rational than those observed for the 1980's or the 1960's!

4 CONCLUDING REMARKS

Christiano et al. provide an intriguing and constructive contribution to our understanding of bubbles and monetary policy. One should not conclude from it that equity booms and busts are predominantly money made. Alternative recent contributions have, on the contrary, insisted on the fact that understanding asset price movements requires, inter alii, insights from public finance and labor markets. Disentangling ex-ante real changes in valuations originating in changes in the cash flow generating process, and in the links between cash flows and distributions, from non-fundamental movements or bubbles such as expectations errors fed by inappropriate monetary policy is a huge task that is far from completed!

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INCORPORATING REAL AND FINANCIAL SECTOR DATA WITHIN AN INFLATION TARGETING FRAMEWORK

BY MARK GERTLER, NEW YORK UNIVERSITY AND FEDERAL RESEREVE BANK OF NEW YORK

In a speech delivered earlier at this conference, Otmar Issing called for more research on the role of the financial sector in monetary transmission. I completely agree. I also totally agree that that these kinds of considerations are relevant to the formulation of monetary policy. In my discussion I would like to outline briefly how I believe financial factors should be integrated into policy design.

In my view, the most natural way to think about these issues is within an inflation targeting framework. Indeed, in the end I will argue that there is no tension between adjusting policy to account for financial factors within the context of a general inflation targeting strategy for monetary policy. I will also suggest financial factors can be incorporating within an inflation targeting framework in a fairly natural way.

It is useful to first distinguish three distinct dimensions of inflation targeting: The first involves setting an explicit numerical objective for inflation. This objective may take the form of a single number or more typically a range. Here the idea is to provide an anchor for expectations in order to make the process for stabilizing inflation as painless as possible.

The second dimension involves setting a plan for the path of inflation to target. In the language of Svensson and Woodford, this involves designing a targeting rule that characterizes the expected transition of inflation to target under the central bank's preferred policy. The exact nature of the targeting rule depends heavily on the characterization of the short term Phillips curve. For example if there is no trade off between inflation and output one could move to the target right away, presuming that central bank is fully credible. Conversely, if there is a trade off, the targeting rule may call for inflation to move gradually to its bliss point over time. How fast will in general depend on sensitivity of inflation to real activity and the relative weight on stabilizing inflation versus output one can derive a path for transition of inflation towards the target.

At this point one question might be why not define the nominal anchor in terms of monetary or credit aggregate and, in this vein, why not design a targeting rule in terms of this kind of aggregate. The experience of the Federal Reserve and other major central banks suggests that these aggregates tend to be very unstable, especially when monetary policy aims to target them. This greatly complicates defining a reasonable target for such an aggregate, as well as a path to target. In addition, since the goal of having a credible nominal anchor its ultimately to influence price setting behavior, it seems most direct to state the aggregate in terms of the desired long run average rate of price change. Thus, overall, it appears best define the nominal anchor in terms of inflation and have the first step in the policy process involve deciding the desired path to this target.

Where where financial factors enter, I believe, involves the third dimension of inflation targeting. This aspect involves choosing a feedback rule for the policy instrument (the short term interest rate) that moves inflation to target along the desired path. Financial factors matter to this decision for three reasons. The first two are closely related: First, financial factors may affect the transmission of monetary policy. Second, they may influence the natural (flexible price equilibrium) real rate of interest. Both these considerations suggest financial factors will influence the direction and size of interest rate adjustments required to generate a given amount of stimulus to spending. The third consideration is that, even if financial market frictions have only a minimal role in economic activity, financial variables may provide useful signals about the state of the economy. They are typically well measured. While no single indicator may be perfectly reliable, a broad array of financial data could provide useful information.

I illustrate these points with two models. The first is a conventional New Keynesian model with investment and asset prices. The second is a slight variation of this framework that allows for financial frictions in the spirit of Bernanke, Gertler, Gilchrist (1999, BGG), Christiano, Motto and Rostagno (2008, CMR) and others.

I begin with the New Keynesian model with investment and asset prices but absent financial frictions. Let me first define the following three variables, all expressed as percent deviations from respective natural (flexible price equilibrium) values: $\tilde{y}_t$, the output gap; $\tilde{rr}^l_t$, the long term real interest rate gap; and; $\tilde{q}_t$ the ratio of the market value to the replacement value of capital (Tobin's Q) gap. Next let r_t denote the nominal interest rate, π_t the inflation rate, rr^n_{t+i} the natural rate of interest and μ_t the price markup. Then based on a loglinear approximation of the model, one can derive the following set of relations that characterize aggregate demand (see Gali and Gertler, 2007):

$$\tilde{y}_t = -\gamma_c \tilde{rr}^l_t + \gamma_i \tilde{q}_t \quad (1)$$

with

$$\tilde{rr}^l_t = E_t \sum_{i=0}^{\infty} (r_{t+i} - \pi_{t+l+i} - rr^n_{t+i}) \quad (2)$$

$$\tilde{q}_t = E_t \sum_{i=0}^{\infty} \beta^i \left[(1-\beta)(E_t \tilde{y}_{t+1} - \mu_{t+1}) - (r_{t+i} - E_t \pi_{t+1+i} - rr^n_{t+i}) \right] \quad (3)$$

Equation (1) links the output gap to the long term interest rate gap and the q gap. Intuitively, an increase in the long term real interest rate gap reduces consumption relative to its natural level (by increasing the incentive to save.) A rise in the q gap induces firms to raise investment relative to its natural value. Due to the expectations hypothesis of the term structure, $\tilde{rr}^l_t$ depends positively on the current and expected path of the short term real interest rate gap. Conversely, $\tilde{q}$ depends inversely on the current and expected path of the short term real interest rate gap. This is because $\tilde{q}_t$ is a discounted sum of the expected discounted return to capital. Accordingly, by manipulating short term interest rates, the central bank can influence the output gap. The effect works through the impact of the current and expected path of the short rate on the long term real rates and Tobin's *q*. Note the natural rate of interest provides an important reference point. What matters for the output gap is the movement in short term real rates relative to the natural values. Thus, any well formulated monetary policy for setting short term rates must take into account movements in rr_t^n. We elaborate on this point below.

The aggregate supply relation is given by a New Keynesian Phillips curve:

$$\pi_t = -\lambda\mu_t + \beta E_t\pi_{t+1} + u_t \tag{4}$$

with

$$\mu_t = -\kappa\tilde{y}_t + \omega\tilde{q}_t \tag{5}$$

where u_t is a cost push shock. Inflation depends inversely on the average price markup (equal to the inverse of real marginal cost) and positively on expected future inflation and the cost push shock. The price markup, in turn, varies inversely with the output gap and positively with the Tobin's *q* gap. The latter affects $\tilde{q}_t$ because, holding constant output, a shift in the composition of output from consumption toward investment reduces real marginal cost by reducing wage pressures (see Gali and Gertler, 2007). If there were only consumption goods, then the markup would simply vary inversely with the output gap, as in the standard formulation of the New Keynesian Phillips curve.

The model determines $\tilde{y}_t$, $\tilde{rr}_t^l$, $\tilde{q}_t$, π_t, and μ_t conditional on the path of the central bank's policy instrument, the short term interest rate r_t and the two exogenous variables, the natural rate of interest, rr_t^n and the cost push shock u_t. I now consider two different policy feedback rules, each of which is consistent with inflation targeting

1. Simple Taylor Rule: $r_t^* = \phi\pi_t$

2. Taylor Rule adjusted for rr_t^n: $r_t^* = rr_t^n + \phi\pi_t$

The first is a simple Taylor rule that has the central bank adjust the target nominal rate r_t^* in response to current inflation and the second is a variant that has the intercept in the rule vary one-for-one with movements in rr_t^n. I assume that $\phi > 1$, so that nominal rates rise more than one-for-one with inflation. This restriction makes either rule consistent with inflation targeting, since it ensures that the central bank changes nominal rares sufficiently to change real rates in a direction that adjusts aggregate demand to offset deviations of inflation from target.

In addition, I presume that there is interest rate smoothing that takes the form of partial adjustment to target:

$$r_t = (1-\rho) r_t^* + \rho r_{t-1}$$

Now let's suppose as in CMR, that in a low inflation environment for developed economy that the main business cycle driving force are shifts in expected productivity growth rates. The question then is how does a Central Bank respond in this instance. In answering this question it is important to keep in mind that these shifts will have important implications for the natural real rate of interest.

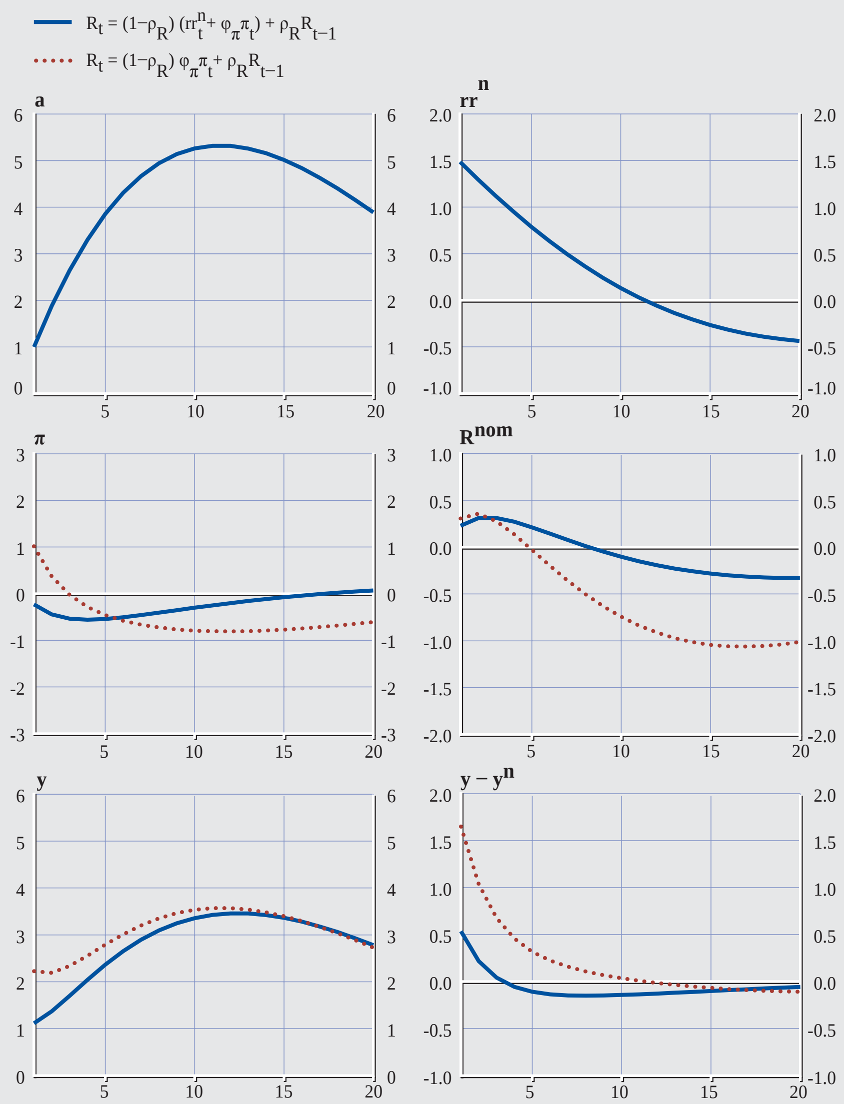
To address the model I presume that there is a persistent burst in the growth rate of productivity that eventually dies out. I parametrize this shock process as well as the rest of the parameters in the model following Gali and Gertler (2007). The calibration, further, is for a quarterly model. The first chart shows the results.

The top left panel shows the burst in productivity growth, which I take to be fully anticipated. The natural real rate rises immediately, as the top right panel shows. Though I do not show the result here, the productivity boom produces a rise in the the natural level of output. The middle and bottom rows show the response of inflation, the nominal rate, output and the output gap under the two different policy scenarios. The solid line portrays the case where the central bank adjusts the nominal rate to compensate for movements in the natural real rate, while the dotted line protrays the case where it does not include rr_t^n in the rule. In the case where the central bank does adjusts for movements in rr_t^n, there is a rise in output that closely tracks the rise in the natural level of output. As the bottom left panel shows, there is a spurt in output growth that is similar pattern to the rise in productivity growth. The rule does a good job though at keeping the output gap close to zero, as the bottom right panel shows. As a consequence, inflation stays close to zero.

Under the rule that does not compensate for movements in rr_t^n, there is a boom in output that outpaces the movement in the natural level of output. As the bottom right panel shows, the output gap rises substantially and stays positive for more than a year. Intuitively, by not raising the nominal rate directly in response to the increase in the natural real rate, the central bank is effectively providing excess stimulus to the economy. This accounts for the excessive movement in the output gap in this case. Overall, by not compensating for movements in rr_t^n the central bank is effectively injecting excess output volatility into the economy.

Note that in either case, the movement of inflation is relatively modest. There is a brief modest spurt of inflation in the case of the simple Taylor rule, but it does not last for more than two quarters. The reason that inflation is relative stable in each case is that we have assumed that the central bank's long run inflation target is credible. Thus the private sector's beliefs about trend inflation are firmly anchored, making the only source of variation in inflation excess

Chart 1 Baseline model: positive shock to technology growth



demand. Given that the slope cofficient on the output gap in the Phillips curve is quite small, this latter source of variation in inflation is not large. Thus, what we conclude from this exercise thus far is that a variant of a Tayor rule that compensates for movements in rr_t^n appears effective at maintaining price and output gap stability in the face of shocks to expected productivity growth, so long as long run inflation expectations are anchored.

We next consider a variant of the model with financial market frictions and then show that the same general principles may apply. We introduce financial market frictions in a very simple reduced form way, but in a way that is very much in the spirit of BGG and CMR. Let: $rr^k \equiv$ required real return on capital and let $z_t \equiv$ external finance premium, i.e. the wedge between the borrower's cost of external funds and the opportunity cost of internal funds. Then by definition:

$$rr^k = z_t + \left(r_t - E_t \pi_{t+1} - rr_t^n\right) \tag{6}$$

We presume that the external finance premium behavers as follows:

$$z_t = -\eta \left(q_t - E_{t-1} q_t\right) + \rho_z z_{t-1} \tag{7}$$

Intuitively, an unanticipated increase in the market price of capital improves that borrower's balance sheet, thus reducing the external finance premium. The effect persists, further, because expected movements in balance sheet positions evolve slowly.

Equation (7) is a rough reduced form representation of the structural relation for the external finance premium that is derived in BGG I accordingly fix the parameters so that the sensitivity of z_t to unexpected movements in q_t and the persistence of z_t is very similar to that in BGG.

The next chart illustrates how financial market frictions affect model dynamics. I repeat the same experiment as before, though with just with the simple Taylor rule that does not respond to rr_t^n. The solid line shows the case with financial market frictions while the dotted line shows the case without. One difference from before is that I examine a negative shock to expected productivity growth, as opposed to a positive one. I do so for no other reason than to illustrate plainly how financial factors might induce a crisis and how the magnitude of the crisis can depend on the monetary policy rule in place.

As the chart shows, at least for the case of the simple Taylor rule, the financial market frictions amplify the contraction in both output and the output gap. As in BGG, the financial market frictions introduce a feedback between asset prices and real activity that works to enhance the contraction in both. News of lower productivity growth, leads to an unexpected contraction in asset prices, which raises the external finance premium. This reduces investment, which then further reduces asset prices, and so on. The volatility of inflation remains relatively modest, again because long run inflation expectations are anchored.

I next show that the severity of the crisis is very sensitive to the monetary rule and in particular, whether or not the rule compensates for movements in the natural rate of interest. I repeat the previous experiment for the model with financial market frictions. The solid line in the next chart is the case of the Taylor rule that responds to rr_t^n, while the dotted line is the case with the simple Taylor rule that does not. As the chart shows, the rule that adjusts for rr_t^n, greatly dampens output volatility without enhancing inflation volatility.

Here we conclude that even though financial factors are important within this model economy, a well designed policy rule in the context of an inflation

Chart 2 Negative shock with and without financial frictions

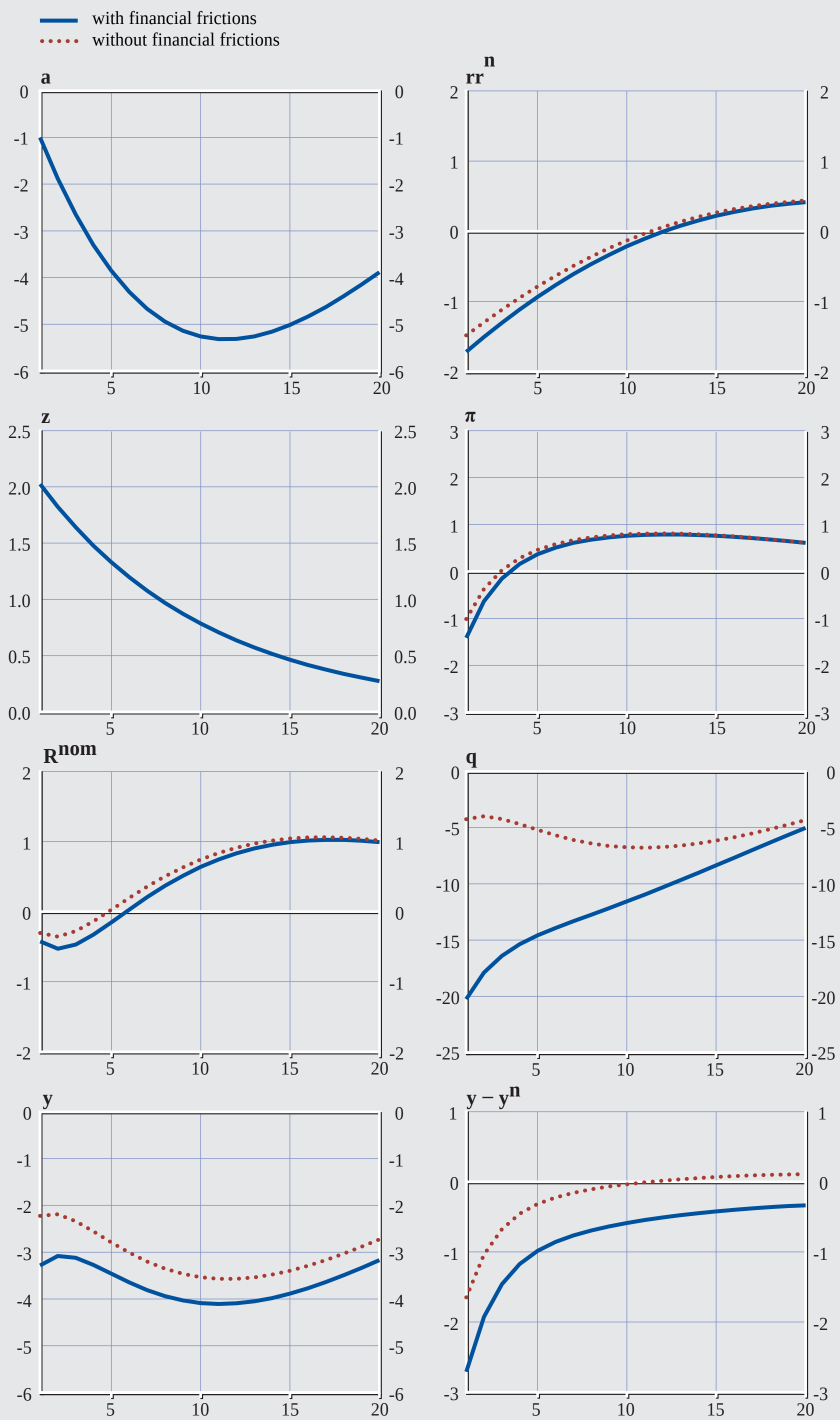
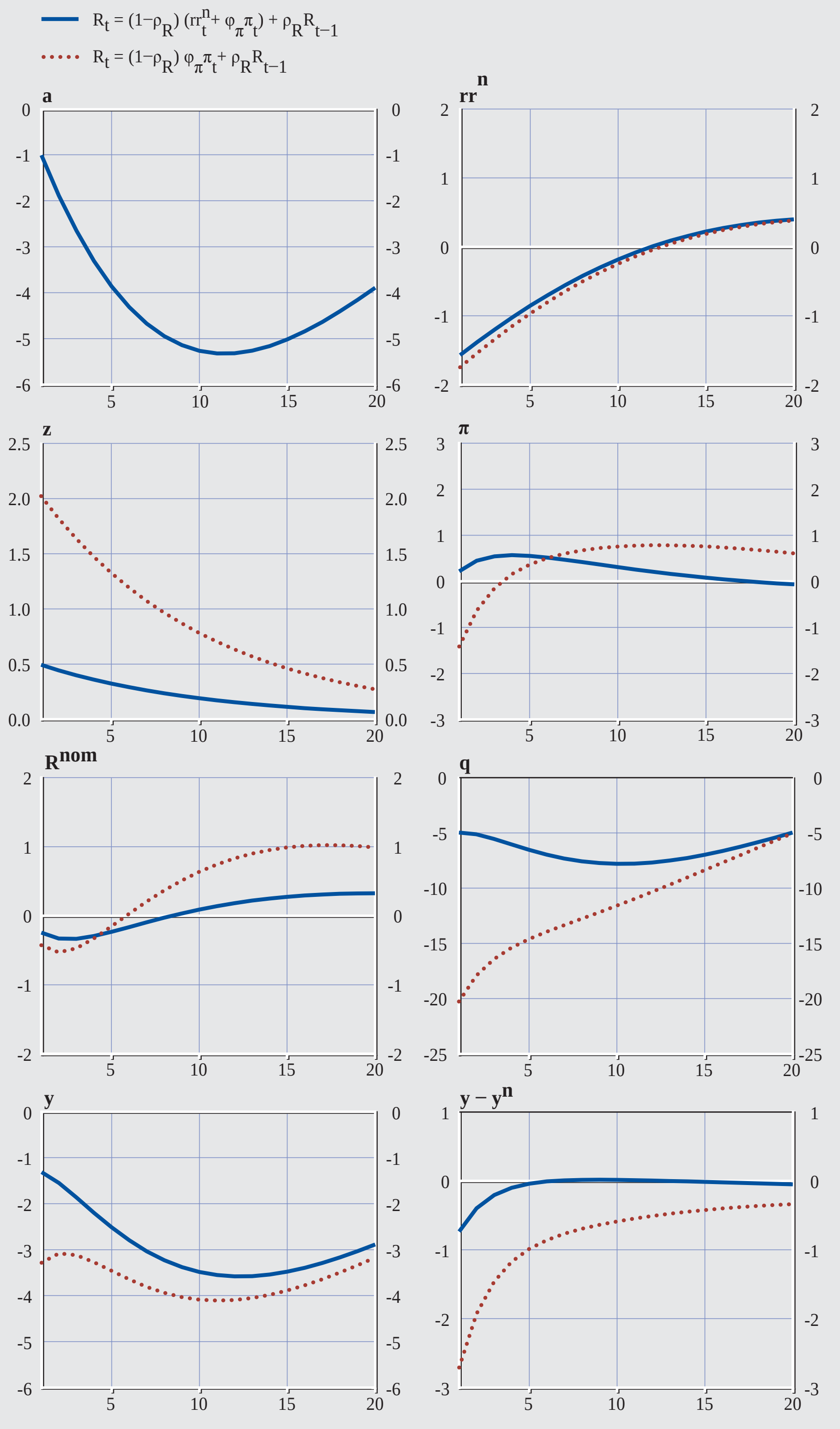


Chart 3 Financial frictions with and without adjusting to rr^n



targeting framework can have desirable stabilizing properties. The message is similar to the conclusions of Bernanke and Gertler (2001).

Let me conclude with several qualifications:

CMR rightly conclude that is nominal wage rigidity is a significant force then inflation may be even less revealing about the state of excess demand than it is in the framework I present here. My hunch though is that the appropriate response in this kind of setting would be to condition policy on a combination of price and wage inflation, as suggested in Woodford (2003).

It is also true that the natural rate of interest is not directly observable. It is possible that the central bank could use a combination of financial market data and inflation to infer movements about the natural rate. One caveat though is that the information content that financial market variables may have about the natural rate may depend on the policy environment, as the last chart illustrates.

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MONEY, LIQUIDITY AND FINANCIAL CYCLES[1]

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Asset price booms are sometimes attributed to excess liquidity in the financial system. Financial commentators are fond of using associated metaphors, such as the financial markets being "awash with liquidity", or liquidity "sloshing around".[2] These comments typically attempt to link the liquidity in the financial system to the stance of monetary policy and the evolution of asset prices such as stock market indices or housing prices. However, the precise economic mechanisms underlying such arguments are less clear.

Here, we attempt to shed light on such arguments by addressing two, more narrowly defined questions. First, can we interpret "excess liquidity" to mean excessive growth of the money stock? Second, what is the relationship between the growth in the money stock and asset prices?

Monetarist economists such as Tim Congdon (2005) argue that asset price booms and busts are caused by the fluctuations in the stock of broad money. Broad money includes not only cash and demand deposits, but the wide range of other short term claims on banks. The mechanism behind Congdon's argument is the desire by non-bank financial institutions (in particular, insurance companies) to target a fixed proportion of money holdings as a proportion of total assets in their portfolio. When the money stock increases, insurance companies end up holding too much money relative to other assets. As they attempt to diversify out of money, they bid up the prices of other assets.

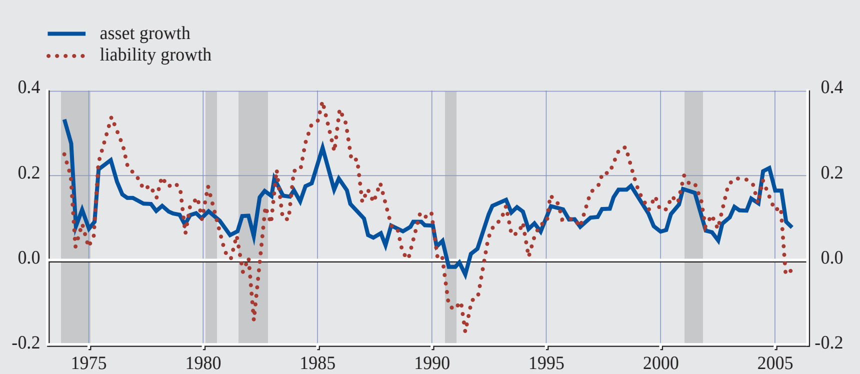
An alternative perspective, and one that we will explore here, is to focus on the actions of the banks themselves. Suppose (for the moment) that we can identify the money stock with the sum of all bank liabilities, including inter-bank liabilities. Then, asking what the relationship is between the growth in the money stock and asset prices is tantamount to asking what the relationship is between the total sum of the liabilities of the banking sector and asset prices.

A bank is a leveraged institution; it has liabilities to depositors and other lenders in the financial system. Thus, when the value of its assets rises, its net worth rises at a much faster rate. Equivalently, when the value of its assets rises, the bank's leverage falls – its net worth as a proportion of its liabilities falls. How does the bank react to such an erosion of its leverage? The empirical evidence on the behavior of banks suggests that they are conscious of changes in overall leverage, and will act so as to manage their leverage actively.

1 The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York or the Federal Reserve System.

2 See "Still gushing forth," The Economist, February 3, 2005, and "Bubbles caused by cheap Cash menace World Economy," Reuters, July 24, 2006.

Chart 1 Asset and liability growth of U.S. bank holding companies (Quarterly)



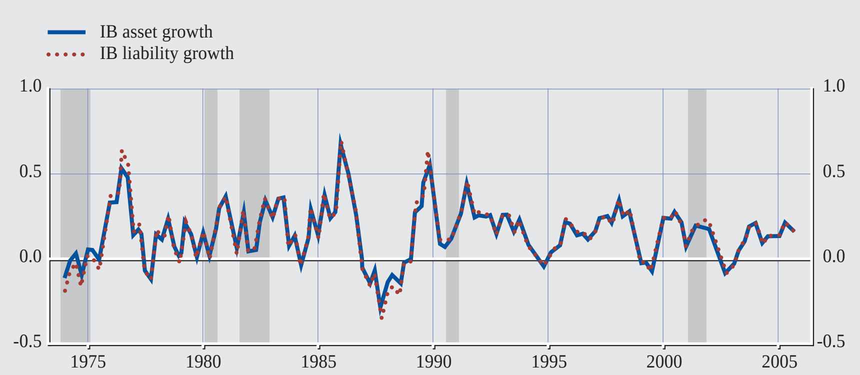
Let us first consider some aggregate numbers. Chart 1 shows the changes in the assets and liabilities of bank holding companies in the United States, drawn from the Federal Reserve's Flow of Funds data. It is apparent that liabilities are more volatile than the assets, implying that the overall book leverage of bank holding companies is high during booms and low during troughs. In other words, bank leverage (as measured by book values) is pro-cyclical. During booms, banks increase their liabilities more than the increases in their assets, resulting in higher leverage. During the troughs, they reduce their liabilities more drastically than the fall in their assets, resulting in lower leverage during downturns.

For bank holding companies, a large proportion of their assets are loans that are carried at book value. During booms, the book value of loans will understate the market value of such loans, while during troughs in the financial cycle, the book value will *overstate* the market value of such loans. Thus, Chart 1 is likely to overstate the fluctuations in leverage by failing to adjust the book value of loans to market values.

Much more striking is Chart 2, again showing aggregate data, but this time for investment banks (including brokerage firms). For investment banks and brokerage firms, their assets consist largely of claims that are either marketable or can be priced reliably, and hence the accounting value of their assets would closely mirror the marked-to-market value of such claims.

What is striking about Chart 2 is that the changes in assets and liabilities are almost one-for-one. Some items on the liabilities side of an investment bank's balance sheet (such as short sales of some assets to fund long positions in other assets) would tend to move in tandem with shifts in value of its assets, and so we could expect some co-movement in the asset and liabilities series. However, much of an investment bank's liabilities consist of short term borrowing (e.g. through repurchase agreements), and so the fact that the asset and liabilities series move together so closely is evidence of active management of leverage

Chart 2 Asset and liability growth of investment banks (Quarterly)



by the banks themselves. In other words, it appears that investment banks have a target leverage ratio, and they will adjust their balance sheets so as to hit this target leverage.

CONSEQUENCES OF TARGETING LEVERAGE

Before delving deeper and looking at the behavior of individual banks, it is worth pausing to consider the consequences for the financial cycle of a target leverage ratio. When there is a target leverage ratio, the demand and supply response to asset price changes can be perverse. Contrary to the textbook norm, demand curves can become *upward-sloping*, and supply curves can become *downward-sloping*.

To see this, consider an increase in the price of assets held widely by the banks that are targeting leverage. The increase in the price of assets strengthens the banks' balance sheets. In other words, the banks' net worth increases as a proportion of their total assets. When banks' balance sheets become stronger, their leverage falls. If the banks have a target leverage, they must respond to the erosion of leverage.

How can they restore leverage? One way that they can do so is by borrowing more, and using the proceeds to buy more of the assets they already hold. In other words, when asset price rises, the banks demand more of the asset. The demand curve is upward-sloping.

If we further hypothesize that greater demand for the asset tends to put upward pressure on its price (a plausible hypothesis, it would seem), then there is the potential for a feedback effect in which stronger balance sheets feed greater demand for the asset, which in turn raises the asset's price and lead to stronger balance sheets. Having come full circle, the feedback process goes through

Chart 3 Target leverage in booms

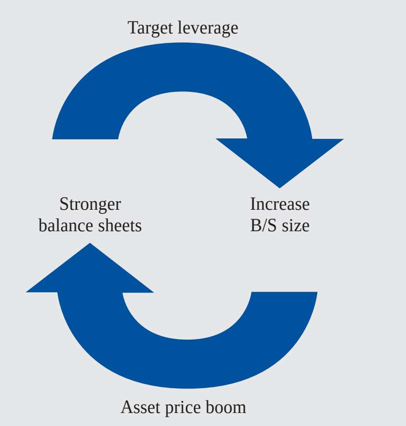
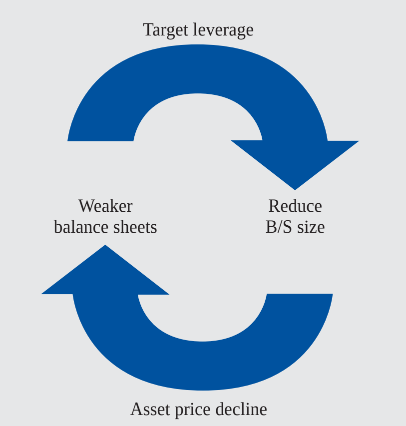


Chart 4 Target leverage in busts



another turn. Chart 3 illustrates the feedback during a boom. Note the critical role played by the behavior of targeting leverage.

The mechanism works exactly in reverse in downturns. Consider a fall in the price of an asset held widely by all the banks. Then, the net worth of the bank falls faster than the rate at which asset falls in value. The leverage of the bank thus increases. If a bank is targeting leverage, it must attempt to reduce leverage in some way. How can it do so? One way it can accomplish this is to sell some of its assets, and use the proceeds to pay down its debt. Thus, a *fall* in the price of the asset can lead to an *increase* in the supply of the asset. The supply curve of the asset can thus be downward-sloping.

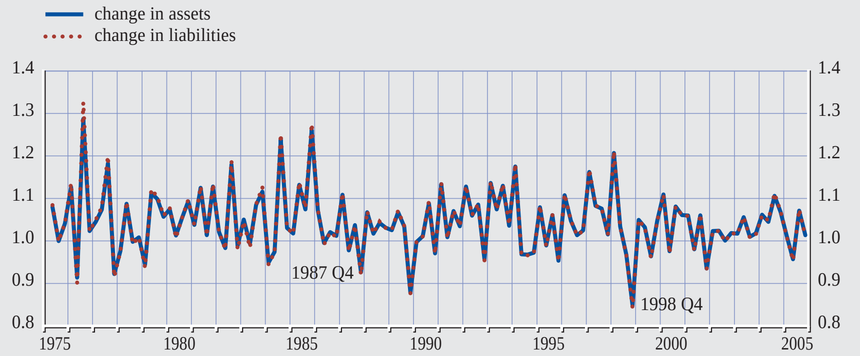
If we further hypothesize that greater supply of the asset tends to put downward pressure on its price, then there is the potential for a feedback effect in which weaker balance sheets lead to greater sales of the asset, which depresses the asset's price and lead to even weaker balance sheets. But weaker balance sheets will kick off another cycle of selling and price falls. Chart 4 illustrates the feedback during a bust. Again, note the critical role played by the behavior of targeting leverage. The scenarios painted in Chart 3 and 4 can be formalized once the apparatus for analyzing balance sheet effects of asset price changes is put in place, for instance, as in Shin (2005).

EVIDENCE FROM INDIVIDUAL BANK BEHAVIOR

More detailed micro evidence on the behavior of individual banks reveals that the close tracking of the asset and liability changes holds at the individual bank level, too. The evidence comes from the banks' published quarterly accounts (as compiled in the Compustat database).

Chart 5 charts the growth in assets and liabilities of Investment Bank 1 at a quarterly frequency. The striking feature of the chart is how closely the two

Chart 5 Investment bank I: Asset and liability growth ratio of current quarter to previous quarter



series move together – so close in fact that it is hard to separate out the two series at first glance. As noted already, short sales are counted as a liability on the balance sheet, and so would tend to move in tandem with shifts in value of assets. However, not all liabilities fluctuate one for one with assets. The fact that the asset and liabilities series move together so closely is evidence of active management of leverage in the face of asset price fluctuations.

Chart 6 charts the ratio of net worth to total liabilities. The ratio has been on a downward trend, falling from over 10% to below 3% in the late 1990s, but has risen in recent years back above 5%. The close co-movement of assets and liabilities is reflected in the relative stability of the net worth to liability ratio.

Perhaps most striking is the scatter plot, given in Chart 7. The horizontal axis measures the change in the ratio of net worth to total liabilities. For a leveraged institution, the ratio of net worth to total liabilities can be regarded as its equity cushion, and so we have labeled the horizontal axis as change in equity cushion. The vertical axis measures the change in total assets. The growth rates are measured at quarterly frequency.

Chart 6 Investment bank I: Net worth to liabilities ratio

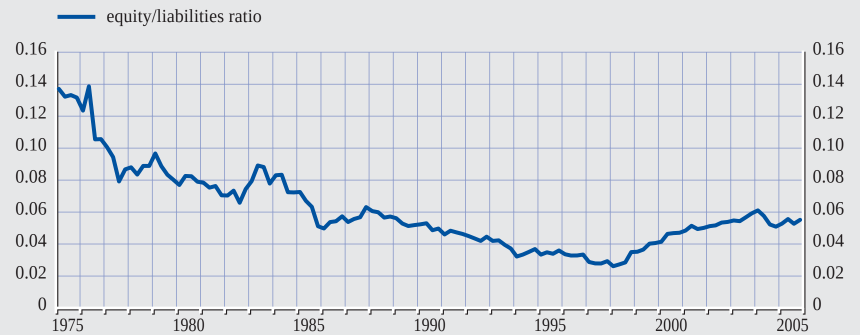
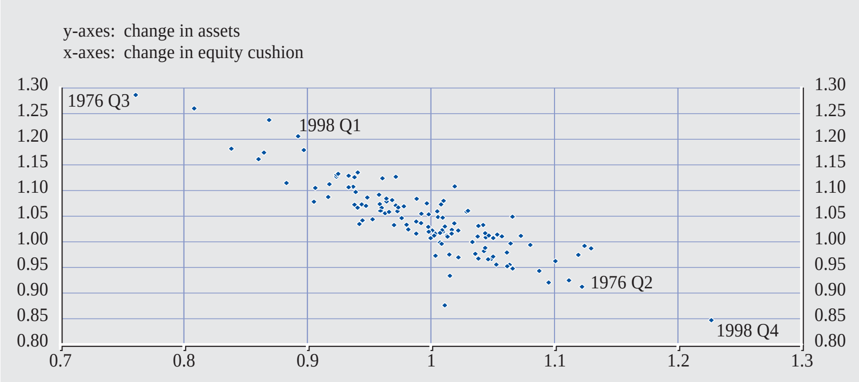


Chart 7 Investment bank 1: Scatter plot of asset growth against growth in ratio of net worth to liabilities (quarterly)



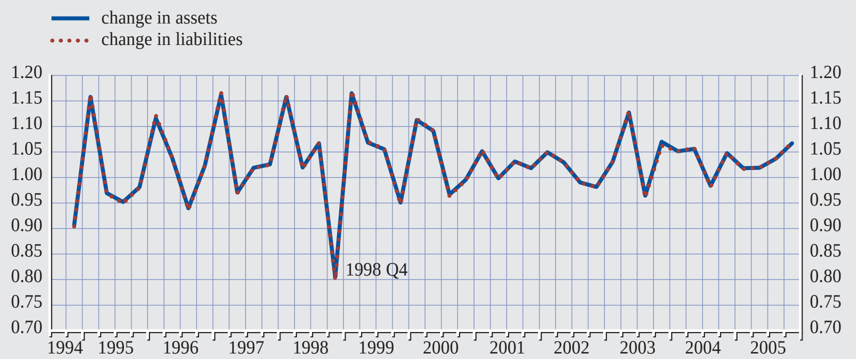
What should we expect from such a plot? If the bank were passive to some degree, then asset growth should lead to an increase in the equity cushion. If the bank were targeting constant leverage, then asset growth would be exactly undone by liability growth to leave the net worth cushion unaffected. Such behavior would tend to amplify financial cycles, as suggested above.

In fact, the evidence shows something even stronger. The scatter plot shows a *negative relation*. The equity cushion *falls* when total assets *rise*. Leverage is adjusted even more than is enough to keep leverage constant. In other words, leverage is managed so actively that the equity cushion is increased during bad times. Some of the outliers in the scatter plot are predictable. The events of the summer and early autumn of 1998 account for the outlier in the bottom right hand corner of the scatter plot. Note that the equity cushion *increases* (by 23%) even as total assets fall by a large amount (a fall in excess of 15%).

Perhaps we should not be too surprised at the negative relationship between asset growth and growth in the equity cushion. Risk management systems would recommend the cutting back of exposures when financial markets are in distress mode. So, it would be natural to see the negative relationship. For an individual bank, such behavior in the face of market turbulence may be an entirely natural, and prudent response. However, if large swathes of the financial system behave in this way, the spillover effects will be considerable. The relevant question is this. If everyone is selling, then who is buying? The answer to this must be the unleveraged institutions, such as pension funds, mutual funds, insurance companies and university endowments. They would be the “purchasers of last resort”, so to speak.

Investment Bank 1 was chosen for illustration due its relatively long presence as a publicly traded bank, and hence the ready availability of publicly disclosed accounting information. For some other investment banks, the available data series is shorter, but a similar picture emerges. We have chosen a second investment bank (Investment Bank 2) in order to illustrate our argument. Chart 8 plots the growth of assets and liabilities of Investment Bank 2 at a quarterly frequency. As with Investment

Chart 8 Investment bank 2: Growth in assets and liabilities



Bank 1, the two series move very close together – so close, in fact, that it is hard to distinguish the two series at a casual glance.

Chart 9 plots the ratio of net worth to total liabilities for Investment Bank 2. In the mid 1990s, the target equity cushion hovers around 3%, but jumps at the time of the LTCM crisis in 1998. Lately, the net worth to total liability ratio as been just over 4%.

Just as with Investment Bank 1, the behavior of Investment Bank 2's equity cushion with changes in assets shows the striking negative relation (see Chart 10). The equity cushion goes up when asset prices fall. Conversely, during asset price booms, the equity cushion goes down. Such behavior would be easy to explain in terms of banks that adjust their exposures according some value at risk (VaR) model that determine internal capital allocation. However, the broader issues concerning aggregate financial cycles and the fluctuations in asset prices remain to be addressed.

Chart 9 Investment bank 2: Ratio of net worth to total liabilities

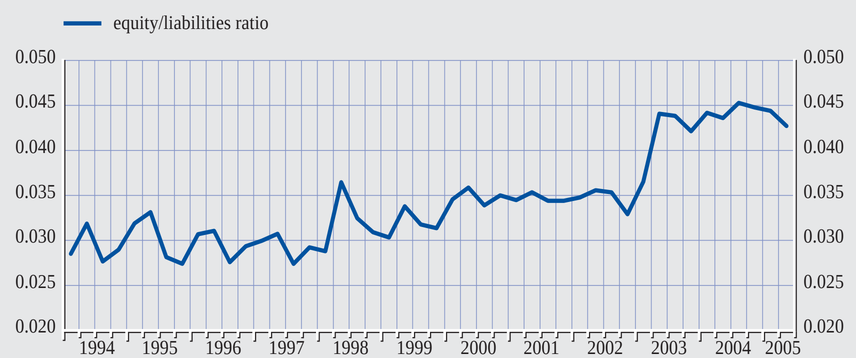
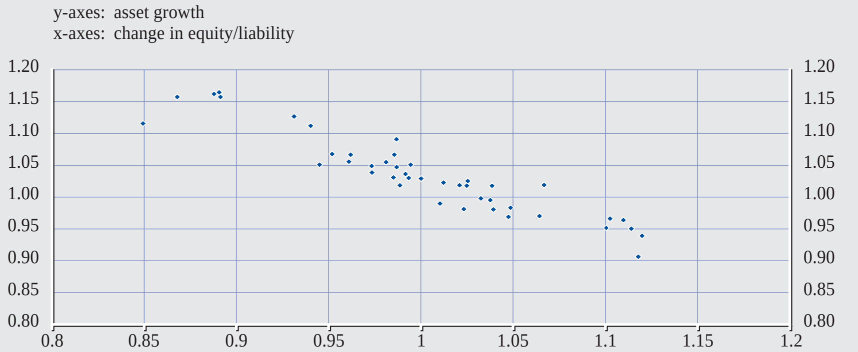


Chart 10 Investment bank 2: Scatter plot of change in ratio of net worth to liabilities against growth in assets



ROLE OF MONEY

In a hypothetical world where banks are the only financial intermediaries and their liabilities can be identified with the various components of money, then the money stock would be a good indicator of the aggregate size of the balance sheets of leveraged institutions. To this extent, the growth of the money stock would play a useful role in signaling changes in the size of the aggregate balance sheet of the leveraged sector.

However, it is not so clear that we can so readily identify the money stock with the aggregate size of the liabilities of leveraged institutions. This is so for two reasons.

- Many of the leveraged institutions (investment banks, hedge funds, and others) do not conform to the textbook ideal of the deposit-funded bank. Hence, their liabilities are not counted as money.

- Even for banks, not all items of liabilities qualify as money.

The first bullet point seems important for financial systems that rely on the capital market, rather than on the banking system. Perhaps we could speculate that the divergent empirical results for the United States and some European countries on the role of money in financial cycles can be attributed to the fact that the capital markets play a much bigger role in the former.

The second bullet point also seems important, when we consider the components of a bank's liability that fluctuates over time. The holding of deposits tends to be rather stable over time, and in any case, it is unclear how much the deposit liabilities are under the control of the banks themselves. However, for other types of bank liabilities from the wholesale market – such as repurchase agreements, certificates of deposits, Eurodollars, etc., we could regard them as being closer to discretionary variables under the control of the banks themselves. It is these other borrowing items that tend to be most volatile over time.

Chart 11 US commercial banks: Growth in deposits and "borrowing" (annual growth rates plotted monthly)

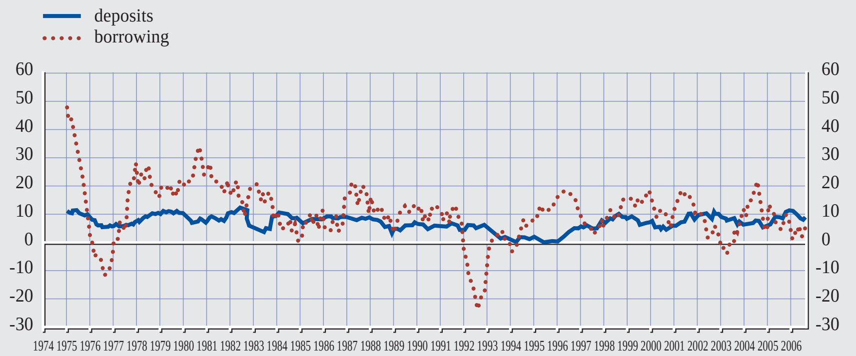


Chart 11 plots the growth of deposits and other bank liabilities for US commercial banks. Although the borrowing category constitutes only around 20-25% of total bank liabilities, it is apparent that they are much more volatile. Also, to the extent that this borrowing category is most likely to be under the discretion of the banks themselves, they would be the best indicator of the bank's intentions concerning its ideal leverage. Tracking this series would be a good way to track the way that banks' target leverage is moving around.

At the outset, we posed two questions. Can we interpret "excess liquidity" to mean excessive growth of the money stock? What is the relationship between the growth in the money stock and asset prices?

When banks target leverage, "liquidity" could be given a less mysterious meaning in terms of the ready availability of funding for the purchase of assets. When banks are constrained by their capital, liquidity corresponds to the (inverse) of the Lagrange multiplier associated with the capital constraint. Interpreted in this way, the answer to the first question would be a qualified "yes" for a bank-dominated financial system where the liabilities of the banking sector can be identified with the various components of money.

Similarly, the answer to the second question depends on the degree to which banks constitute the bulk of the leveraged sector, and money is a good measure of the aggregate size of the balance sheet of the leveraged sector. If the financial system is organized around the capital market, conventional measures of money represent only a small proportion of aggregate size of the leveraged sector. Money is less useful as a measure of liquidity in such a financial system. We must look at other institutions – such as investment banks and hedge funds – as well as the implicit leverage associated with off-balance sheet items such as over-the-counter (OTC) derivatives.

Nevertheless, in a bank-dominated economy where money captures all elements of banking sector liabilities, money growth would be a superior measure of financial conditions than, say, the growth of credit. This is so for two reasons.

First, the components of money have short maturity, and hence the book value corresponds better to market value. Second, credit (i.e. loans granted by banks) is only one class of assets held by banks. If the banking sector holds other assets such as property or stocks directly on its balance sheets, then money is a better counterpart for the total size of the banks' balance sheet. There is indeed some evidence that money growth does a better job of explaining residential property price booms than the growth of private credit (Adalid and Detken 2007).

OPEN QUESTIONS

There are many questions that come to mind when confronted with evidence that banks' leverage fluctuates in synchrony with the financial cycle.

- Why do banks target leverage?
- Does improved corporate governance through the use of high-powered incentive schemes mitigate financial cycles, or amplify them?
- Can individually prudent risk management have the perverse effect of amplifying the financial cycle?
- How will the financial cycle change when insurance companies are constrained by accounting rules, such as those on marking their liabilities to market?
- What are the consequences for financial cycles of the greater adoption of mark-to-market accounting rules?

We cannot do justice to all these important questions in our short piece. However, much rides on the answers to these questions. The targeting of leverage seems intimately tied to the bank's attempt to target a particular credit rating. To the extent that the "passive" credit rating should fluctuate with the financial cycle, the fact that a bank's credit rating remains constant through the cycle suggests that banks manage their leverage actively, so as to shed exposures during downturns. Kashyap and Stein (2003) draw implications from such behavior for the pro-cyclical impact of the Basel II bank capital requirements.

The impact of remuneration schemes on the amplifications of the financial cycle have been addressed recently by Rajan (2005). The possibility that a market populated with value at risk (VaR) constrained traders may have more pronounced fluctuations has been examined by Danielsson, Shin and Zigrand (2004). The last two questions concerning mark-to-market accounting appear more esoteric, but have potentially important implications for financial cycles when considering that insurance companies are the natural couterparties for purchases and sales made by leverage institutions. The discretion that the insurance companies could exercise in playing the role of the "purchasers of last resort" may be impaired if their actions are constrained by accounting rules. Plantin, Sapra and

Shin (2005) examine some possible macroeconomic implications of marking insurance liabilities to market.

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Shin, H. S. (2005), *Risk and liquidity in a system context*, Working Paper, Princeton University, http://www.princeton.edu/~hsshin/working.htm

Stephen Cecchetti remarked that in his view it seems attractive to adapt a risk management perspective that would help keeping bad things from happening. At the same time, the real time analysis of such developments is complex and similar issues like those that are known for the real time derivation of output gaps or the natural interest rates do apply as well in the analysis of assets. **Benjamin Friedman** clarified two issues. First, recursivity does not imply an absence of predictability of any particular variable, as recursivity means absence of causation, but causation is not necessary for having predictive power. He mentioned the example of somebody who puts on a coat before leaving the house in winter. It is obvious that one does not leave the house because one puts on a coat but the causation goes the other way round. Nevertheless it might be useful to use the fact that someone puts on his coat as a predictor that somebody is going out. The same issue applies to money. In a NK modelling framework, money enters recursively. However, when allowing for a conventional lead and lag structure, recursiveness does not mean that money cannot be used for predicting output and prices. Thus, even in NK models, money might have leading indicator properties which central banks should like to take into account appropriately. Second, the idea that financial stability is important does not mean that there is something special about money. It can well mean that the quantities and prices of non-monetary assets are the relevant issue to be modelled and analysed. This, however, is an empirical but not a theoretical issue. **Lars Svensson** mentioned that financial stability is an important issue to be taken into account by policy makers. However, he does not see that this would imply that money as such would be particularly important. A much broader class of assets should be given importance instead. **Diana Choyleva** indicated that in her view, the asset price bubble analysis performed by Caballero, will be driven by the motivation of the borrowers rather than that of the savers as indicated by Caballero. **Alex Cukierman** said that regarding Caballero's presentation it is important to clarify that global excess demand for assets should rather be defined as global excess demand for assets of an appropriate quality. Furthermore, he hinted at the need to separate the demand emanating from central banks and governmental institutions from the demand of the private sector. **Willem Buiter** remarked that no presenter has shown a link between asset price developments and money, not even to other nominal variables.

Mark Gertler replied that there are a number of caveats in using credit aggregates to analyse boom-bust cycles in asset markets. First, credit demand suffers from similar instability problems as money demand. Second, due to the countercyclical demand for assets at the end of the cycles, credit aggregates are not a good leading indicator for cyclical situation. **Hyun Shin** expressed a preference for money as compared to credit as the relevant aggregate to be monitored in a bank dominated financial system. This is because credit is measured in book values and in understanding the balance sheet situation of bank dominated systems, the short-term oriented monetary assets measured in market values might give a clearer picture. Second, as leverage institutions hold other assets than loans, the monitoring of loans would miss other speculative assets. He agreed with Buiter that it is important to analyse the aggregate balance sheet effect of leverage sectors as a whole rather than looking at money. **Jean-Pierre Danthine** agreed on the importance of taking the housing market into account, as real estate is more relevant than equity with regard to wealth. At the same time, given that in the euro area the cross-country correlation between markets in real estate is considerably less than for stock market indices, the implications for the common monetary policy when observing local housing bubbles are less clear. Finally, **Ricardo Caballero** hinted in his reply at the issue that not only the analysis of house prices but rather a complete portfolio view would be important. When analysing global imbalances, in his view, it was more important to look at the wealth side of the balance sheets.

Lucrezia Reichlin, Ben S. Bernanke, Kazumasa Iwata, Jean-Claude Trichet and Zhou Xiaochuan (from left to right)

SESSION 5

PANEL: MONEY AND MONETARY POLICY – POLICY VIEWS

MONETARY AGGREGATES AND MONETARY POLICY AT THE FEDERAL RESERVE: A HISTORICAL PERSPECTIVE

BY BEN S. BERNANKE, CHAIRMAN OF THE BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

My topic today is the role of monetary aggregates in economic analysis and monetary policymaking at the Federal Reserve. I will take a historical perspective, which will set the stage for a brief discussion of recent practice.

The Federal Reserve's responsibility for managing the money supply was established at its founding in 1913, as the first sentence of the Federal Reserve Act directed the nation's new central bank "to furnish an elastic currency."[1] However, the Federal Reserve met this mandate principally by issuing currency as needed to damp seasonal fluctuations in interest rates, and during its early years the Federal Reserve did not monitor the money stock or even collect monetary data in a systematic way.[2,3]

The Federal Reserve's first fifteen years were a period of relative prosperity, but the crash of 1929 ushered in a decade of global financial instability and economic depression. Subsequent scholarship, notably the classic monetary history by Milton Friedman and Anna J. Schwartz (1963), argued that the Federal Reserve's failure to stabilize the money supply was an important cause of the Great Depression. That view today commands considerable support among economists, although I note that the sources of the Federal Reserve's policy errors during the Depression went much deeper than a failure to understand the role of money in the economy or the lack of reliable monetary

1 Board of Governors of the Federal Reserve System (1998), 1-001. In his recent history of the Federal Reserve, Allan Meltzer (2003, p. 66) notes of some of the Act's proponents that: "[o]ne of their principal aims was to increase the seasonal response, or elasticity, of the note issue by eliminating the provisions of the National Banking Act that tied the amount of currency to the stock of government bonds."

2 See Mankiw and Miron (1986) for a discussion of the Fed's seasonal interest-rate smoothing. The Federal Reserve did publish data on the issuance of Federal Reserve notes from its inception. Federal Reserve notes were only part of total currency in circulation, however, the remainder being made up of national bank notes, United States notes, Treasury notes, gold and silver certificates, and gold and silver coin. Beginning in 1915, the *Federal Reserve Bulletin* included data on currency that had been collected by the Treasury and data on total bank deposits that had been collected by the Office of the Comptroller of the Currency as a byproduct of its regulatory role, but publication was irregular.

3 Indeed, the Federal Reserve's adherence to the real bills doctrine – which counseled against active monetary management in favor of supplying money only as required to meet "the needs of trade" – gave the new institution little reason to pay attention to changes in the money stock. See Humphrey (1986) for a history of the real bills doctrine. The constraints of the gold standard also restricted (without entirely precluding) active monetary management by the Federal Reserve.

statistics. Policymakers of the 1930s observed the correlates of the monetary contraction, such as deflation and bank failures. However, they questioned not only their own capacity to reverse those developments but also the desirability of doing so. Their hesitancy to act reflected the prevailing view that some purging of the excesses of the 1920s, painful though it might be, was both necessary and inevitable.

In any case, the Federal Reserve began to pay more attention to money in the latter part of the 1930s. Central to these efforts was the Harvard economist Lauchlin Currie, whose 1934 treatise, *The Supply and Control of Money in the United States,* was among the first to provide a practical empirical definition of money. His definition, which included currency and demand deposits, corresponded closely to what we now call M1. Currie argued that collection of monetary data was necessary for the Federal Reserve to control the money supply, which in turn would facilitate the stabilization of the price level and of the economy more generally.[4] In 1934, Marriner Eccles asked Currie to join the Treasury Department, and later that year, when Eccles was appointed to head the Federal Reserve, he took Currie with him. Currie's tenure at the Federal Reserve helped to spark new interest in monetary statistics. In 1939, the Federal Reserve began a project to bring together the available historical data on banking and money. This effort culminated in 1943 with the publication of *Banking and Monetary Statistics*, which included annual figures on demand and time deposits from 1892 and on currency from 1860.

Academic interest in monetary aggregates increased after World War II. Milton Friedman's volume *Studies in the Quantity Theory of Money,* which contained Phillip Cagan's work on money and hyperinflation, appeared in 1956, followed in 1960 by Friedman's *A Program for Monetary Stability,* which advocated that monetary policy engineer a constant growth rate for the money stock. Measurement efforts also flourished. In 1960, William J. Abbott of the Federal Reserve Bank of St. Louis led a project that resulted in a revamping of the Fed's money supply statistics, which were subsequently published semimonthly.[5] Even in those early years, however, financial innovation posed problems for monetary measurement, as banks introduced new types of accounts that blurred the distinction between transaction deposits and other types of deposits. To accommodate these innovations, alternative definitions of money were created;

4 In the second edition of his book, Currie (1935) wrote: "The achievement of desirable objectives … rests entirely upon the effectiveness of control. The achievement, for example, of the objective of a price level varying inversely with the productive efficiency of society demands a highly energetic central banking policy and a high degree of effectiveness of monetary control… Even for the achievement of the more modest objective of lessening business fluctuations by monetary means, the degree of control of the central bank is of paramount importance." (pp. 3-4).

5 Board of Governors of the Federal Reserve System (1960).

by 1971, the Federal Reserve published data for five definitions of money, denoted M1 through M5.[6]

During the early years of monetary measurement, policymakers groped for ways to use the new data.[7] However, during the 1960s and 1970s, as researchers and policymakers struggled to understand the sharp increase in inflation, the view that nominal aggregates (including credit as well as monetary aggregates) are closely linked to spending growth and inflation gained ground. In 1966, the Federal Open Market Committee (FOMC) began to add a proviso to its policy directives that bank credit growth should not deviate significantly from projections; a similar proviso about money growth was added in 1970. In 1974, the FOMC began to specify "ranges of tolerance" for the growth of M1 and for the broader M2 monetary aggregate over the period that extended to the next meeting of the Committee.[8]

In response to House Concurrent Resolution 133 in 1975, the Federal Reserve began to report annual target growth ranges, 2 to 3 percentage points wide, for M1, M2, a still broader aggregate M3, and bank credit in semiannual testimony before the Congress. In an amendment to the Federal Reserve Act in 1977, the Congress formalized the Federal Reserve's reporting of monetary targets by directing the Board to "maintain long run growth of monetary and credit aggregates … so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."[9] In practice, however, the adoption of targets for money and credit growth was evidently not effective in constraining policy or in reducing inflation, in part because the target was not routinely achieved.[10]

6 In 1971, M1 was currency and demand deposits at commercial banks. M2 was M1 plus commercial bank savings and small time deposits, and M3 was M2 plus deposits at mutual savings banks, savings and loans, and credit unions; data from the latter type of institution were available only monthly. M4 was M2 plus large time deposits, and M5 was M3 plus large time deposits. Changes in definitions make it difficult to track the historical development of the various monetary aggregates. Approximately, the 2006 definition of M1 is equivalent to this older definition, the 2006 definition of M2 is equivalent to the older definition of M3, and the definition of M3 at its date of last publication was equivalent to the older definition of M5. M4 and M5 were dropped in a 1980 redefinition of the monetary aggregates. See Board of Governors of the Federal Reserve System (1976), pp. 10-11 and Anderson and Kavajecz (1994).

7 For instance, in late 1959 and early 1960, money growth declined as other economic indicators rose. The minutes of the December 1959 FOMC meeting report Chairman Martin as saying, "I am unable to make heads or tails of the money supply," but those of the February 1960 meeting record his comment that "the System ought to be looking at the growth of the money supply." For further discussion, see Bremner (2004), pp. 141-142.

8 M2 now includes currency and demand deposits (the components of M1) plus time deposits, savings deposits, and non-institutional money market funds.

9 Board of Governors of the Federal Reserve System (1998), 1-017.

10 Monetarists criticized the use of multiple targets, rather than a single objective. Another object of criticism was "base drift," a set of practices that had the effect of re-setting the base from which money growth targets were calculated when the growth of one or more monetary aggregates exceeded the upper end of the Federal Reserve's target range.

The closest the Federal Reserve came to a “monetarist experiment” began in October 1979, when the FOMC under Chairman Paul Volcker adopted an operating procedure based on the management of non-borrowed reserves.[11] The intent was to focus policy on controlling the growth of M1 and M2 and thereby to reduce inflation, which had been running at double-digit rates. As you know, the disinflation effort was successful and ushered in the low-inflation regime that the United States has enjoyed since. However, the Federal Reserve discontinued the procedure based on non-borrowed reserves in 1982. It would be fair to say that monetary and credit aggregates have not played a central role in the formulation of U.S. monetary policy since that time, although policymakers continue to use monetary data as a source of information about the state of the economy.

Why have monetary aggregates not been more influential in U.S. monetary policymaking, despite the strong theoretical presumption that money growth should be linked to growth in nominal aggregates and to inflation? In practice, the difficulty has been that, in the United States, deregulation, financial innovation, and other factors have led to recurrent instability in the relationships between various monetary aggregates and other nominal variables. For example, in the mid-1970s, just when the FOMC began to specify money growth targets, econometric estimates of M1 money demand relationships began to break down, predicting faster money growth than was actually observed. This breakdown – dubbed “the case of the missing money” by Princeton economist Stephen Goldfeld (1976) – significantly complicated the selection of appropriate targets for money growth. Similar problems arose in the early 1980s – the period of the Volcker experiment – when the introduction of new types of bank accounts again made M1 money demand difficult to predict.[12] Attempts to find stable relationships between M1 growth and growth in other nominal quantities were unsuccessful, and formal growth rate targets for M1 were discontinued in 1987.

Problems with the narrow monetary aggregate M1 in the 1970s and 1980s led to increased interest at the Federal Reserve in the 1980s in broader aggregates such as M2. Econometric methods were also refined to improve estimation and to accommodate more-complex dynamics in money demand equations. For example, at a 1988 conference at the Federal Reserve Board, George Moore, Richard Porter, and David Small presented a new set of M2 money demand models based on an “error-correction” specification, which allowed for transitory deviations from stable long-run relationships (Moore, Porter, and Small, 1990). One of these models, known as the “conference aggregate” model, remains in use at the Board today. About the same time, Board staff developed the so-called P^* (*P-star*) model, based on M2, which used the quantity theory of money and estimates of long-run potential output and velocity (the ratio of nominal income to money) to predict long-run inflation trends. The P^* model received

11 Whether the Federal Reserve’s policies under Chairman Volcker were “truly” monetarist was a much-debated question at the time.

12 The new accounts included negotiable-order-of-withdrawal (NOW) accounts and money market deposit accounts.

considerable attention both within and outside the System; indeed, a description of the model was featured in a front-page article in the *New York Times*.[13]

Unfortunately, over the years the stability of the economic relationships based on the M2 monetary aggregate has also come into question. One such episode occurred in the early 1990s, when M2 grew much more slowly than the models predicted. Indeed, the discrepancy between actual and predicted money growth was sufficiently large that the P^* model, if not subjected to judgmental adjustments, would have predicted deflation for 1991 and 1992. Experiences like this one led the FOMC to discontinue setting target ranges for M2 and other aggregates after the statutory requirement for reporting such ranges lapsed in 2000.

As I have already suggested, the rapid pace of financial innovation in the United States has been an important reason for the instability of the relationships between monetary aggregates and other macroeconomic variables.[14] In response to regulatory changes and technological progress, U.S. banks have created new kinds of accounts and added features to existing accounts. More broadly, payments technologies and practices have changed substantially over the past few decades, and innovations (such as Internet banking) continue. As a result, patterns of usage of different types of transactions accounts have at times shifted rapidly and unpredictably.

Various special factors have also contributed to the observed instability. For example, between one-half and two-thirds of U.S. currency is held abroad. As a consequence, cross-border currency flows, which can be estimated only imprecisely, may lead to sharp changes in currency outstanding and in the monetary base that are largely unrelated to domestic conditions.[15,16]

The Board staff continues to devote considerable effort to modeling and forecasting velocity and money demand. The standard model of money demand, which relates money held to measures of income and opportunity cost, has been extended to include alternative measures of money and its determinants, to accommodate special factors and structural breaks, and to allow for complex dynamic behavior of the money stock.[17] Forecasts of money growth are based on expert judgment with input from various estimated models and with

13 Hallman, Porter, and Small (1991) and Kilborn (1989).

14 Another possible explanation for this instability is the Goodhart-Lucas law, which says that any empirical relationship that is exploited for policy purposes will tend to break down. This law probably has less applicability in the United States than in some other countries, as the Federal Reserve has not systematically exploited the relationships of money to output or inflation, except perhaps to a degree in 1979-82.

15 For a recent summary, see U.S. Department of the Treasury (2006).

16 As another example, U.S. regulations require servicers of mortgage-backed securities to hold mortgage prepayments in deposits counted as part of M2 before disbursing the funds to investors. A wave of mortgage refinancing and the resulting prepayments can thus have significant effects on M2 growth that are only weakly related to overall economic activity. See O'Brien (2005) for more discussion.

17 See Judson and Carpenter (2006) for a summary. A special factor that helps to explain some episodes of variable money demand is stock market volatility (Carpenter and Lange, 2003).

knowledge of special factors that are expected to be relevant. Unfortunately, forecast errors for money growth are often significant, and the empirical relationship between money growth and variables such as inflation and nominal output growth has continued to be unstable at times.[18]

Despite these difficulties, the Federal Reserve will continue to monitor and analyze the behavior of money. Although a heavy reliance on monetary aggregates as a guide to policy would seem to be unwise in the U.S. context, money growth may still contain important information about future economic developments. Attention to money growth is thus sensible as part of the eclectic modeling and forecasting framework used by the U.S. central bank.

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THE ROLE OF MONEY AND MONETARY POLICY IN JAPAN

BY KAZUMASA IWATA, DEPUTY GOVERNOR OF THE BANK OF JAPAN

INTRODUCTION

The role of money in implementing monetary policy is one of the most controversial issues in Japan. Although the importance of the role of money in the transmission mechanism of monetary policy cannot be denied, there exists a wide divergence in views on the impact of changes in monetary aggregates on economic activity and prices among academics and policy makers. This is particularly true when faced of the zero bound on nominal interest rates in combating deflation.

In evaluating the role of money, I would like to take up three episodes in post-war Japan; namely,

1) the oil price hikes from the mid-1970s to early 1980s,

2) the emergence and bursting of the asset price bubble from the mid-1980s to early 1990s,

3) the experience of persistent deflation under the zero interest rate and the quantitative easing policy covering from the mid-1990s to March 2006.

FIRST EPISODE: OIL PRICE HIKES AND THE MONEY SUPPLY-ORIENTED MONETARY POLICY

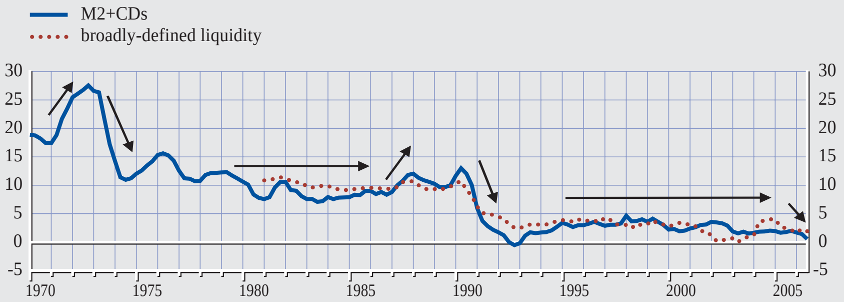
In the first episode, the rapid acceleration of money supply growth amid expansionary fiscal policy after 1971 induced rampant inflation. In spring of 1973, Japan moved to the flexible exchange rate system to mitigate the tradeoff between the free international capital flows and the control of the money supply. Yet, the first oil price hike in late 1973 exacerbated the already strong inflationary pressures.

The Bank of Japan succeeded in overcoming the rampant inflation and its stagflationary impact arising from the two oil price hikes by monitoring the money supply (M2+CDs) carefully. After the mid-1970s, the money supply growth was held down steadily, while the volatility of money supply changes diminished significantly. Corresponding to the gradual deceleration of money supply growth, the inflation rate subsided remarkably (Chart 1).

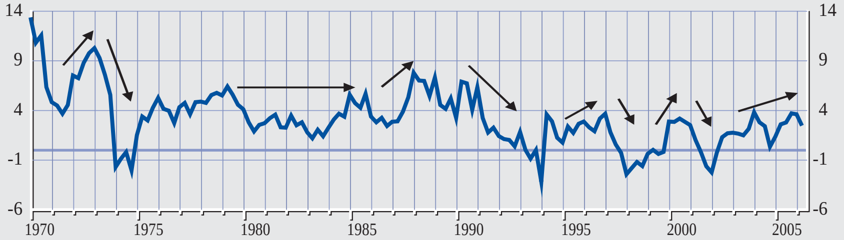
Chart 1 Money stock, real GDP, CPI, stock prices, and land prices

(annual percentage changes)

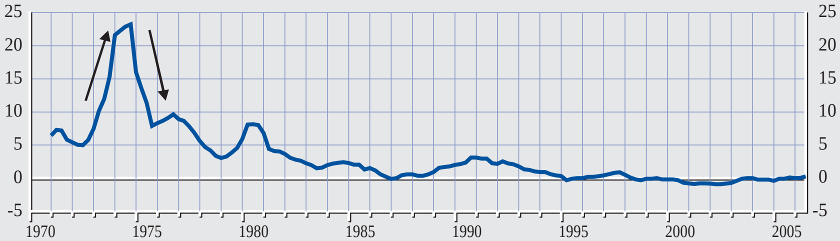
a) Money Stock



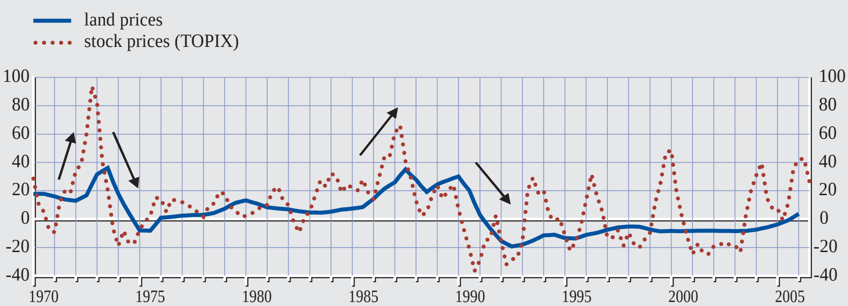
b) Real GDP



c) CPI (general, excluding perishables and adjusted for effects of consumption tax)



d) Stock prices and land prices



Source: Bank of Japan

In 1982, Milton Friedman described Japan's monetary policy in the 1970s as "less monetarist in rhetoric, yet far more monetarist in practice than the policies followed by the United States and Great Britain."

Despite the praise of Friedman, Japan's money supply-oriented monetary policy cannot be regarded as "monetary targeting policy". In 1975, the Bank of Japan employed monetary aggregates as one of the important information variables, yet it eschewed attaining the reference value of the monetary growth target (Bank of Japan (1975)).

Instead, from 1978 the Bank of Japan began to announce a quarterly forecast for money supply growth, yet the forecast was different from the "intermediate target growth rate" announced by the Federal Reserve or the M3 reference target rate by the ECB.[1] The forecast was close to the actual outcome, yet money supply reaccelerated and diverted from the trend nominal GDP growth after the mid-1980s in the wake of financial deregulation and innovation.

To conclude, the first episode reconfirms the lesson that the control of money supply (which was restored under the flexible exchange rate system) played an essential role in containing the rampant inflation prevailing in the early 1970s.

SECOND EPISODE: ASSET PRICE BUBBLES AND THE REAL MONEY GAP

Let me turn to the second episode. Lax monetary policy after the mid-1980s was evidenced by the sustained deviation of actual real money stock from the equilibrium real money stock. Given the positive "real money gap", asset price bubbles emerged in the equity and real estate markets while general price stability was maintained (Chart 2).[2] Once land prices started to move up, the augmented collateral value of land triggered the rapid expansion of bank credit through the "financial accelerator mechanism" or the "credit cycle" on the imperfect financial market.[3] On the other hand, price stability was reinforced

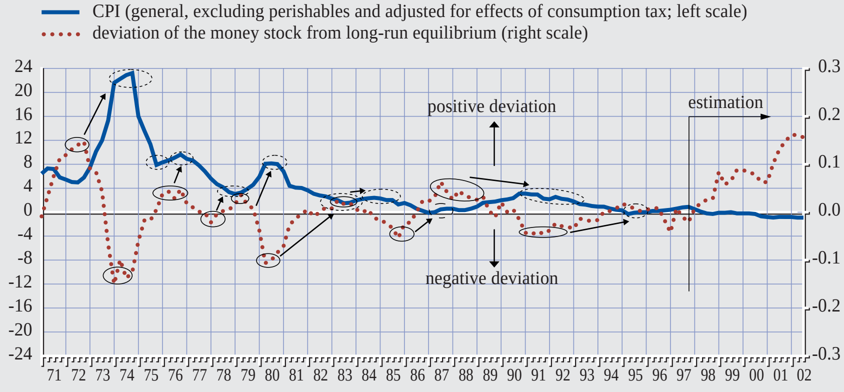
1 Neuman (2003) justified the reference value of M3 growth rate by the ECB based on the link from core money to core inflation. Given the means of the range (4.5%) consisting of the potential growth rate (2-2.5%), normative rate of inflation (less than 2%) and the trend decline of velocity ranging from 0.5% to 1%, he detected the true normative rate of inflation to be equal to 1.5%.

2 Gerlach and Svensson (2002) compared the usefulness of the "real money gap" (which can be decomposed into the "GDP gap" and the "velocity gap") as an information variable with the GDP gap. They thus noted that the deviation of actual monetary growth from the "unconditional" monetary growth target is likely to be a misleading indicator of risks to the price stability because of the tradeoff between the price stability and monetary growth target stability: in their view the Bundesbank actually gave priority to price stability rather than monetary target stability when the tradeoff between the "unconditional" money growth target and the inflation target becomes serious.

3 Kiyotaki and Moore (1997) developed the "credit cycle" theory, on the assumption of the financial constraint to borrow on the imperfect financial market. Regarding the emergence of the asset price bubble, the explanation based on the "Pigou cycle" of boom-bust of industrial fluctuation is plausible: the expectation on the strong technological progress stimulates the investment boom, although the expectation is not realized ultimately (Pigou (1927), Christiano and Fujiwara (2006)).

Chart 2 CPI and deviation of money stock from long-run equilibrium

(annual percentage changes)



Source: Bank of Japan (2003).

by the yen appreciation after the Plaza Accord in 1985 in spite of the accelerating money supply.[4]

Plentiful market liquidity facilitated the active management of risk portfolios through relaxing the liquidity constraint and affected the willingness of investors to take more risks, leading to the reduction in risk and term premia.

From the second episode, we can draw the lesson that a positive "real money gap" can cause the asset price bubbles through the "financial accelerator mechanism" and the reduction in risk and term premia, precisely because price stability is maintained.

THIRD EPISODE: DEFLATION AND THE QUANTITATIVE EASING POLICY

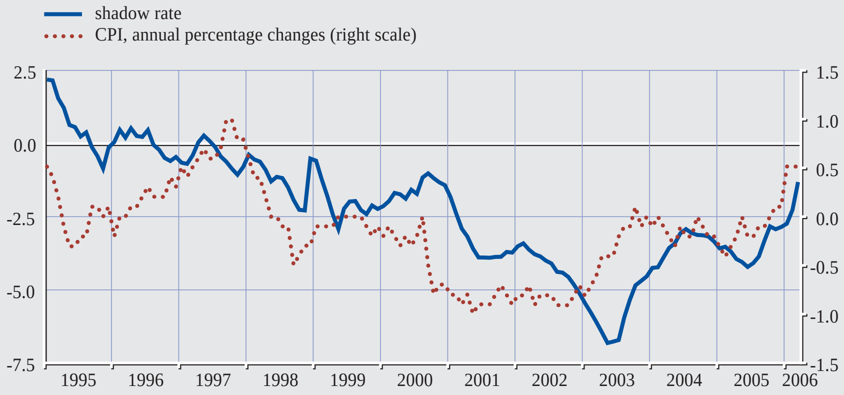
Turning to the third episode, after the bubble burst in the early 1990s, the required adjustment to the balance sheets of both the corporate and banking sectors tended to significantly lower the natural interest rate and reduce the potential growth rate from about 5% to about 1% in the mid-1990s.[5] It is not difficult to gauge the consequence from the Wicksellian process perspective: deflation began to prevail as the natural interest rate became significantly lower than the real market interest rate.

4 Aside from the well-maintained price stability, we can mention factors which might work to delay the timing of tightening of monetary policy as follows: the need for international cooperation at the time of the October crash in 1987 with Japan as the largest creditor country as well as tax reforms to introduce the consumption tax in 1988-89, in addition to the apprehension of the consequences of the rapid yen appreciation on economic activity. Ikeo (2006) put emphasis on the absence of corporate governance due to the joy ride of "developmentalism" and the eroded role of the "main bank" as delegated monitor in explaining the excessive credit provision by banks.

5 On the cause of lower potential growth in the 1990s, Prescott and Hayashi (2002) focused on the importance of the negative supply shock arising from the shortening of labor hours.

Chart 3 Shadow rate and CPI

(percentages)



Source: Ichiue and Veno (2006).

After the "zero interest rate policy" from February 1999 to August 2000, the "quantitative easing policy" was initiated in March 2001. The quantitative easing policy set bank reserves as an operating target and reconfirmed the commitment to continue the virtual zero interest rate policy until the core CPI growth rate stands above zero in a stable manner.[6]

The perceived emergence of the "liquidity trap" under the zero short-term interest rate seemed to undermine the effectiveness of the quantity-oriented monetary policy, as the interest rate elasticity of demand for money became close to infinity at the zero short-term interest rate.[7]

Moreover, the linkage between monetary aggregates and income or prices has largely disappeared since 1997, mainly reflecting the increase in precautionary demand for money due to financial instability and nonperforming assets on the banks' balance sheets.[8]

Yet the unstable demand for money as well as the zero bound on policy interest rate do not imply that money has no role to play in the transmission mechanism of monetary policy.

Citing the experience of Japan's quantitative easing policy, Governor Mervyn King (2002) questioned whether the excess supply of money under the zero

6 Yet, this did not imply that "nominal income targeting" by using the monetary base as an operating instrument was adopted.
7 The "vector-error-corrections model" confirmed the breakdown of the long-run cointegrating relation between money supply and income or prices, although the cointegration linkage still exists with respect to the total fundraising by moneyholders and economic activity (Bank of Japan (2003)). Miyao (2005) also confirmed the disappearance of the predictive content of M2+CDs in the late 1990s by carrying out cointegration analysis.
8 Actually Kimura, Kobayashi, Muranaga and Ugai (2002) confirmed the possibility of the infinite interest rate elasticity of money demand in the vicinity of the zero short-term interest rate.

interest rate policy would lead to the potency or impotency of monetary policy.[9]

At the panel discussion of the Jackson Hole Conference in 2005, I gave my answer to this question: under the quantitative easing policy the extent of the zero interest rate was widened to cover the one-year maturity in tandem with the increasing amount of reserve target from 5 trillion yen to 30-35 trillion yen.

I argued that ample provision of liquidity contributed to preventing the economy from falling into a deflationary spiral. Besides, the additional injection of liquidity into the market complemented the commitment about the future path of the policy interest rate, thereby strengthening the "policy duration effect".

Furthermore, at the satiation level of money holdings, a fiscal policy aimed at achieving a zero primary balance by FY2011, combined with the positive rate of increase in the monetary base, contradicts the existence of the "deflation trap", due to the violation of the transversality condition (Iwata (2005)).

The effect of liquidity injection can be interpreted in two ways. First, I recall that Fisher Black (1995) reformulated the role of interest rates as an option, assuming that the equilibrium shadow interest rate, or the natural interest rate, can become negative.

Yet, individual investors can safely avoid negative interest rates by holding currency at zero interest rate. Thus, the observed zero interest rate can be regarded as a call option on the equilibrium shadow interest rate.

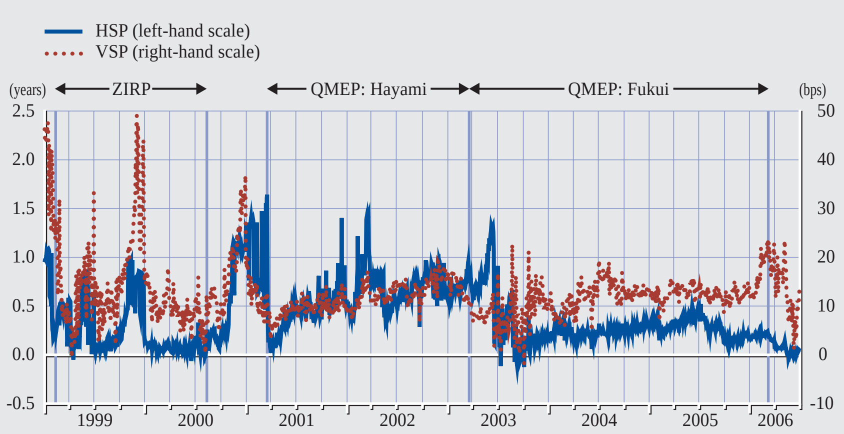
Black argued that the long-term interest rate will remain positive under the "liquidity trap" in the presence of a zero bound on nominal short rates, because of the more-than-usual term premiums and the expectation of future development of the short-term interest rate at zero embedded in the long-term interest rate.

The commitment on the duration of the zero interest rate policy suggests that the shadow interest rate will be negative, as long as deflation is expected to persist into the future; the longer the duration of the zero nominal interest rate, the larger the size of negative interest rate.[10]

9 In other words the question is whether the excess supply of money at the zero marginal utility of money or at the satiation level of money holdings will lead to massive substitution for risky financial and real assets or the accumulation of "idle money balance". Notably, critics on the quantitative easing policy pointed to the useless and harmful accumulation of idle money balance by the banking sector. Yet it may be noted that the effect on the risk premium or the credit spread through portfolio rebalancing under the zero short-term interest rate is not excluded, though the effect seems to be small (Kimura and Small (2006)).

10 The empirically estimated shadow price reflected the policy duration effect linked to the persistence of deflation under the quantitative easing policy; it reached the bottom (the negative value of 6%) in early 2003, when the deflationary expectation reached the peak. It became close to zero, when the quantitative easing policy was expected to be abandoned (Ichiue and Ueno (2006)).

Chart 4 Vertical and horizontal spreads between futures and forward rates



Source: Iwamura, Shiratsuka, and Watanabe (2006).

Accordingly, while the additional liquidity injection strengthened the commitment on the duration of the zero interest rate policy, it was supposed to result in more currency holdings (Chart 3).

Secondly, we can add a new insight into the role of money; money provides a liquidity service which is not identical to the service provided by government bonds.

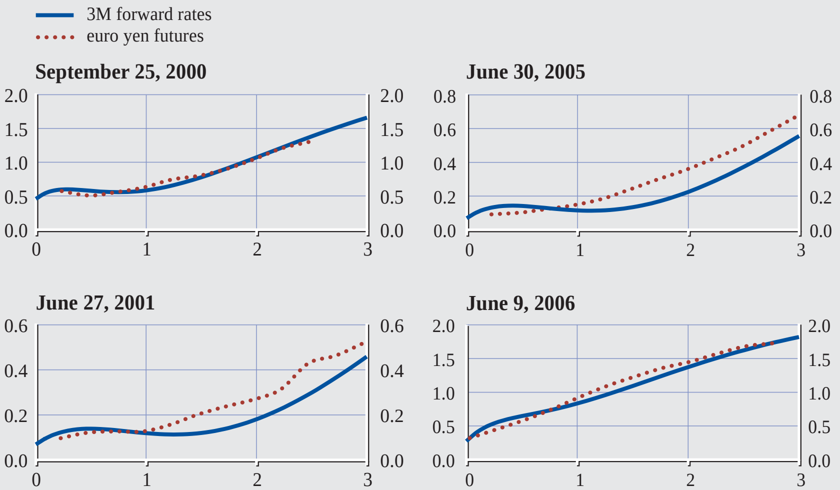
If we reformulate the utility function to include not only money but also bonds of various maturities (money and bonds in utility function), the zero short-term interest rate is not equivalent to the zero marginal utility of money, because there remains the arbitrage relationships with the longer maturity bonds with positive interest rates (Iwamura, Shiratsuka and Watanabe (2006)). As long as the marginal utility of money remains positive, the "satiation of money holdings" will not emerge even though the zero bound on short-term interest rates appears in the economy.

In this case, the increase of real money balance can affect the market interest rates, pushing down the forward rate relative to the future rate. As a result, the spread between the forward and the future rate has never closed under the quantitative easing policy (Chart 4, 5).[11]

11 Iwamura, Shiratsuka and Watanabe (2006) argued that this fact is difficult to explain in the absence of differentiated liquidity services provided by money and government bonds. Yet, there arises a further question as to why money can provide liquidity services superior to bonds. The technological function of money as memory on record-keeping on market transactions may be a partial answer (Kocherlakota (2005)).

Chart 5 Futures vs. forward rates

(x-axis: time-to-settlement, years; y-axis %)



Source: Iwamura, Shiratsuka, and Watanabe (2006).

From the third episode, we can draw the following two lessons.

First, the large option-like value of nominal interest rates at zero, or close to zero under persistent deflationary expectations stimulates the incentive to hold currency. At the same time, the injection of liquidity complemented and reinforced the policy duration effect of the zero interest rate policy, serving to flatten the yield curve (Ichiue and Ueno (2006)).

Secondly, in contrast, if money provides better liquidity services than government bonds, then the increase in real money balance affects the market interest rates, independently of the expectation channel arising from the commitment on the duration of expansionary monetary policy.

NEW FRAMEWORK FOR THE CONDUCT OF MONETARY POLICY

In early March 2006 the Bank of Japan introduced a "new framework for the conduct of monetary policy" when it ended five years of quantitative easing policy. The "understanding of medium- to long-term price stability" provided "common knowledge" to the market participants.[12]

Further, the new framework introduced two perspectives on examining economic activity and prices; the first perspective is examining, as regards economic activity and prices one to two years in the future, whether the outlook deemed most likely by the Bank follows a path of sustainable growth under price

12 The public information shared commonly by Board Members and market participants is likely facilitate coordinated action toward returning to the normal state of the economy.

stability. In the second perspective, we identify the potential risks beyond the forecast period. For instance, excessive investment induced by sustained expansionary monetary policy may give rise to undesirable wide fluctuations of economic activity.

The second perspective is designed to cope with the situation where the probability of the event is low, yet the damage to the economy could be quite large if it materializes.

This second perspective corresponds to the risk management approach to monetary policy of Greenspan or the "mini-max approach to monetary policy management under Knightian uncertainty".

We have observed the upward revision of the potential growth rate under the circumstances of low real long-term interest rates on the global market. Recent developments in monetary aggregates suggest a return to the equilibrium trend, after the sustained upward deviation from the equilibrium trend under the zero interest rate and the quantitative easing policy.

Given the lessons from the second episode, we should cautiously watch the developments in money and credit, and examine the policy implications of changes in monetary and credit aggregates, as the role of money is more subtle and far-reaching as suggested by the option-like value of currency holdings and liquidity effect under the quantitative easing policy.

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THE ROLE OF MONEY: MONEY AND MONETARY POLICY AT THE ECB

BY JEAN-CLAUDE TRICHET, PRESIDENT OF THE EUROPEAN CENTRAL BANK

In his opening address Mr Stark raised three questions. His first question was whether monetary analysis helped us to anchor inflation expectations in the euro area. As I have stressed on earlier occasions,[1] I am convinced that a thorough monitoring of monetary developments is important for the anchoring of inflation expectations. On the empirical side, there is ample evidence showing that there is a strong long-run link between money growth and inflation. This has recently been re-emphasised in the academic literature.[2] On the theoretical side, Professor Woodford has argued yesterday[3] that money does not play an important role in the conduct of monetary policy in standard modern-style macroeconomic models. However, as Professor Christiano has pointed out in his presentation, when such models are extended in a realistic way, also good theoretical arguments in support of a clear commitment to take monetary developments into account in the conduct of monetary policy emerge. This is because it directly helps to stabilise long-term inflation expectations, and as Lucas has also pointed out yesterday, because it can help to mitigate the effects of boom-bust cycles in asset markets.[4] In fact, the ability of monetary developments to indicate imbalances in the financial system and the implied potential risks to long-run price stability has recently been stressed in particular by the BIS[5] and is confirmed by recent research at the ECB.[6]

The money pillar of our monetary policy strategy constitutes a visible commitment to take the long-run link between monetary developments and

1 See for example Trichet (2005a,b).
2 See e.g. Assenmacher-Wesche and Gerlach (2006), Kugler and Kaufmann (2005) and Hofmann (2006).
3 See Woodford (2008).
4 Christiano and Rostagno (2008) present a theoretical framework showing that monitoring monetary dynamics can help to minimise the possibility that inflation expectations might settle on a point inconsistent with the central bank's inflation objective. In this context, a central bank commitment to systematically monitor and factor monetary indicators into policy would act as an insurance device which prevents instability to arise in the first place. The interesting feature of this commitment is that, in equilibrium, such a central bank would not necessarily be observed to *react* to unstable dynamics in monetary aggregates, as these would never materialise in the first place. However, such a favourable outcome would *presuppose*, rather than disprove, the existence of the strategic commitment to act forcefully in case of abnormal developments in monetary indicators. Christiano, Motto and Rostagno (2006) show that taking into account monetary indicators in the conduct of monetary policy can also alleviate the macroeconomic volatility arising from overly optimistic expectations. In an earlier paper, Christiano, Motto and Rostagno (2003) have also shown that a monetary policy rule that assigns more weight to monetary developments would have substantially mitigated the severity of the Great Depression.
5 See Borio and Lowe (2002, 2004), Borio, English and Filardo (2003), Borio (2005) and White (2006).
6 See Detken and Smets (2004) and Adalid and Detken (2007). For a more detailed discussion see Trichet (2005c) and ECB (2005).

inflation into account in monetary policy decisions. From my experience I can tell that this played indeed an important role in our success to anchor inflation expectations in the euro area.

At the time of the transition to EMU, giving money a prominent role in our strategy ensured continuity with the most credible central banks joining the Eurosystem. I am absolutely convinced that the monetary pillar was crucial to stabilise inflation expectations in the euro area at the low level prevailing in the countries with the most stable currencies at that time. Given the historical dimension of the launch of the euro and the great number of watchers and academics who were very sceptical, to say the least, about EMU, it is to me very surprising that the successful transition to the euro has received so little attention from academic researchers.

Stressing the importance of the monetary pillar at the time of the introduction of the euro must not be interpreted as if, now that the ECB has matured, we do not need it any more. In fact, in helping us to take good and timely policy decisions, the monetary analysis played an important role in our success to fully preserve the achieved anchoring of inflation expectations over the last eight years.[7] This in turn contributed to low macroeconomic volatility in the euro area.[8] When inflation expectations are well anchored, temporary deviations of inflation from levels consistent with the central bank's inflation objective are not expected to be long-lasting. As a result, macroeconomic shocks will have a smaller impact on inflation expectations and the evolution of inflation over time will be less persistent, so that inflation and economic activity will be more stable.

It is certainly true that also other central banks which put less emphasis on monetary analysis have achieved low and stable inflation expectations and low macroeconomic volatility. However, it is important to bear in mind that the uncertainty faced by the ECB has been much higher than that faced by other more established central banks. Our success to maintain low and stable inflation expectations in a rather adverse macroeconomic environment is also owed to the commitment to be continuously vigilant upon monetary trends built into our strategy by the money pillar.

This brings me to Mr Stark's second question, on the critique that our policy actions have not corresponded to the announced role of money in our strategy.

7 This is the clear indication of the low level and low volatility of measures and indicators of long-term inflation expectations that are available from surveys and from capital markets. For instance, the average level of long-term inflation expectations for the euro area according to the long-term Consensus forecasts was 1.85%, which is fully in line with the ECB's medium term inflation objective. The volatility (measured by the standard deviation) of the long-term Consensus inflation forecasts was below 0.1 percentage points and therewith among the lowest in the group of the major economies.

8 Since the start of EMU, the volatility (measured by the standard deviation) of annualised quarterly consumer price inflation in the euro area was 0.85 percentage points and the volatility of annualised quarterly real GDP growth was around 1.5 percentage points. For comparison, over the same period the volatility of inflation and real GDP growth in the US was respectively 1.3 and 2.1 percentage points.

I know that this objection is sometimes brought forward by critical observers who argue that there is no direct correlation between our policy rate decisions and monetary developments. This kind of criticism does not discomfort me, because the relevance of the monetary pillar can anyway not be judged based on the simple bivariate correlation of policy rates with the growth rate of headline M3 (or any other single monetary indicator). First, such a simplistic approach cannot reflect the crucial role of cross-checking the information derived from the economic and the monetary analysis that is a key feature of our monetary policy strategy. Second, it overlooks the broad based and by no means mechanical character of the ECB's approach to monetary analysis, which Jürgen has also stressed yesterday.

Allow me to elaborate on the second point. Monetary data are contaminated by noise at higher frequencies blurring the signal from their low frequency movements which inform about medium to longer run inflation trends. The ECB's monetary analysis aims at extracting this low frequency signal by assessing a large range of monetary indicators based on statistical tools and judgement in real time. Since the signal extracted from the monetary analysis refers to the low frequency it will not change much from month to month. As a consequence, it will by its very nature normally not be closely correlated with individual policy moves, but will rather influence the medium term direction of policy rates. As Otmar has explained this morning,[9] money can be seen as a kind of anchor for the longer-term direction of our monetary policy.

As I have mentioned before, the monetary analysis played an important role in our success to anchor inflation expectations and to contain macroeconomic volatility in the euro area by helping us to take good and timely policy decisions. It is generally very difficult to disentangle the respective contribution of the two pillars of our strategy to monetary policy decisions. Nevertheless, let me give you two examples where I felt that monetary analysis had a particularly decisive influence.[10] The first goes back to the period of late 2002 through the course of 2003. At that time, some commentators were concerned that the euro area might be heading for deflation and called for a more aggressive loosening of monetary policy. Our decision not to follow these calls was also owed to the observation that the underlying monetary expansion was rather sustained and therefore clearly ruled out any deflationary pressures over the medium term.[11] The monetary analysis therefore played an important role at that time, preventing us from lowering interest rates to unwarranted low levels. With the benefit of hindsight we know that this decision was right.

9 See Issing (2006).

10 For a more comprehensive account of the role of the internal monetary analysis for the direction of euro area policy rates see the narrative evidence presented at this conference by Fischer et al. (2008).

11 For example, in a speech on potential risks of deflation in the euro area in December 2002, Issing (2002) said: "Considering a longer horizon, we take note that annual M3 growth rates are consistently above the ECB's reference value … Our analysis confirms that recent money growth rates are influenced by portfolio shifts … But despite this likely bias, for sure, none of these figures shows any danger of deflationary pressure".

My second example refers to the recent sequence of policy rate increases. In December 2005, when we first increased policy rates, many commentators judged our move as premature against the background of a seemingly fragile economic recovery. In fact, at that time the signals coming from the economic analysis were not yet so clear and strong. But the continued strong expansion of money and credit through the course of 2005 gave an intensifying indication of increasing risks to medium term price stability which played a decisive role in our decision to start increasing policy rates in late 2005. In retrospect, also the strength of the economic recovery unfolding in the course of 2006 has shown that our decision was right and well timed. Without our thorough monetary analysis we would probably have been in danger of falling behind the curve, which would have had negative consequences for price stability in the euro area and our credibility to safeguard this stability.

Mr Stark's last question referred to communication challenges related to monetary analysis. We have consistently communicated the results of our monetary analysis and any uncertainty surrounding it to the public. The conference paper by Fischer, Lenza, Pill and Reichlin helps in this respect by further increasing the transparency of the analysis. After all, a central bank that is not successful in explaining the principles guiding its monetary policy decisions will not be able to preserve its credibility. To me, the success of our policy and the high predictability of our policy decisions[12] clearly suggest that we have been able to communicate our monetary policy strategy and the role of the monetary analysis in a transparent and successful way.

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CHINA'S MONETARY POLICY: ITS FEATURES AND CHALLENGES

BY ZHOU XIAOCHUAN, GOVERNOR OF THE PEOPLE'S BANK OF CHINA

1 NEW TOPICS IN MONETARY POLICY

In recent years, in the circle of mature market economies, new ideas in the theory and practice of monetary policy and central bank have emerged, including the following.

A central bank's objective. Should a central bank work towards one single objective or a multiple of objectives?

Inflation targeting. A good number of central banks have adopted inflation targeting and gained some successful experience in their practice.

Effectiveness of adjusting quantity of money. The practice of inflation targeting raises a question. That is, quantity of money, such as money supply, might not be the leading factor affecting inflation, as we had previously thought. Inflation expectation is a more important factor. In order to stabilize expectation, it is necessary to make better use of price mechanism. In addition, indicators of money supply or conventional monetary analysis techniques are becoming increasingly blurred and unstable, to the extent that some experts tend to believe that they are basically not relevant.

Credibility and independence of a central bank. A central bank's policy operation should be more credible, transparent and independent. When a central bank adopts inflation targeting and takes measures to enhance credibility of its policies, logically, these measures will play a key role in stabilizing the public's inflation expectations. Consequently, the bank will be in a fairly comfortable position to achieve low inflation. This means that money supply operations might not be of particular importance.

2 THE CURRENT STAGE OF CHINA'S ECONOMIC DEVELOPMENT: ITS FEATURES

In the days of planned economy, even for some time after establishment of the People's Bank of China in 1984, there was no monetary policy of a real sense in China. Before the *Law on the People's Bank of China* was promulgated in 1995, monetary and fiscal policies were not clearly delineated. In the move from having no monetary policy to formulating and implementing such policy, China carefully studied theory and practice of monetary policy of mature market economies. Up till now, the People's Bank of China has been a learner in monetary policy decision making and conduct.

Before 1980, China could be characterized as a closed economy. After more than two decades of reform and opening-up, it is more like a market economy. At its current stage, the Chinese economy has two prominent features:

1. *It is a low-income country.* As China is still a developing country, the majority of population attaches great importance to economic growth and job creation, in order to raise productivity and income level. Its impact on choice of monetary policy objectives is not to be overlooked. Also, because of such an orientation, people are keen to study the relationship between actual output and potential capacity.

2. *It is an economy in transition.* China is still undergoing transformation from a planned economy to a market system. In the transition, prices of resource commodities, services and factors of production are more and more market-based. This process will definitely produce additional impact on price and quantity of money, and present a factor not known to mature market economies.

3 CHINA'S MONETARY POLICY: ITS FEATURES

Compared with developed countries and mature market economies, China's monetary policy has its own distinctive features.

3.1 THERE ARE A MULTIPLE OF OBJECTIVES

At the current stage of development, we think it is desirable not to adopt inflation targeting for the time being. As an economy in transition, if instability in the value of yuan occurs, it is more likely to be caused by the special traits of a transition economy, rather than quantity or price of money.

Also, for a low-income developing country and an emerging market economy, economic growth and employment are important objectives of the country. The central bank needs to take this seriously. Economic growth objective is indirectly related to employment objective, as well as balance of payments objective. Although the essential function of the central bank is keeping value of its currency stable and maintaining low inflation, the Chinese central bank has a multiple of objectives, as it looks at inflation and keeps an eye on economic growth, balance of payments and employment etc. And, in particular, it needs to promote financial reform.

3.2 A COMBINATION OF QUANTITY AND PRICE INSTRUMENTS IS EMPLOYED

Since 1980s, China experienced three inflations, in 1985, 1988 and 1995 respectively. Later on, affected by the financial crisis in Asia, China went through a deflation between 1998 and 2000. An empirical analysis of these experiences reveals obvious correlation between money supply and inflation.

The People's Bank of China thus believes that monetary aggregate remains an important component in the monetary policy framework at the current stage.

As things evolve, the role of money supply indicators changes as well. It is not plausible to use a rigid or dogmatic method to evaluate or measure their impacts on the overall economy and inflation. In China, we also need to take into consideration monetization that has accompanied reform and transition. Monetization is a process in which the market-based allocation of many things that were distributed in kind in the years of planned economy such as housing may require prices of these things to rise in tandem with workers' income. As a result, unlike the basically parallel growth of money supply and nominal GDP in mature market economies, money supply has grown slightly faster than that of nominal GDP in China for many years, and the excess of money supply over GDP growth is, to a very large extent, related to monetization reform. Of course, this is unlikely to be a long lasting phenomenon. Yet, analysis of money supply needs to take into consideration the "temporary" factor of monetization.

Also, for an economy in transition, its interest rates, exchange rate, financial market and micro-level financial institutions are being improved at any given time, and price elasticity is progressively going up. It will take a "slow process" to put in place an effective monetary policy transmission mechanism. Therefore, the central bank needs to use both price and quantity instruments in monetary policy operations throughout transition.

Price and quantity instruments interact with each other as well. If quantity is not within a proper range, transmission mechanism of prices is often likely to be problematic. Also, when reform measures are not completed, a quantity-oriented monetary policy will encounter problems of one kind or another. In both circumstances, efficiency of monetary policy is compromised. Of course, any instrument, quantity or price, needs a transmission channel for its impact to reach economic agents. After weighing many factors, our conclusion is that monetary policy needs to employ both price instruments and quantity instruments since China is an emerging economy and a developing country in reform and transition. Based on the above judgment and consideration, I said two years ago that the use of price instruments would be gradually scaled up to reduce dependence on quantity instruments. This has indeed happened. As you have seen, we use a combination of these instruments, including open market operations, required reserve, interest rate and exchange rate, etc.

3.3 PRIORITIES OF REFORM

Maintaining stability of Chinese currency's value, or achieving the low-inflation objective, is, to a very large extent, related to the progress of transition and reform. If financial institutions are in distress, stability of value of currency becomes impossible; if transmission mechanism is not smooth, it is difficult to effectively implement those monetary policies that are very appealing in theory. Therefore, we need to press ahead reform to bring the economy into a more reliable state.

In the reform, inflation statistics of various coverage, core or headline, is not in a very stable state. Yet, we cannot afford to slow down reform for the sake of preserving stability, because delaying reform would not only negatively affect overall economic development and implementation of monetary policy, but also make it difficult to build an institutional environment desirable for the conduct of monetary policy in the long run. Therefore, from the central bank's point of view, promoting reform and transition is the starting point of our efforts to achieve low inflation and build an effective economic and financial system in the mid term. We regard pressing ahead reform as a high priority and believe that continued reform is essential to boost China's resilience in the face of a financial crisis. This is how we are different from a mature market economy.

Based on the above considerations, we do not practice inflation targeting for the time being. Yet, we do value the credibility, accountability and transparency of monetary policy for it is important to stabilize inflation expectations of the public. This is a very prominent trend. There are lots of domestic comments on the transparency and independence of monetary policy, which, in my view, are probably related to our current stage of development.

If we take promoting reform as a high priority, we need to work under leadership of the State Council, coordinate and cooperate with other government agencies, in order to bring about substantive progress in the reform. To some extent, this outweighs the importance of a central bank's monetary policy independence in a period to come.

4 CHINA'S MONETARY POLICY: ITS CHALLENGES

Some of the issues that China faces in formulating and conducting monetary policy may be rare or even unheard of in other countries, and not analyzed in a systematic manner in the literature of economic history and economic theory. For example, it is probable that the above-mentioned relationship between financial stability and financial institution reform did not receive sufficient attention before the financial turbulence in Asia for one reason or another. Besides, there are several other issues. First, growth of M2 has exceeded that of GDP for many years in China. Second, theoretically, current account surplus and persistently high M2 growth are potentially inflationary. In practice, with the exception of one or two months in 2004, China's CPI did not experience considerable growth. Third, in order to address deflation in the aftermath of the financial turbulence in Asia, the Chinese government took a number of measures, including restructuring enterprise, reforming banking sector, raising household income and stimulating consumption, and adopted a proactive fiscal policy to improve infrastructure. Large FDI inflows came in. With the rapid expansion of manufacturing capacity, prices were under downward pressures due to excess capacity. Fourth, China's savings rate is very high, exceeding the anticipation of many. In particular, the savings rate has gradually edged up in the aftermath of Asia's financial turbulence, almost ten percentage points higher than that at the time when the turbulence broke out. The good thing about a high savings rate is that massive investment is available, as reflected in infrastructure improvement, industrial and exporting capacity expansion, and inevitably some over capacity. Economic and monetary analysis is complicated by these factors working together. It seems that neither traditional money theory nor new monetary policy models could provide a plausible explanation for these challenges.

Against such a background, we need to carefully monitor the developments, act prudently, and think about monetary policy and use of various instruments in a pioneering spirit. We will closely watch the evolution of theory and practice of monetary policy, including experience of other countries, and analyze under what kind of situations, certain mechanism and monetary policy can work effectively. We acknowledge that China has its own specificities that are different from other countries. In particular, we are a developing country undergoing reform and transition. Therefore, in order for monetary policy to transmit effectively, we have to aggressively promote reform, including reform of institutions at the micro level; we need to strike a balance and properly handle the relationship among reform, stability and development.

Stephen Cecchetti pointed to the risk of giving too much weight to inflation expectations. In his view there is a wide consensus that monetary policy is about managing expectations. But it is important to ensure that by managing expectations one does not fall into the trap of explicitly targeting expectations. **Luigi Buttiglione** asked about the role of monetary aggregates in the monetary pillar of the ECB, which he sees as assigning an explicit role for the financial sector that should not be neglected. In the view of **Sylvester Eijffinger** the twin objectives of monetary policy of the FED, as assigned in the 1977 amendment of the Federal Reserve Act, can be seen as legacy from the Keynesian area. They would cause a lot of problems for the FED in explaining what it is doing. He sees this as a lack of political transparency. Improved transparency, however would lead to lower and more stable inflation and lower longer-term interest rates. **Francesco Papadia** requested confirmation about the hypothesis that the importance of money in monetary policy is not constant and depends on the level and uncertainty of inflation. In his view, attributing much weight to monetary aggregates helps moving from high and unstable inflation to low and stable inflation but when the new level of lower inflation has been achieved money would turn from being very important to being just relevant. **Michael Bordo** concurred with this view and reported that recent work by him and Filardo shows that in currency zones characterized by a high and volatile inflation environment, monetary aggregates seem to have a high information content. Once a currency area reaches the zone of low and stable inflation, monetary aggregates seem not to add much information. This shows that flexibility is needed when applying different tools. In addition, as it is not excluded that a currency area leaves the zone of stable and low inflation, money, in his view, should remain in the toolkit of central banks. **Axel Weber** expressed his view that the discussion of the monetary policy in this conference focussed too narrowly on money. It is important first to discuss the importance of the role of an explicitly and well defined strategy on reaching the goals. In his view, some other central banks do not have such explicitly spelled out monetary policy strategies. **Edward Offenbacher** agreed with Cecchetti that only analysing inflation expectations from markets might lead to a lock-in problem. As the Bank of Israel looks at a whole range of market expectations and other market information it obtains an overall picture of financial markets, which in his view leads to an avoidance of the lock-in problem. **Alex Cukierman** remarked in his observation that once inflation in developed countries is brought into a low and narrow band, inflation expectations seem to be insensitive to policy actions. He asked for comments on his view that as long as the rate of inflation remains in a narrow range, central banks should not worry about inflation expectations, but should be on guard and vigilant and use a range of alternative tools in order to monitor the possibility of inflation moving out of those bands. **Larry Ball** asked if his perceived difference in the presentation of President Trichet and Chairman Bernanke on the relevance of monetary developments for monetary policy in recent years hints at a dispute about theoretical issues or at differences stemming from empirical properties of money demand in different currency areas. **John Driffill** requested more information on the view of policy makers about the potential benefits of a co-ordination of national monetary policies in a globalised world.

In his reply, **Governor Zhu** stressed the already intensive dialog between monetary policy makers amongst each others and with finance ministers on an international level as for example in G8, G20, or BIS meetings. In his observation, this is important as inflation expectations seem to have got more globalised as well. For example, the inflation expectations in China seem to be influenced by inflation expectations in the US, the Euro area and Japan. **President Trichet** agreed with Weber that the assessment of a successful monetary policy is always linked with the success of the full body of concepts and not of individual aspects. He agreed that within a low and stable inflation regime, monetary considerations are to some extend less important than in high and unstable inflation regimes. At the same time giving a role to money is crucial also in a low and stable inflation regime in order to prevent adverse developments. He stressed the point that by analysing monetary aggregates, their components, counterparts and structural developments in the financial system monetary analysis was considerably broader and more comprehensive than generally assumed by some academics. He pointed out that considerable international co-operation between monetary policy makers are often underestimated by the public. From his observation, it was not the lack of opportunities to exchange views or disagreements about the analysis of potential important issues, but rather the complex implementation process that was the key issue. **Deputy Governor Iwata** stressed that from his point of view, there is no clear relation between the unwinding of past expansion of the monetary base and the temporary slowdown in the Japanese economy. In addition, the currently observable shrinkage of the monetary base was compensated by the reactivation of the interbank market. In addition, the monetary aggregates M3+CD and M2+CD were growing and not shrinking. Finally, **Chairman Bernanke** in his reply agreed with the view that the use of money in monetary policy in a high inflation regime seems plausible. In his view, in case of a low inflation regime, existence of velocity shocks makes it harder to extract the relevant signal from money so that it remains an empirical matter whether interest rates or money give a more reliable signal. He hinted at potential differences in the money demand pattern between the US and the Euro area that are driven by differences in the financial systems and financial innovations. Concerning the role of expectations, he referred to work by Woodford and himself that explains how expectations based monetary policy might yield problems of indeterminacy. Chairman Bernanke did not agree with Eijffinger that the two monetary policy objectives of the FED lead to transparency problems, as having two objectives is fully consistent with standard monetary theory.

Jean-Claude Trichet

CLOSING ADDRESS

THE ROLE OF MONEY AND MONETARY POLICY IN THE TWENTY-FIRST CENTURY

BY JEAN-CLAUDE TRICHET, PRESIDENT OF THE ECB

Ladies and Gentlemen,

It has been a great pleasure to host you at this fourth ECB central banking conference. Over the past day and a half, we have enjoyed several outstanding presentations and stimulating discussions, which have helped clarify the role of money in modern monetary policy-making.

The richness of the discussions stems in large part from the diversity of views that have been expressed. In selecting the leading participants at this conference, we consciously chose speakers who would challenge our established views and those of others. At the conclusion of the conference, I can agree with *Prof. Woodford* that there is always room for further refinement of the intellectual framework used as a basis for monetary policy deliberations. At the same time, I remain convinced that we should not lightly discard elements – such as monetary analysis – that have served central banks well in the past.

With these two points in mind, what are the main messages we should draw from the proceedings? At the beginning of this conference, my colleague Jürgen Stark asked three questions:

- *First*, to what extent is analysis of monetary developments relevant for the conduct of a monetary policy aimed at the maintenance of price stability?

- *Second*, how should the analysis of money be organised in the policy process leading to interest rate decisions about the policy rates?

- *And third*, how should the monetary analysis and its implications for monetary policy be presented to the financial markets and public?

With the benefit of hindsight and taking the risk of repeating a number of arguments that have just been made in the panel discussion, let me take stock of what I have learned over the past couple of days.

With regard to the first question, *Prof. Flandreau* has demonstrated that, in assessing the success of central bank policy, the historical context always needs to be taken into account. Political, institutional, and economic circumstances need to be adequately considered. During the run-up to Monetary Union, money and monetary analysis played a crucial role in the experiences of most central banks in Europe. Viewed in this context, the ECB's choice of strategy was a natural continuation of previous best practice, while at the same time incorporating insights from economic theory and the experience of other central bank. I think it is fair to say that the strategy has served us well.

The clearest evidence of this is the high credibility which the ECB has enjoyed since its inception. The historical fact that, at the time of the introduction of the euro, market interest rates on instruments denominated in euro all along the yield curve were to be aligned with the lowest – and not with the average – rates prevailing prior to the euro was not foreseen prior to Stage III. The historically low level of short, medium and long-term market interest rates was unthinkable in some countries, which had experienced much higher inflation in the past. In my view, the incorporation of monetary analysis into our monetary policy strategy served as an anchor for expectations that in no small way contributed to our success in building and maintaining credibility.

Milton Friedman's famous dictum that "inflation always and everywhere is a monetary phenomenon" is one of the central tenets of economic theory. It has been overwhelmingly supported by an impressive number of empirical studies, both across countries and across time. On the basis of the discussions at this conference, I draw the conclusion that there is no disagreement in the economics profession on this central tenet.

The monetary policy strategy of the ECB announced in October 1998 explicitly recognises the monetary nature of inflation by assigning a prominent role to money in the formulation of monetary policy decisions aimed at the maintenance of price stability. As *Prof. Issing* explained to us in detail, there were and still are many good reasons to do so.

This brings me to Jürgen's second question: how to organise the monetary analysis so that it has an appropriate influence on interest rate decisions.

As was pointed out by *Prof. Christiano* and his co-authors *Rostagno* and *Motto*, including informational asymmetries, transactions costs and financial frictions in "state-of-the-art" macroeconomic models allows to better reflect the role of money and credit aggregates within such frameworks. Using such models, Prof. Christiano illustrated why booms and busts in capital markets, often associated with phenomena of excessive enthusiasm or excessive pessimism about the future, have often accompanied large swings in monetary and credit growth. I find compelling the argument that monetary analysis be used to monitor (and possibly offset) macroeconomic risks which are not related to price stability at shorter horizons, but which may nevertheless have important consequences for maintaining price stability over the medium and long run, like risks to financial stability. This is also consistent with the view that taking full advantage of monetary analysis can best be done by encompassing the long-run link between money and inflation with a detailed analysis of its microeconomic underpinnings. Although the use of such models for policy purposes is in its infancy, their further development is a promising way forward and should, therefore, remain an important field of ongoing research.

However, at present the practical challenge of conducting the monetary analysis requires the adoption and employment of practical and fully operational tools. Conducting such an analysis has not always proven to be an easy task. But, as the paper by *Fischer*, *Lenza*, *Pill* and *Prof. Reichlin* demonstrates, the careful analysis of monetary developments in real time has helped the ECB to shape its assessment of the economic situation and the associated risks to price stability and to better identify the nature of the shocks impacting on the euro area economy. I am convinced that, over the past eight years, monetary analysis has helped the ECB to improve its policy decisions. At the same time, the importance attached to the monetary pillar has also signalled that the ECB's monetary policy has an appropriate medium-term orientation. I strongly believe that this has contributed to shaping agents' expectations in a manner which enhanced the credibility of the ECB.

In this context, the third question raised by Jürgen – namely how monetary analysis should be presented to the public – is crucial. Presenting the monetary analysis in a manner that serves to stabilise private sector long-term inflation expectations by clearly signalling the ECB's vigilance with respect to risks to price stability at longer horizons is key.

Thus, it is particularly important that markets and the public at large have a good understanding of the systematic and conditional conduct of monetary policy by the central bank, so that expectations about future price developments and the path of policy rates are in line with the central bank's mandate. Transparency enhances the effectiveness of monetary policy by helping to guide the expectations of economic agents and bring them into line with policy objectives and actions. For these reasons, the ECB has striven to be as transparent as possible, communicating clearly, and by a variety of means, its policy objective, its strategy, its assessment of the economic situation, and its view of the outlook for price stability and associated risks.

There is no doubt, however, that communication is a challenging task. I can assure you that we at the ECB – in light of the mandate that was assigned to us by the Maastricht Treaty and the trust and credibility we have earned from more than 313 million citizens – take this challenge very seriously.

Quite obviously, there is a trade-off between the complexity of economic reality, well reflected by the multiplicity of the theoretical and econometric models describing it, and the need to communicate in a simple and comprehensible manner. Given the various challenges faced in recent years, this trade-off may have been particularly acute and also relevant for the monetary pillar. I leave it to your judgment if you share my view that the ECB has mostly been very successful in balancing the trade-off between transparency about the inevitable complexities and clarity about the key policy-relevant messages.

To conclude, at the ECB we should guard against complacency by always remaining open to constructive criticisms and suggestions for further improvement of our monetary policy framework. The debate over the past few days have been fruitful in this regard. Thank you again for all your invaluable contributions.

THE ROLE OF MONEY: MONEY AND MONETARY POLICY IN THE TWENTY-FIRST CENTURY 4TH ECB CENTRAL BANKING CONFERENCE

FRANKFURT AM MAIN, 9-10 NOVEMBER 2006

THURSDAY, 9 NOVEMBER 2006

14.30	Opening address: **Jürgen Stark** (Member of the Executive Board, European Central Bank)
14.45	**Session 1** **How important is the role of money in the monetary transmission mechanism?** Chair: **Gertrude Tumpel-Gugerell** (Member of the Executive Board, European Central Bank) **Monetary policy and stock market boom-bust cycle** **Lawrence Christiano** (Professor, Northwestern University) **Roberto Motto and Massimo Rostagno** (European Central Bank) **Is money important for monetary policy?** **Michael Woodford** (Professor, Columbia University) Discussants: **Christian Noyer** (Governor, Banque de France) **Harald Uhlig** (Professor, Humboldt University) A general discussion of approximately 30 minutes will follow
17.00-18.30	**Session 2** **How useful are monetary and credit aggregates in the conduct of monetary policy?** Chair: **José Manuel González-Páramo** (Member of the Executive Board, European Central Bank) **Money and monetary policy: ECB 1999-2006** **Björn Fischer, Michele Lenza, Huw Pill and Lucrezia Reichlin** (European Central Bank)

Discussants:
Philipp M. Hildebrand
(Member of the Governing Board, Swiss National Bank)
Jordi Galí (Professor, Universitat Pompeu Fabra and Massachusetts Institute of Technology)

A general discussion of approximately 30 minutes will follow

19.30 Reception and dinner "Palais im Zoo"

Keynote speech: **Lucas Papademos**
(Vice-President, European Central Bank)

Friday, 10 November 2006

09.00 **Session 3**
What are the benefits of responding to monetary developments?
Chair: **Lorenzo Bini Smaghi** (Member of the Executive Board, European Central Bank)

A history of monetary targets 1815-2006
Marc Flandreau
(Professor, Institut d'Etudes Politiques de Paris-I)

Discussants:
Michael Bordo (Professor, Rutgers University)
Christian de Boissieu (Professor, University of Paris)

A general discussion of approximately 30 minutes will follow

10.30 Honorary address: **The ECB's monetary policy strategy: Why did we choose a two pillar approach?**
Speaker: **Otmar Issing** (Former member of the Executive Board, European Central Bank)

11.15 **Session 4**
Panel: money and monetary policy – an academic view

Introduction: **Volker Wieland**
(Professor, Goethe University of Frankfurt and Center for Financial Studies)

Panellists:
Ricardo Caballero
(Professor, Massachusetts Institute of Technology)
Jean-Pierre Danthine
(Professor, HEC, Université de Lausanne)
Mark Gertler (Professor, New York University)
Hyun Song Shin (Professor, Princeton University)

A general discussion of approximately 30 minutes will follow

14.45 **Session 5**
Panel: money and monetary policy – a policy makers' view

Introduction: **Lucrezia Reichlin**
(Director General Research, European Central Bank)

Panellists:
Ben Bernanke
(Chairman, Board of Governors of the Federal Reserve System)
Kazumasa Iwata (Deputy Governor, Bank of Japan)
Jean-Claude Trichet (President, European Central Bank)
Zhou Xiaochuan (Governor, People's Bank of China)

A general discussion of approximately 30 minutes will follow

16.30 Closing address:
Jean-Claude Trichet (President, European Central Bank)

16.45 End of conference

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