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Abstract

The paper attempts at disentangling the main sources of the rise in the Italian unemployment rate over the last four decades on the basis of a small model *a la* Layard-Nickell, identified and estimated using a structural VAR approach. Unemployment movements are assumed to be driven by fully permanent and long-lived but temporary shocks.

The component of unemployment related to current and lagged demand shocks deriving from the sVAR estimation is found to be relevant and quite persistent, its swings accounting for approximately a 4 percentage points change in the unemployment rate. In particular, while temporary by construction, this component shows an almost continuous increase since the beginning of the 1980s.

Nonetheless, the results confirm that the bulk of the rise in Italian unemployment is to be attributed to non-demand factors: temporary (namely productivity and labour supply shocks) and fully permanent (namely shocks to the wage bargaining schedule). The latter explain a gradual rise of about 2.5 percentage points between the end of the 1960s and the beginning of the 1980s; over the last 15-20 years, however, they do not seem to have further contributed to the worsening of unemployment situation.

1 Introduction

Italy has been characterised by one of the worst labour market performances among the countries of the European Union (EU). A look at the evolution of the unemployment rate over time highlights a clear pattern in which a very high degree of persistence is compounded by an upward drift, resulting, as far as the last 25 years are concerned, in an almost unbroken upward trend.

After the decline that took place in the first half of the 1960s, the unemployment rate fluctuated around 4% up until the middle of the next decade (see Figure 1).[1] Then, a steady increase was witnessed in the second half of the 1970s and, even more so, in the 1980s; this was briefly reversed at the beginning of the 1990s, after which a new sharp rise – to up to 12% – took place in the period between 1992 and 1995. Since then unemployment has remained stubbornly high, with the limited rise in employment – albeit significant in light of the subdued GDP evolution – being only marginally translated into a reduction in the unemployment rate.

The rise in average unemployment has gone hand in hand with an increase in the degree of segmentation of the labour market (see Table 1), resulting in an almost steady rise in unemployment rate differentials across age, gender and regional divides. By comparison with the other EU countries, gender and age-related unemployment differentials are very large, and the long-term unemployed represent about two thirds of total unemployed. Unemployment duration and age and gender differentials are clearly interrelated, as the duration of the job search is much shorter for job-losers than for first-job seekers. Probably the most typical feature of the Italian labour market is the large unemployment differential across regions, particularly among female and new entrants. The unemployment rate in the South was close to double that in the other regions during the 1970s and the first half of the 1980s; over the period from the end of the same decade up to the present it has been almost three times as much.

The upward drift in the unemployment rate and, even more, the evolution of its composition, hint at the presence of structural elements that have favoured the rise and the persistence of labour market imbalances.

However, this standard characterisation may be too simplistic, as it neglects the role of other macroeconomic factors and shocks. Precisely because of the still prevailing rigidities of the Italian labour market it is, in fact, very likely that several sources of shocks have played a role in the rise in the unemployment rate. Since these institutional aspects themselves have not been stable over time, a framework that investigates their changes and the persistence they create in the effects of shocks seems the most suitable one for a thorough analysis of unemployment in Italy.

This paper aims at carrying out such an analysis by adopting a structural vector autoregressive (sVAR) approach, which explicitly allows account to be taken of the institutional setting, its modifications over time and its interaction with a number of shocks that have hit the Italian economy. After having investigated the effects and the propagation pattern of such shocks, the paper provides a breakdown of the Italian unemployment rate into its cyclical and structural components, by identifying the latter as that part of observed unemployment driven by non-demand shocks. The approach adopted allows the derived measure of structural unemployment/ NAIRU to be broken down further into the effects of the various supply-side shocks identified in the sVAR, namely into those of the wage bargaining schedule, which have fully permanent effects, and productivity and labour supply shocks, which, despite being transitory, may still have sustained effects on unemployment. In order to somehow assess the reliability of the results provided by this

[1] *Throughout the paper we use a reconstructed series for the unemployment rate adjusted for the several breaks in the unemployment data and definitions occurred over time. For further details see Casavola (1994).*

methodology, they are compared with a benchmark measure of NAIRU/structural unemployment based on a number of statistical techniques commonly adopted in the literature on the subject.

Table 1

The Italian labour market: some synthetic indicators[1)]

	1977	1982	1987	1992	1993	1998
				percentages		
Male activity rate[2)]	79.6	78.3	76.1	74.4	73.4	71.7
Female activity rate[2)]	36.3	39.1	42.5	44.3	42.2	44.5
Total unemployment rate	7.1	9.1	12.0	11.5	10.1	11.8
Unemployment rate differential by gender[3)]	2.72	2.44	2.31	2.14	1.93	1.79
Regional unemployment rate differential[4)]	1.74	1.78	2.29	2.87	2.50	3.11
Unemployment rate differential by education[5)]	0.50	0.65	0.85	0.87	0.98	1.16
Youth unemployment rate differential[6)]	3.33	3.25	2.97	2.84	2.98	2.72
Share of job losers in total unemployment[7)]	13.6	13.7	19.3	19.7	36.2	37.2
Share of first job seekers in total unemployment[7)]	44.9	56.3	47.8	48.9	43.0	42.5
Incidence of long-term unemployment[8)]	24.6	32.1	49.0	51.5	59.7	68.6
Long-term unemployment among job losers[8)]	18.4	23.3	31.3	33.2	44.7	57.5
Long-term unemployment among first job seekers[8)]	33.0	38.6	61.4	66.1	73.6	80.5

Source: Our calculations on the basis of ISTAT labour force survey data.
1) *Data are not corrected to take into account the various changes in definition and methodology occurring during the period in question. (A break is present in 1993). The total unemployment rate does not correspond with that used in the model estimations (see Appendix 2).*
2) *Activity rates refer to the 14-64 age group before 1992 and to the 15-64 age group from 1993 onwards.*
3) *The ratio between unemployment rates in the female and male groups.*
4) *The ratio between unemployment rates in southern and northern regions.*
5) *The ratio between unemployment rates of low and high-level education groups.*
6) *The ratio between the unemployment rate in the 14-24 age group (15-24 from 1993 onwards) and the aggregate one.*
7) *The composition of unemployed (job losers, first job seekers, re-entrants) has been greatly affected by the 1993 revision.*
8) *Share of long-term unemployment defined as duration exceeding one year up to 1992, and 12 months and over since 1993.*

The paper is structured as follows: in Section 2 we briefly review some of the main factors behind the rise in Italian unemployment over the last four decades, starting with a discussion of the main institutional features of the labour market. In Section 3 we present some preliminary "direct" estimates of the Italian NAIRU. Section 4 describes the model adopted for the sVAR estimation and the results obtained. Section 5 presents a reconstruction of the various components of unemployment. Section 6 provides a conclusion.

2 Broad factors behind Italian unemployment

The upward drift of the unemployment rate and, even more, the evolution of its composition, hint at the possibility that the widening of labour market imbalances in Italy has been the result of the interaction between the negative shocks that have hit the economy over time and structural elements hindering the adjustment process. As for the latter, a number of analyses of the Italian labour market have singled out the role of two main features of its institutional setting: the regulatory framework concerning the employment protection legislation (EPL), and the system of collective wage bargaining.

In many respects Italy stands out as a paradigmatic case of labour market rigidities. As concerns the EPL[2], Italy has been deemed in almost every cross-country comparison as one of the most extreme cases in the OECD area. Moreover, even if it can be singled out as one of the countries with the lowest generosity of standard unemployment benefits, peculiar schemes (Wage Supplementation Fund, mobility lists) tailored on workers hit by layoffs and collective dismissal taking place in large firms (in the industrial sector, which represents the stronghold of the unions' movement) have played an important role in supporting unionised prime-age breadwinners while unemployed.

Another crucial factor affecting the functioning of the Italian labour market has been the system of collective bargaining. Its role in shaping the wage structure has been strengthened by the fact that unions' contracts tend to cover the vast majority of workers (those excluded are mostly the underground economy employees, so that the coverage rate may be estimated at around 80%), notwithstanding the not particularly high unions' density rate (around 35% today after the peak of 49% in 1977; Della Rocca, 1998). The setting emerged in the 1970s featured an automatic wage indexation clause, determining a very high nominal inertia, and a multi-level bargaining framework with a dominant role of industry-level collective contracts, with a strong bias against wage differentiation, particularly along regional lines.[3] Therefore, the Italian bargaining system has been traditionally depicted as centralised and uncoordinated, falling in the worst category among the ones depicted by Calmfors and Driffill (1988) and the related literature.

One has however to take into account the changes experienced over time by such structural features. It is in fact a commonly shared view that many rigidities have been reduced, and not increased, at least since the eighties. For instance, as for unions' bargaining, the four decades under scrutiny have been characterised by a number of substantial changes in the institutional framework of wage setting and, even more, in the relative strength of social partners and their stance in the negotiation process. We are referring here to changes which are not explained by labour market conditions, i.e. corresponding to autonomous shifts in the wage-setting curve. An important example of such changes is the cycle of industrial conflicts and social unrest that began in 1969 and extended at least until the mid-1970s, which corresponded to a strong rise in unions' power that started receding by the end of the decade. On the other hand, the strong political ties and ideological biases of Italian unions have allowed several episodes of wage moderation and centralised co-ordination. In the 1980s there were a few attempts to rein in nominal wage growth through income policy instruments; the main result was (in 1986) the modification of the indexation mechanism that became less responsive to price changes and more neutral in terms of wage differentials. At the beginning of the 1990s - in the wake of a severe economic and financial

2 *The causal relationship between EPL and unemployment is a much debated issue as theoretical models produce ambiguous results, at least as far as the direct impact of hiring and firing costs on average employment - for given wages - is concerned (see Bertola, 1999 for an overall assessment), while the empirical literature abounds of inconclusive results with only few very recent papers purporting to show a negative employment effect of EPL (see Boeri et al., 1999 and Di Tella and Mc Culloch, 1998).*

3 *Firm-level bargaining took place mainly in large firms and acted mostly as a wage drift mechanism, as such more relevant and widespread in periods when economic and other factors increased unions' bargaining power. Its presence exacerbated the difficulties of bargaining co-ordination while contributing little to the flexibility of pay differentials as the links with productivity gains and local labour market conditions have been usually quite loose.*

crisis - important changes to the wage determination mechanism took place (based on tri-partite agreements between the social partners), aimed at introducing tight income policy guidelines. The wage indexation mechanism (*scala mobile*) was abolished at the end of 1991; the subsequent episode of outright wage moderation contributed substantially to lower the cost of disinflation at least up to 1995.[4] The reform of the bargaining framework that took place in 1993 increased the degree of centralisation and co-ordination of wage setting. However, the ability of the wage determination system to cope with the imbalances of a labour market marked by a high degree of segmentation remained very low. In particular, wage differentials remained rather unresponsive to the territorial and generational divides that plague Italian unemployment.

Similarly, what was said above about EPL may fail to take on board the host of small but important changes that has taken place during the 1980s and the 1990s, in particular those related to the relaxation of the regulation concerning the use of fixed-term and temporary contracts.

At the same time, however, the last two decades have experienced a steady rise in the tax wedge, which might be considered as one of the factors shifting up structural unemployment.[5]

More generally, as forcefully argued by Blanchard (1998)[6], one needs to consider the interaction between the effects of adverse shocks and the institutional features of the labour market preventing the proper working of self-equilibrating mechanisms. All in all, it seems reasonable to assume that the obstacles to job reallocation deriving from employment regulations have interacted with the rigidity of the wage bargaining framework in hindering the adjustment of the labour market and in strengthening the power of insiders in wage negotiation. In turn, this explanation seems fully consistent with the composition of unemployment previously described. Although some institutional rigidities have been partially relaxed in the 1980s and the 1990s, the features of the Italian labour market have set the conditions to make the effects of adverse shocks very persistent and likely to produce a maybe not fully permanent but very long-lasting rise in the unemployment rate.

As these adverse macro shocks are concerned, at least three factors have to be recalled. First, one needs to take into account the different macroeconomic policy regimes experienced over the last three decades in order to understand why unemployment had been rising more over the 1980s and the 1990s than over the 1970s. While a complete characterisation of the stance of monetary and fiscal policies is out of question here, there are some episodes worth recalling. Monetary and fiscal contractions were not uncommon during the 1960s and the 1970s (for instance an abrupt monetary restriction curbed the overheating of the economy in 1963), but the overall policy stance remained accommodating as the social costs of disinflation after the wage push of 1969-1970 and the oil shock of 1974 were generally considered too high. During the 1980s, the monetary authorities exploited Italy's participation to the EMS in order to progressively restore monetary discipline through the exchange rate constraint. Even more severe were the contractionary impulses induced by the mix of fiscal consolidation and disinflationary monetary stance that prevailed in the 1990s.

A second candidate factor may relate to the slowdown in the long-term rate of economic growth that has taken place since the 1970s. While this development has been common to the EU as a whole (and also to the US), in Italy it has been more pronounced, particularly in the last decade, when the average annual rate of growth has barely exceeded 1%, remaining well below the ones

[4] *On this aspect see Fabiani et al. (1997).*

[5] *For a forceful argumentation about the role of taxes on labour see Daveri and Tabellini (1997). Further cross-country evidence is presented in Nickell (1997) and Elmeskov et al. (1998), whose results are however less extreme (and more plasusible) quantitatively. From a theoretical perspective, Pissarides (1998) states under what conditions a tax rise may increase equilibrium unemployment.*

[6] *See also, among others, Nickell (1997) and Sargent and Ljungqvist (1995).*

experienced by the other economies of the euro area. The roots of this slowdown are far from being clearly understood and the structural shocks that have determined it have probably to be traced back to a host of variables that have affected the trend in economic growth. However, it might be interesting to attempt at capturing such elements through a proxy that can be thought of as the sequence of shocks driving the permanent component of output growth.[7] Considering the rigidities in the skill and regional wage differentials previously highlighted, a similar role may have been played by the occurrence of regional shocks (as the catching-up process of Southern regions prematurely came to a halt in the mid-1970s) and skill biased technical progress.

Finally, an often neglected variable that seems to have played, at least in some crucial periods, an important role in generating adverse shocks for the labour market is the "exogenous component" of labour supply. Over the 1970s and the 1980s the rise in the unemployment rate has gone hand in hand with a rise in labour supply. The labour supply rise itself may be to a large extent related to exogenous factors: demographic developments (mainly related to the effects of the baby-boom) that determined a strong rise in the working-age population during the 1970s and up to the first half of the 1980s; the rise in the female participation rate still occurring, which has also changed the gender and age (the rise in the female participation affecting mainly the young age-group) composition of the labour force.

Starting from the stylised facts sketched above, our quantitative analysis is focused on developing a suitable framework aimed at disentangling the different sources of shocks that have driven the fluctuations of the unemployment rate from the effect of changes in institutional factors affecting the way the labour market operates. As will be described in more detail in section 4, we specify a sVAR model that allows the identification of four different sources of shocks impinging on unemployment. Three of them can be considered as the empirical counterpart of factors that have been pinned down in the previous discussion, because of their role in shaping the evolution of labour market disequilibria: aggregate demand disturbances, that can be traced back to the impulses generated by monetary and fiscal policy; productivity shocks, representing the forces affecting the permanent component of output; labour supply shocks, corresponding to "exogenous" movements in the labour force, due to demography and to changes in participation behaviour. The fourth shock identified in the sVAR model is meant to represent the impact of changes in the institutional setting of the wage bargaining system and, in a more general fashion, the host of variables affecting the functioning of the labour market (the strictness of the EPL, the tax wedge, regional and skill composition of unemployment resulting in labour mismatch, etc.).

Given the limitations of the information set utilised in the quantitative exercise, many aspects that are likely to have played a relevant role in the evolution of unemployment will be lumped together. Nevertheless, conditional on the reliability of the restrictions introduced to identify the shocks, the empirical results should shed some light on the relative contribution to the rise of unemployment deriving from some broad class of determinants, in particular those of a structural nature.

3 A benchmark identification of structural unemployment

The empirical measurement of the component of observed unemployment driven by structural factors is not a straightforward exercise, given that such a component is not directly observable. As already stated in the introduction, the sVAR approach adopted in this paper for this purpose is based on the estimation of a system of equation, which, together with a set of identifying

[7] *On the role of the "TFP growth slow-down" in the rise of European unemployment see Blanchard (1998).*

restrictions, allows reconstructing the various components of unemployment movements over time. Drawing on such a reconstruction, we aim at providing an estimate of the Italian NAIRU/ structural unemployment over time.

This approach lies somewhat in between two broad classes of empirical methodologies developed in the literature to estimate the NAIRU/structural unemployment, that is, the so-called "structural" and "direct" methods. As in the former - which derive the NAIRU as the equilibrium outcome of structural models representing aggregate price and wage behaviour (Layard, Nickell and Jackman, 1991) - the sVAR methodology focuses explicitly on the different components of unemployment. These are identified, however, through suitable assumptions applied to an unrestricted system rather than through restricted estimates of a two-equation system. In this respect, the main advantage of the sVAR method[8] is that it circumvents the measurement difficulties plaguing most attempts to find proxies for shocks and institutional changes and the arbitrariness of many of the usual identifying assumptions adopted in estimating structural price and wage equations. With respect to direct methods, which are mainly based on time series analysis of unemployment (and, in multivariate framework, other variables such as inflation), the sVAR approach allows to explicitly investigate several sources of shocks, attributing to each of them an explicit economic meaning.

Needless to say, the approach has its own limitations. The remainder of this section focuses, therefore, on some statistical techniques - within the class of direct methods - that are commonly adopted in the literature to address the issue of NAIRU measurement. The aim of this exercise is to provide a preliminary benchmark against which to compare the estimates of this unobservable variable for the Italian economy deriving from the system estimation carried out in the subsequent sections.

In more detail, we consider filtering techniques based both on univariate time series and on the information provided by the relationship between unemployment and inflation. They range from simple univariate filtering approaches to more complex multivariate methods based on Phillips curve relationships. As a first step, we focus on the Hodrick-Prescott and Baxter-King filters, which decompose unemployment into a structural, or trend, component and a cyclical one within an "atheoretical" framework, i.e. leaving the interaction between unemployment and other economic variables completely indeterminate.

We then turn to the time-varying-parameter approach proposed by Gordon (1996) and Staiger, Stock and Watson (1996), which exploits the information provided by inflation and other supply side factors to identify the structural component of unemployment by means of Kalman filter estimation. The advantage of this approach is that it attempts at introducing more economic structure in the estimation procedure by explicitly incorporating in the decomposition of unemployment the definition of the NAIRU as the unemployment rate at which inflation is stable. More in detail, we set up a two-equation system comprising a Phillips curve that relates inflation to the tightness of the labour market (defined as the difference between current unemployment and the NAIRU) and a random walk process for the NAIRU.

The strategy we adopt to estimate the model follows Stock's (1999) two-step approach. In the first step, we estimate the Phillips curve by ordinary least squares; in the second step, we take the obtained parameters and residual as input for a Kalman filter. As for the state-space specification of the model, the Phillips curve is used to derive the measurement equation and the random walk process for the NAIRU to derive the transition equation.[9] The two steps are then iterated until the

[8] *As evidenced by Dolado and Jimeno (1997).*

[9] *As concerns the initial estimates of the NAIRU (necessary for second step) a grid search, ranging from a constant NAIRU to others closely tracking observed unemployment, pointed to the Hodrick-Prescott filter as a good starting point. As for the variance of the random walk, its initial value was set to be equal to that of observed unemployment, both being expressed in first differences.*

likelihood function is maximised.[10] The Kalman filter procedure is implemented on two alternative specifications of the Phillips curve: one linking price inflation to the unemployment gap and world prices; the other distinguishing explicitly between movements in prices and in wages, and modelling the latter as a function of price inflation, the unemployment gap and world prices.[11] In both cases a dynamic homogeneity restriction is imposed, although its relaxation does not seem to alter the results in any fundamental way.

Figure 1 presents the NAIRU estimates obtained by applying the methods described so far. The various results tell a broadly similar story, the main difference being that the measure derived from univariate filters seems to follow actual unemployment much more closely than the ones obtained by Kalman filter. The NAIRU and observed unemployment decrease slightly from the beginning of our sample period until the mid-sixties; both are broadly constant in the next decade, after which they start to rise somehow in line. It is not until the beginning of the eighties that a clear and systematic increase in the unemployment gap occurs, at least as concerns the measures obtained by Kalman filter estimation. The gap disappears at the turn of the decade, becomes negative, and, finally, it increases again after 1993.[12]

One of the main drawbacks of the direct methodologies applied above is that they do not allow capturing and identifying the variety of factors that may have influenced structural unemployment over time. These methods, in fact, lump together the effects of the different types of shocks that hit the economy and affect both the pattern and the size of unemployment. A step in this direction is instead allowed by the use of structural vector autoregression models that include specific restrictions to identify structural components. Such restrictions have to be imposed a priori on the basis of theoretical considerations that, for example, motivate the identification of shocks that have permanent effects and shocks that have only transitory ones.

[10] *The main drawback of this procedure is that it is not a full optimisation of the filter. The number of iterations needed for maximising the likelihood turned out to be low as long as the starting values were good enough. Each time the procedure converged, it was established, within a neighbourhood of the solution, that the maximum was not a local one.*

[11] *In both specifications the dependent variable (either price or wage growth) was regressed on its lagged values (for the curve modelled in terms of wage growth, also on contemporaneous and lagged inflation), on lagged values of world price changes and on lagged values of the unemployment gap.*

[12] *As for the final part of the sample period, we refer only to the NAIRU measures derived through the Kalman filter, given that the reliability of the HP filter NAIRU is strongly affected by the lack of precision of end-of-sample estimates of the unobservable variable.*

4 The sVAR approach

In the discussion presented in section 2 we have argued that the interaction between macroeconomic shocks and structural features producing persistence may have been at the root of the rise of unemployment in Italy. Even though in the whole post-war period the system was characterised by an unchanged set of general rules, different historical periods may be identified. This suggests that a multivariate structural approach is needed in order to take proper account of the interaction between the institutional framework and the shocks that buffeted the labour market. The difficulty is that the relevant aspects to be considered are too many and that there is no clear mapping between them and any single measurable variable[13]: arbitrarily considering a single feature, selecting for instance those aspects which are more easily measurable over a long span of time, risks overstressing the changes in that single aspect.

It is precisely for these measurement difficulties, which have a stronger influence on single-country studies than on international-wide comparisons, that we adopt a structural VAR approach. Such a technique has a number of advantages, namely it allows (i) to recover the shocks impinging on the economy; (ii) to disentangle them from the propagation and amplification mechanisms working through the functioning of markets; (iii) to avoid the measurement difficulties implicit in the approach proposed by Layard et al (1991), which relies entirely on observables; (iv) to overcome some of the well-known identification difficulties implicit in the estimation of structural models of the labour market (see also Manning, 1993). Clearly, the sVAR approach has shortcomings as well: the over-parameterisation of the reduced form model, which affects the precision of the estimates, and the identifying assumptions, which may be quite controversial when the model is a large one.

The methodology we use here is in many respects similar to that described in Dolado and Jimeno (1997). The driving forces we identify are shocks to technology, labour supply, nominal aggregate demand and to the wage-price block. Differently from the mentioned study, we distinguish between disturbances having temporary but long-lasting effects on unemployment and shocks to the wage-price block, which have permanent effects on unemployment and hence drive the "very long-run" component of structural unemployment.[14]

With reference to the informal discussion carried out in section 2 two things have to be clarified. First, we tend to interpret shocks to the wage-price block as innovations to the structure of unions' bargaining even if several other sources of innovations to labour market institutions may be comprised into it. Second, although for the other shocks we focus on macroeconomic factors, other disturbances of a more structural nature (related to skill supply and demand balance or to regional features) might be also present and not explicitly identified.

As the core of our approach is the identification of the various shocks, in the remaining part of this section we first present a relatively simple model adopted for identification purposes. We then discuss the basic properties of the data and of the reduced form estimates. Finally, we present the properties of the structural model as summarised by the impulse response functions.

[13] *For instance, while unions' bargaining is clearly a relevant feature, it appears rather difficult to say what is the single variable more likely to capture all its facets.*

[14] *Dolado and Jimeno (1997) have either full hysteresis, with each shock exerting permanent effects, or a constant long-run unemployment rate.*

4.1 The stylised model

The reference model is an extension of the framework set out in Blanchard and Quah (1989), augmented to allow for a richer variety of shocks, and in particular with a wage-price block building upon the Layard et al (1991) framework. The model, disregarding constant terms, is described by the following set of equations, where all variables but the unemployment rate are in logs and have, unless otherwise specified, standard economic meaning:

$$(1)\quad y_t = \phi(d_t - p_t) + a\vartheta_t$$
$$(2)\quad y_t = n_t + \vartheta_t$$
$$(3)\quad p_t = w_t - \vartheta_t + \beta u_t$$
$$(4)\quad l_t = \alpha E_{t-1}(w_t - p_t - \vartheta_t) + \tau_t$$
$$(5)\quad w_t = E_{t-1}(p_t + \vartheta_t) + k_t - \sigma E_{t-1} u_t$$
$$(6)\quad u_t \equiv l_t - n_t$$
$$(7)\quad \vartheta_t = \vartheta_{t-1} + \varepsilon_t^s$$
$$(8)\quad \tau_t = \tau_{t-1} + \varepsilon_t^l$$
$$(9)\quad k_t = \rho k_{t-1} + \varepsilon_t^w$$
$$(10)\quad d_t = d_{t-1} + \varepsilon_t^d$$

According to equation (1), aggregate demand is a function of the policy stance (modelled in equation 10 as a random walk process) and productivity (also modelled as a random walk process in equation 7). The first term can be viewed as the exogenous component of aggregate demand due to fiscal and monetary policy, while the second reflects the fact that productivity affects permanent income and therefore consumption and that technological innovations are incorporated into new capital. Equation (2) is a constant return to scale production function, once capital has been substituted out under the assumption that in the long run it is a constant fraction of output.[15] Equation (3) is a price setting equation. Firms have market power and set prices on the basis of unit labour costs and depending on unemployment conditions. Equation (4) describes the labour supply, which depends in the long run on demographic and other exogenous factors (modelled through equation 8). As for the effect of real wages on labour supply, we adopt a shortcut in order to impose the absence of long-run trends due to technical progress. Therefore, while in the short run (left unmodelled) labour supply may react to real wages, in the long run we assume that it reacts to the difference between real wages and productivity. This simplification may be rationalised by assuming that the opportunity cost of labour supply (the value of leisure) is itself in the long run related to productivity. Equation (5) is the wage setting schedule: unions bargain so as to tie real wages to expected productivity increases. Compensations move pro-cyclically and depend also on the exogenous variable k_t, which represents either wage-push shocks or changes in the outside wage opportunities and is modelled in equation (9). Equation (6) defines the rate of unemployment. The degree of persistence in unemployment is determined by the value of the parameter ρ in equation (9): if ρ=1 the unemployment rate is a difference stationary process; if $|\rho|$<1 it is stationary.

[15] *We do not take explicitly into account capital-labour substitution under the assumption – holding in the Cobb-Douglas case and approximately confirmed by Italian data – that the capital-output ratio remains unchanged.*

Under the assumption that shocks to wage bargaining have permanent effects (i.e. ρ=1), solving out equations (1) to (10) for real wage growth, output, price inflation, and the first difference the rate of unemployment, yields:[16]

$$\begin{bmatrix} \Delta u_t \\ \Delta(w_t - p_t) \\ \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} c_{11}(1) & 0 & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) & 0 \\ c_{41}(1) & c_{42}(1) & c_{43}(1) & c_{44}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_t^w \\ \varepsilon_t^s \\ \varepsilon_t^l \\ \varepsilon_t^d \end{bmatrix} + C^*(L) \begin{bmatrix} \Delta\varepsilon_t^w \\ \Delta\varepsilon_t^s \\ \Delta\varepsilon_t^l \\ \Delta\varepsilon_t^d \end{bmatrix}$$

For this specification (hereafter "difference" specification), the six necessary restrictions are the following. Wage bargaining shocks (ε^w) may potentially affect all variables and therefore provide no usable restriction. Having specified unemployment in differences allows to get a restriction for the technology shock (ε^s) which, according to our illustrative model, has no long-run impact on unemployment but affects in the long run real wages, output and the price level. Two further restrictions are provided by the assumptions concerning labour supply shocks (ε^l) which have no long-run impact on unemployment and real wages. The additional three identifying assumptions refer to nominal shocks (ε^d), restricted to have no long-run effect on unemployment, real wages and output.

The structure of the matrix of long-run multipliers is heavily modified if one assumes that wage bargaining shocks are temporary (i.e. $|\rho|$<1). The final form of the model becomes:

$$\begin{bmatrix} \Delta(w_t - p_t) \\ \Delta y_t \\ \Delta p_t \\ u_t \end{bmatrix} = \begin{bmatrix} c_{11}(1) & 0 & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) & 0 \\ c_{41}(1) & c_{42}(1) & c_{43}(1) & c_{44}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_t^s \\ \varepsilon_t^l \\ \varepsilon_t^d \\ \varepsilon_t^w \end{bmatrix} + C^*(L) \begin{bmatrix} \Delta\varepsilon_t^s \\ \Delta\varepsilon_t^l \\ \Delta\varepsilon_t^d \\ \Delta\varepsilon_t^w \end{bmatrix}$$

The ordering of the variables shows how the structural shocks can be identified in this specification where the unemployment rate is modelled in levels (hereafter "level" specification). The main features of the model are the following. The unemployment rate is determined by the interaction between a wage bargaining schedule and a price fixing equation and has no drift since the disturbances buffeting the wage bargaining locus have only temporary effects. Nominal shocks may, however, push it temporarily above or below its equilibrium value. Also other shocks may temporarily affect it but neither productivity nor labour supply shocks have long-run effects on equilibrium unemployment. Given that labour supply reacts in the short run to all shocks but is assumed to be totally wage-inelastic in the long run - so that its evolution is driven by shifts in labour participation and demographic trends – the real wage is permanently affected only by technology shocks. Output is eventually only a function of the rate of growth of population and technology, while inflation depends on all stochastic trends (only temporarily on shifts to the wage bargaining locus as these are assumed to be mean reverting).

We consider the "difference" specification as our baseline, our aim being the decomposition of unemployment into a fully permanent component (driven by shocks to the wage bargaining locus), a further structural one (long-lived but in principle not permanent, related to productivity and labour supply shocks) and a cyclical one, identified as that produced by the cumulated effects of

[16] *A more detailed description of the steps required for the solution of the model is presented in Appendix 1.*

nominal shocks. In our interpretation of the results (presented in the next section) the first two components, taken together, represent the empirical counterpart of the concept of structural unemployment (or the NAIRU).

We also report the results for the "level" specification, as the temporary or permanent nature of shifts in the wage bargaining locus is unclear (and the statistical properties of the unemployment rate do not provide conclusive evidence on the presence of a drift in the series, as it will be discussed in the next section). For the baseline model we also consider some additional experiments. In particular, we assess the robustness of the results with respect to different lag structures for the VAR (as the appropriateness of one versus another lag structure is not crystal clear) and to the introduction of additional exogenous driving factors (related to impulses from abroad).[17]

4.2 Preliminary univariate testing

In order to gain insight on the statistical properties of the variables used in the paper, the first step of the empirical analysis is to pre-test the relevant time series.[18] A clear understanding of the statistical properties of the data is in fact of primary importance in conducting proper inference and deriving meaningful economic interpretations. Three classes of tests are performed: (1) unit root tests; (2) cointegration tests; (3) test for the presence of structural breaks. A detailed description of the specific methodologies adopted and the related results are presented in Appendix 3. The economic questions these tests are, in principle, intended to clarify concern the nature of the trend and cycle components of the series, the nature of the shocks causing cyclical fluctuations, the pattern of causality and the existence of equilibrium properties. However, since such tests generally cannot clearly distinguish between integrated and highly autocorrelated series, their results are not to be taken at face value, but rather interpreted in the light of economic theory and of the general knowledge of the post war Italian economic history.

The tests show that for none of the variables the null of non-stationarity can be rejected. Two results in particular are worth mentioning: the first one is that there is not enough evidence to suggest that the lower pace of ouput growth, which characterises the second part of the sample, is due to a permanent reduction in trend productivity, rather that to a sequence of negative productivity shocks; the second one is that there is some evidence that the inflation rate is not a stationary process. The last result is however dubious: the graphical analysis of the series indeed indicates that the inflation rate shows a clear tendency to revert to the unconditional mean. Given the contradictory evidence provided by formal and informal testing of the data and in the light of the well-known low power properties of unit root tests, in the VAR estimation we model such a variable as an I(0) process, its temporary jumps being captured by means of either dummies or exogenous (foreign) factors. The choice is also motivated by the consideration that the time series used in this paper are obtained by joining different sources and are therefore likely to be affected by sizeable measurement errors, which might bias the results of any statistical testing. Consistently with our priors in favour of the "difference" specification, also the unemployment rate seems to be better approximated by an I(1) process rather than a trend stationary one, although neither of the two processes is very appealing, given that the unemployment rate is a bounded variable. In the

[17] *We also attempted at introducing a fifth shock, namely a shock to the mark-up, with the aim of obtaining a more precise characterisation of the factors assumed to be drifting unemployment. A description of this additional exercise and of the related results is presented in Appendix 4.*

[18] *For a description of the data used and the methodology adopted to reconstruct the quarterly time series from 1955, see Appendix 2. It must be stressed that the data included in the first part of the sample (namely the '50s and the '60s) are affected by substantial shortcomings: there are breaks in the series and quarterly observations are often obtained though interpolation of yearly data based on indirect indicators. However, as those measurement errors affect about one third of the sample and concern mainly the high frequency movements of the series, it seem safe to assume that they do not induce major effects on the specification of the model.*

VAR estimation we consider both specifications. In the second case, however, we do not allow for a deterministic trend, in the presumption that the long memory of the series can provide for the trending behaviour of the last three decades.

4.3 Empirical evidence: VAR estimates

Lacking over-identifying restrictions, single equation OLS are used in estimation. The order of the VAR is chosen according to both the likelihood ratio test and information criteria (Akaike and Schwarz). A few dummies are also included, in order to ensure parameter constancy and to generate well-behaved residuals. The first one, which takes a unit value in 1967Q1, helps explaining the acceleration in the growth rate of output[19]; two other dummies allow to smooth the spikes in real wages showing up in 1969Q4 and 1970Q1[20]; the last one proxies for the first oil shock in the price equation.[21] All models are estimated on the same sample period, from 1956Q1 to 1998Q3.

We estimate first the "level" specification. The results obtained are presented in Table 2 and show that single equation statistics are in most cases satisfactory. The residuals in the equation for inflation and real wage growth are apparently non-normal and heteroskedastic, suggesting that OLS may not be an accurate estimator.

Table 2

Summary tests for the "level" specification

AR 1-5	***F(5,136)***	***p-value***
$\Delta(w_t\text{-}p_t)$	1.3161	[0.2609]
Δy_t	0.9281	[0.4649]
Δp_t	1.5988	[0.1645]
u_t	2.3164	[0.0469]
Normality	$\chi^2(2)$	***p-value***
$\Delta(w_t\text{-}p_t)$	1.5288	[0.4656]
Δy_t	2.5437	[0.2803]
Δp_t	12.4211	[0.0020] **
u_t	3.4952	[0.1742]
ARCH 4	***F(4,133)***	***p-value***
$\Delta(w_t\text{-}p_t)$	6.0341	[0.0002] **
Δy_t	0.77387	[0.5441]
Δp_t	3.5324	[0.0090] **
u_t	0.90149	[0.4651]
Heteroskedasticity	***F(50, 90)***	***p-value***
$\Delta(w_t\text{-}p_t)$	1.2594	[0.1700]
Δy_t	0.85121	[0.7305]
Δp_t	0.90963	[0.6379]
u_t	1.0990	[0.3436]
Vector	*AR 1-5:* 1.34	[0.0344] *
	Normality: 20.9	[0.0073] **
	Heterosk: 0.79	[0.9975]

Notes: (*) indicates statistical significance at the 5% level, (**) at the 1% level.

[19] *The quarter on quarter rate of growth of output in 1967Q1 was 3.5%, the third largest figure in the sample. Since output decreased in the previos period, the acceleration exceeded 4 percentage points. As no other variable changed at a similar pace, the model does not succeed in tracking the historical pattern.*

[20] *The 1969Q4 dummy captures the fall in real wages caused by the strikes which accompanied the deterioration in industrial relations during the "autunno caldo"; the 1970Q1 one accounts for the subsequent rise in compensations which followed the renewal of contracts and may also be justified by the overlapping of two different sources of data. To a large extent, the two dummies offset each other and are likely to play no role in the estimation.*

[21] *The inclusion of the last dummy is deemed necessary to eliminate the instability in the inflation process provoked by the surge in oil prices of the mid-seventies and is a viable alternative to double differentiate the price level, which we dislike as a modelling option.*

Table 3

Summary tests for the "difference" specification

AR 1-5	*F(5,136)*	*p-value*	
Δu_t	1.6160	[0.1599]	
$\Delta(w_t\text{-}p_t)$	1.6091	[0.1617]	
Δy_t	0.8392	[0.5241]	
Δp_t	1.9420	[0.0913]	
Normality	$\chi^2(2)$	***p-value***	
Δu_t	4.9399	[0.0846]	
$\Delta(w_t\text{-}p_t)$	1.8067	[0.4052]	
Δy_t	2.4586	[0.2925]	
Δp_t	10.727	[0.0047]	**
ARCH 4	***F(4,133)***	***p-value***	
Δu_t	0.6819	[0.6057]	
$\Delta(w_t\text{-}p_t)$	4.6427	[0.0015]	**
Δy_t	0.6905	[0.5998]	
Δp_t	2.9909	[0.0211]	*
Heteroskedasticity	***F(50, 90)***	***p-value***	
Δu_t	0.6717	[0.9372]	
$\Delta(w_t\text{-}p_t)$	1.1428	[0.2877]	
Δy_t	0.6304	[0.9619]	
Δp_t	0.9098	[0.6376]	
Vector	*AR 1-5:* 1.185	[0.1465]	
	Normality: 20.3	[0.0092]	**
	Heterosk: 0.707	[1.0000]	

Notes: (*) indicates statistical significance at the 5% level, (**) at the 1% level.

Plots of the squares of the residuals show that the high-volatility observations are concentrated in the aftermath of the first oil shock and suggest that, unless the information set of the model is enlarged, it is difficult to solve this problem. Some autocorrelation appears in the equation for the unemployment rate and, as a consequence, in the whole system.

We then estimate the "difference" model. As Table 3 indicates, this specification, as expected, improves in many respects the statistical properties of the system: residual autocorrelation disappears; the goodness of fit of all the equations increases; the value of the likelihood function rises; heteroskedasticity in the inflation equation decreases.

4.4 The impulse response functions

The economic meaningfulness of our estimates depends very much on the identifying assumptions adopted. While no formal testing is possible, a look at the shape of the response of the different variables to the structural shocks is a useful guide. Figure 2 presents the impulse response functions (IRFs) obtained adopting the set of identifying assumptions discussed above for our baseline "difference" model.[22] Both the average response function and the 80% confidence bands (obtained through bootstrapping techniques) are reported.[23] Each shock is normalised by its standard error.

Technology shocks quite immediately increase wages, while output reacts much more sluggishly. Even after about 60 quarters the positive wage effect is much larger than that on output. Poorly identified are the effects on unemployment: the immediate impact is positive, a result consistent with the slow positive output response and with the idea that initially labour saving effects prevail.

[22] *For the unemployment rate, real wages and output, the response functions are expressed in levels, while for prices they are in terms of inflation.*

[23] *We plot the IRF's obtained by averaging the estimates of 1000 replications since they track very closely the historical ones.*

The response is subsequently reduced and becomes negative after 5 quarters, with further small reductions in the following 10 quarters, after which it very slowly goes back to zero. Inflation is reduced on impact and then goes back to zero, but again the effects are statistically not significant.

The effects on impact of labour supply shocks are negative for real wages and positive for output. Those for output continue to build up and are rather precisely estimated.[24] Those on wages gradually shrink in absolute size (as implied by the identifying restrictions) and are never statistically different from zero. The average response function shows a negative impact on inflation and a positive one on unemployment, both effects being consistent with the nature of the shock under scrutiny.

Nominal shocks, which do not have real effects in the long run, affect all variables on impact. The effect is much larger and more precisely estimated for output than for the other variables. The response of inflation is positive on impact and hump-shaped; unemployment is negatively affected already in the short run but the effect becomes statistically significant only after some periods (remaining so over the 5 to 15 quarters horizon), after which it gradually goes to zero.

Shocks to wage bargaining have a sizeable effect on both inflation and unemployment. While the latter rises over time, with a statistically significant IRF, the effect for the former is positive on impact and then dies out very quickly. The output response mirrors that of unemployment but is much less precisely estimated. On average its size is approximately twice as large, possibly because of the presence of discouraged worker effects which reduce labour supply. Quite puzzling is the response of real wages, which is never positive and remains always statistically insignificant.

All in all, the response functions for each shock are broadly consistent with economic priors. Technology has beneficial effects on all variables (apart from an initial rise in unemployment which is itself rather plausible); a wage bargaining shock appears as a negative supply-side shock; labour supply shocks improve output and inflation outcomes (increasing the latter and reducing the former) while deteriorating workers' conditions; nominal shocks push up both inflation and output while improving workers' conditions.[25]

However, the obtained IRFs present some shortcomings. First, the results are in some cases statistically unreliable, as the confidence bands include the zero. A second caveat concerns the meaning and plausibility of the two non demographic supply-side shocks: the relative size of the long-run effect of the productivity shock on real wages and output (the former being on average twice the latter) and the absence of any significant real wage response to wage bargaining shocks are both quite puzzling. This latter result is not totally implausible, as in a Layard-Nickell framework the long-run real wage effect of a wage-push shock depends upon the slope of the price fixing equation (there would be no impact with a flat price schedule). Even in the short run the real wage response depends on the velocity of response of nominal wages and prices, but the absence of an initial rise in real wages may put some doubts on the precise labelling of this shock as reflecting wage-push phenomena.

In order to shed further light on these issues we therefore consider the results deriving from the "level" specification, under the assumption that unemployment is a stationary variable and that the shocks impinging on it have only temporary effects. Figure 3 shows the IRFs for this experiment. Leaving aside for the moment the wage bargaining shock, the responses to the other three shocks resemble very closely what already shown for the baseline model, apart from some interesting

[24] *The size and the shape of the response of output to the various shocks does not contrast with the empirical evidence provided by previous studies applied to the Italian economy (see Gavosto and Pellegrini, 1999).*

[25] *The improvement in unemployment is somehow implicit in the output increase. The rise in real wages is less straightforward as it depends on the relative responsiveness of nominal wages and prices and on the strength of the unemployment/real wage relationship.*

differences in the pattern of the unemployment response. As for the technology shock, the reversal towards zero is now less marked (having not been imposed as one of the identifying restrictions) and the response on impact appears to be negative (i.e. a technology advance immediately decreases unemployment), a result not very congruent with the folk view that technological advances initially are predominantly labour saving. However, this divergence is not too significant, as in both models the confidence bands include zero. As for the labour supply shock, the temporary rise in unemployment caused by the enlarged pool of people looking for a job is less clearly established than it was in the baseline specification. Not remarkably different, but more precisely estimated, is the unemployment response to nominal shocks. Obviously different is the response to the wage bargaining shocks, which have now a sizeable positive impact effect on real wages. The effect gradually shrinks and after 20 quarters it is still statistically significant. The rather puzzling result is that also output is positively affected by a similar amount, even if the decline towards zero is faster. Possibly due to the offsetting output response, unemployment is not very much affected even if its rise appears long lasting. As for inflation, after a gradual rise in the first 6 quarters, the effect goes back to zero.

Overall, the "difference" and the "level" specifications differ mostly on the features of the wage bargaining shock. In the latter such a shock increases real wages and output (possibly through a Kaldorian aggregate demand channel), so that unemployment is increased only to a limited extent. In the former, the bargaining push has no remarkable effect on real wages and output declines mirroring the rise in unemployment.

In both cases the reaction of unemployment is very sluggish, a result which corresponds to the well-known features of the Italian labour market. However, there are differences in the degree of persistence of the shocks. In the "difference" specification, this feature reflects the identifying assumptions adopted (as there is only one shock with permanent effects while all the others vanish in the long run), but also in the "level" specification some discrepancies emerge as the wage bargaining and the productivity shocks have more persistent effects than the other shocks.[26]

All in all, while both specifications show some internal inconsistencies, the "difference" specification appears preferable at least in two aspects. First, it explicitly allows for a distinction between shocks with fully permanent effects and ones with long-lived but temporary effects on unemployment. Second, it shows nicer properties for technology shocks, which in the very long run affect real wages and not unemployment.

5 Reconstructing unemployment

Before focusing on the historical reconstruction of the main components of unemployment, we perform a forecast error variance (FEV) decomposition exercise to further assess the ability of the two VAR specifications to correctly identify the shocks driving the dynamics of the system. Table 4 reports the decomposition, at some selected points in time, for the "difference" and the "level" model.

[26] *We also considered some further exercises, either allowing for exogenous factors as driving forces or considering different lag structures. First, we considered two exogenous variables, the change in the growth rate of world demand and the change in the world inflation rate, both attempting to capture those temporary shocks impinging from abroad. The aim was that of purging the primitive shocks from cyclical movements in the world economy. The specification of the model was consistent with the idea that Italy, as a small open economy, is likely to be affected by external factors but, in the long run, does not need to follow any precise path imposed by them. In the second exercise the exogenous driving force considered was the international relative price of oil. While the results in terms of the reconstructed values of the several components of unemployment presented some differences with respect to the baseline, the response functions did not differ much. Therefore we avoided reporting them. Similarly, we did not report the results obtained for the estimates obtained using a different lag length for the VAR estimates (we experimented with 4 and 8 lags, the baseline being only marginally to be preferred).*

In the "difference" model, aggregate demand disturbances account for a quite relevant share (around 20%) of unemployment fluctuations. A strong persistence effect seems to be at work, for such a share is very stable as the forecast horizon lengthens. Also relevant is the contribution of labour supply shocks to unemployment (in turn not very relevant in explaining real wage variability). As for the role played by wage bargaining and productivity shocks, the latter explain, at any time horizon, most of the FEV of real wages and only a small fraction of that of unemployment. Conversely, wage bargaining shocks explain unemployment but account very little for the real wage FEV.

Table 4

Forecast error variance decomposition

"Difference" specification *Periods ahead*	*Shock* **Bargaining**	**Productivity**	**Labour supply**	**Demand**
Unemployment change				
1	45.0	3.8	30.9	20.2
8	44.6	5.4	29.4	20.5
16	44.6	5.5	29.3	20.6
∞	44.4	5.5	29.1	20.9
Real wage growth				
1	2.4	95.8	1.6	0.1
8	6.2	86.1	3.5	4.1
16	7.1	85.2	3.5	4.1
∞	7.3	84.7	3.6	4.4
Output growth				
1	0.2	17.4	16.2	66.2
8	1.8	17.7	18.8	61.8
16	2.1	17.5	18.9	61.4
∞	2.7	17.4	18.7	61.3
Inflation				
1	51.7	12.5	21.3	14.4
8	40.1	9.9	14.6	35.4
16	37.3	9.3	13.4	40.0
∞	33.1	9.9	11.6	45.3

"Level" specification *Periods ahead*	*Shock* **Bargaining**	**Productivity**	**Labour supply**	**Demand**
Unemployment level				
1	11.1	35.4	13.6	39.9
8	2.7	36.7	12.6	47.9
16	1.7	45.5	8.9	44.0
∞	0.5	74.6	2.9	21.9
Real wage growth				
1	49.6	14.3	33.8	2.2
8	46.6	17.1	33.8	2.4
16	45.4	19.5	32.5	2.6
∞	40.9	27.1	29.3	2.6
Output growth				
1	48.3	1.2	3.4	47.1
8	45.4	3.2	6.9	44.4
16	44.3	5.7	6.8	43.2
∞	41.3	11.8	6.5	40.3
Inflation				
1	5.5	66.4	9.7	18.4
8	8.5	45.0	12.7	33.8
16	7.3	42.0	13.8	36.9
∞	5.8	32.9	15.1	46.2

Concerning wage bargaining and productivity shocks an interesting contrast emerges with the "level" specification. In this case the latter account for a large share of unemployment variability, particularly in the long run, but hardly contribute to real wage movements. Conversely, wage bargaining shocks explain a large fraction of the real wage FEV and account very little for that of unemployment. As for the contribution to inflation and output variability, in the "difference" specification the weight of wage bargaining shocks in the inflation FEV is large in the short run and slowly declines over time, while it is almost negligible for the output FEV at any time horizon. The opposite happens in the "level" specification where, in turn, productivity shocks account for a very large share of inflation variability.

As already noticed while discussing the impulse response functions, both specifications are not fully satisfactory. However, even if the "difference" model has an important shortcoming in its inability to pin down the influence of wage bargaining shocks on real wages, it appears preferable when focusing on the unemployment FEV decomposition. Actually, there does not seem to be a dominant driving force: all shocks play a role in explaining unemployment movements. In the "level" model unemployment fluctuations seem to be excessively dominated by productivity shocks, which in the long run are by far the most important factor, and by demand disturbances.

As a final step of the empirical analysis we carry out an exercise aimed at tracing back the influence of the primitive shocks identified by the VAR model on the historical evolution of the unemployment rate and hence at identifying the Italian NAIRU/structural unemployment. This is implemented by computing the unemployment pattern generated by the model when the innovations attributed to specific sources are set to zero. In this light, as already mentioned in the introduction, the series omitting the effects of demand disturbances represents a measure of the "structural component" of unemployment and, symmetrically, the one obtained setting to zero the non-demand and non-stochastic elements represents a measure of its demand-induced (i.e. cyclical) component.

The cyclical component for both the "difference" and the "level" specification is shown in Figure 4, which also compares them with the estimates obtained utilising the bivariate filtering techniques presented in section 3.[27] In both sVAR models the portion of the unemployment evolution due to demand disturbances matches, by and large, the timing of the Italian business cycle, but is also characterised by an underlying upward drift in the last fifteen years. In particular, the long expansion that extended up to 1963, the 1972-74 upswing and the one that took place at the end of the 1970s correspond to well defined falls in the unemployment rate; the size of those declines ranges from more than 3 percentage points in the first episode to less than one point in the last one. As for the subsequent decade, the model attributes to demand shocks a sustained rise in unemployment that extends well beyond the end of the recessionary phase (dated by standard chronologies in 1983). This rise may be related to a change in the stance of macroeconomic policy on foot of the new exchange rate regime and to the first attempts to reduce public deficits. Only in the final part of the cyclical upswing the contribution of demand disturbances shows a mild decline (by half a percentage point between 1988 and 1991). A similar pattern is apparent in the 1990s, with two marked unemployment upswings interrupted by a brief decline reflecting the 1994-95 economic expansion. Overall, the size of the component due to aggregate demand shocks rises from zero in the mid-1980s to less than 1 percentage point at the beginning of the 1990s, to 2 points in 1998.[28]

[27] *We consider the Kalman filter specification based on the wage-price Phillips curve on the ground that it provides, for the last decade, a more plausible outcome. The cyclical component (computed as the difference between observed unemployment and the NAIRU) obtained from the two alternative specifications of the Phillips curve included in the Kalman filter is very similar for a good deal of the sample period but differs significantly since the beginning of the '90s. In particular, the one derived from the "price-price" specification declines steeply since 1995, missing the mild recession that took place in 1996 and not reflecting the sluggishness of the following upturn. In this respect the estimates from the "wage-price" specification seem much more reliable.*

[28] *The estimates derived from the "difference" and the "level" specification of the sVAR model are very close to each other at cyclical frequencies but less at medium-long term frequencies, the one produced by the first model being characterised by larger fluctuations.*

Under many respects the cyclical component of unemployment emerging from the sVAR approach resembles the one estimated by Kalman filter. However, the latter has on average less pronounced swings. The ones generated by sVAR show much more persistent deviations from zero. The persistence feature seems to better correspond to the stylised facts of Italy's labour market, hinting at the possibility that the sVAR specification is more powerful in its ability to capture the effects of demand disturbances on unemployment. In particular, substantial differences emerge over the last decade, as the sVAR estimates are always positive and almost progressively increasing until the end of the sample period, a result consistent with the view that adverse demand shocks, coupled with persistence, have played a central role in the evolution of the Italian economy over the last decade.

Nonetheless, even if the cyclical component generated by the sVAR model has a range of 4 percentage points over the whole sample period, the results seem to confirm that the rise in the Italian unemployment rate is to a large extent a "structural" phenomenon (Figure 5).

In order to further distinguish among the different non-demand components, we focus here on the "difference" specification, which appears to be preferable, particularly as regards unemployment patterns. The historical reconstruction confirms that all three sources of non-demand shocks have mattered. As concerns the component related to productivity shocks, the negative contribution (i.e. a reduction of unemployment) in the sixties contrasts with the positive one in the 1980s and 1990s. This result seems consistent with the evidence recalled in the discussion on the stylised facts of the Italian labour market: a significant contribution to the rise of unemployment can be traced back to the adverse effect on economic growth of the productivity slowdown that has taken place over the last two decades. Indeed, the productivity shocks identified by the model can capture the impact of different factors influencing the supply side, which our approach does not allow to disentangle. Labour supply shocks also play a role, even if to a lesser extent, in pushing up unemployment between the 1970s and the 1980s. Again, this result appears to confirm our priors about the determinants of the evolution of unemployment and, in particular, it seems consistent with the evidence presented at the onset of this paper about the particularly large share of female and youth (namely first job seekers) unemployment in the second half of the 1970s and the first half of the following decade.

The most important component is the one related to wage bargaining shocks (Figure 6). Its evolution shows, after an initial decline, a clear upturn at the end of the 1960s, which steepens in the early 1970s and then continues, amid mild fluctuations, up to the beginning of the next decade accounting, overall, for almost 2.5 percentage points of the unemployment rate. This pattern is consistent with our assessment of the evolution of labour market institutions and, in particular, it squares with the sequence of changes that took place in that period: the rise of trade unions' strength, the increase in the stringency of EPL, the strengthening of the indexation clause that augmented substantially the nominal rigidity of wages. The contribution of wage bargaining shocks to the evolution of unemployment over the last two decades is instead very limited, with a temporary drop at the very beginning of the 1990s that reverts rapidly before the middle of the decade. In fact, the timing of these last swings is quite puzzling, as the final rise is at odds with the episode of wage moderation that took place between 1992 and 1995. It is possible that the favourable impact on the labour market of that episode has been offset by the adverse effects due to the worsening of the territorial composition of labour mismatch, which is an issue we are not explicitly addressing here.

6 Concluding remarks

In this paper we have aimed at disentangling the main driving forces behind the rise in the Italian unemployment rate. We have tried to distinguish between fully permanent and sustained, but temporary, shocks to unemployment, the latter potentially being both demand and supply-side disturbances. We have developed a small Layard-Nickell type model, estimated and identified utilising a sVAR approach. The historical account we obtained is in many respects plausible, hence confirming the advantages of this approach with regard to other standard techniques adopted for measuring structural and cyclical unemployment.

The component of unemployment relating to current and lagged demand shocks deriving from the sVAR estimation shows higher variability and persistence over time than the one estimated by bivariate filters, hence better reflecting, in our view, the characteristics of the Italian labour market. Over the sample period as a whole, this component explains approximately a 4 percentage point rise in the unemployment rate (from a minimum reached in the mid-1960s to a maximum at the end of the sample period). In particular, this component, after having pushed unemployment down, on average, over the 1970s, has been almost continuously increasing since the beginning of the 1980s.

Nonetheless, our results confirm that the bulk of the rise in Italian unemployment is to be attributed to non-demand factors. The effects of both productivity and labour supply shocks have been significant in certain particular periods, while those which we labelled as wage bargaining shocks emerge as one of the main sources of unemployment fluctuations in our benchmark model. Such shocks explain a gradual rise of about 2.5 percentage points between the end of the 1960s and the beginning of the 1980s; over the last 15-20 years, however, they do not seem to have further contributed to the worsening of the unemployment situation.

As regards the features of the model itself, the results also seem to be plausible in general terms. The responses to each shock are broadly consistent with economic theory: technology shocks have favourable effects on all variables (apart from an initial rise in unemployment, which is itself rather plausible); wage bargaining shocks appear as negative supply-side shocks; labour supply shocks improve output and inflation outcomes (increasing the latter and reducing the former), while lowering wages and raising unemployment; and nominal shocks push up inflation, output and wages while reducing unemployment. In terms of the FEV decomposition, productivity shocks dominate the evolution of real wages, while all shocks play a relevant role in explaining unemployment movements.

However, our preferred specification may yet fail to pin down the influence of wage bargaining shocks on real wage movements: while the absence of any long-run impact is not implausible, their irrelevance in the short run too casts some doubt on the precise labelling of these shocks as reflecting wage-push phenomena. Also possibly related to these difficulties are some puzzling results concerning the historical account of some unemployment components, as shown, in particular, by the evolution of that resulting from wage bargaining shocks over the current decade.

In the light of these problems, we believe that our results are still preliminary and that a more thorough investigation of a richer model aimed at better disentangling shocks to wage bargaining from other sources of innovations would be worthwhile.

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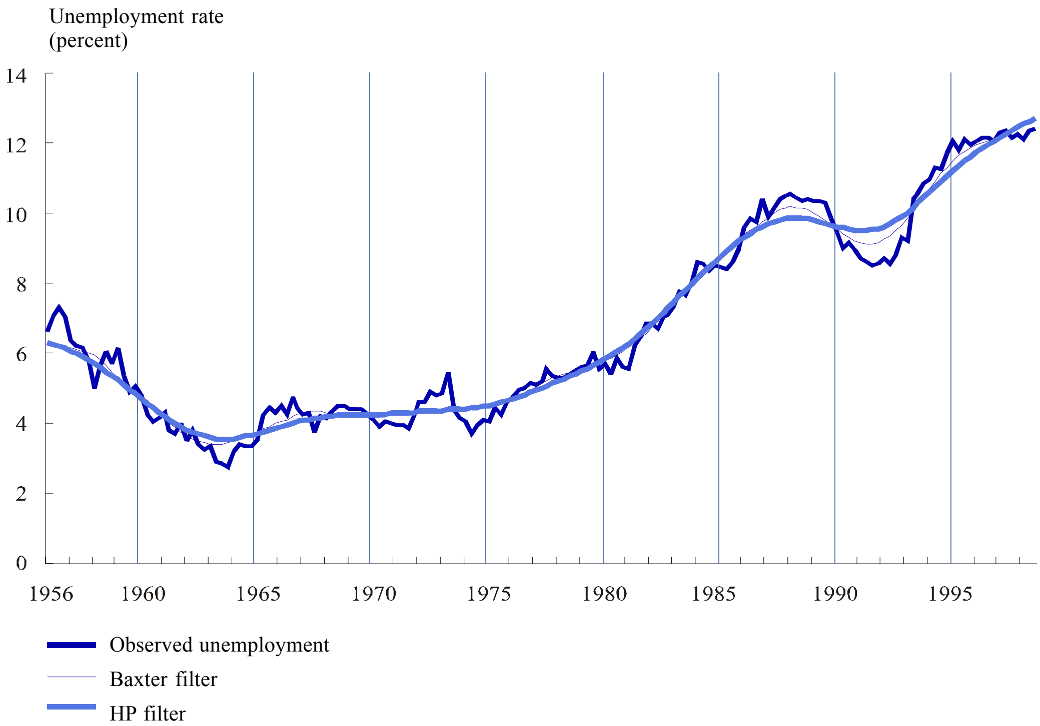
Figure 1

NAIRU estimates based on filtering techniques

Univariate filters



Multivariate filters

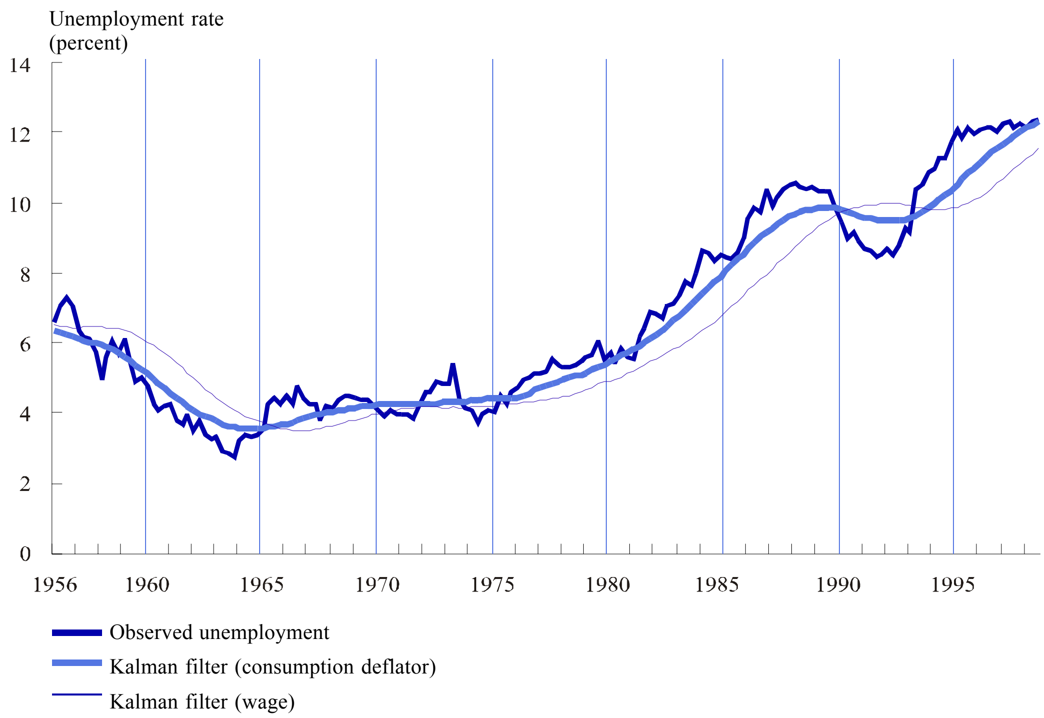
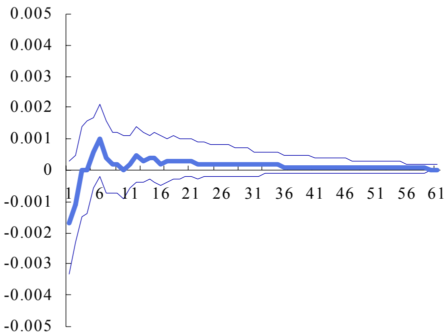


Figure 2

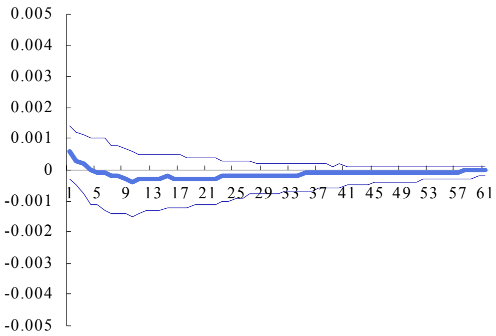
Impulse response functions for the "difference" specification

Productivity shocks

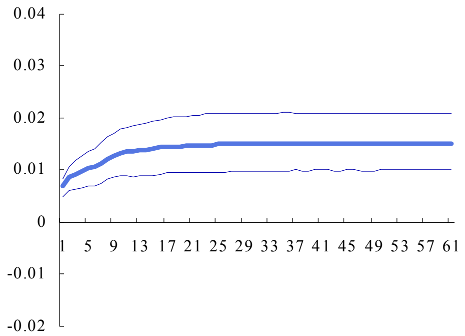
Inflation



Unemployment



Real wage



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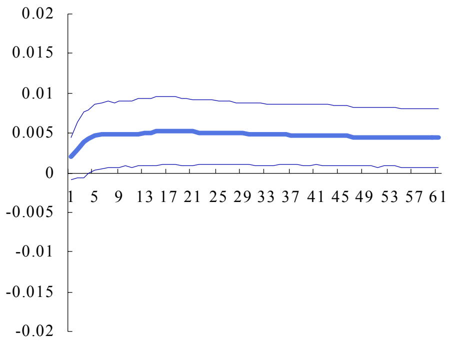
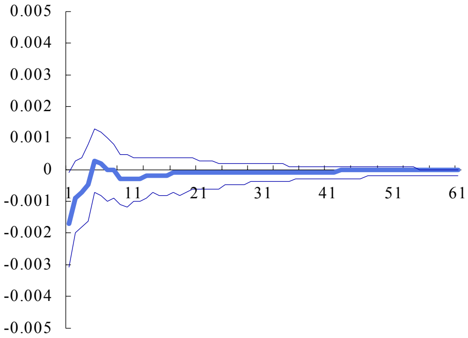
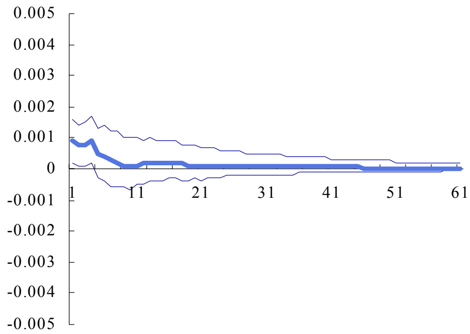


Labour supply shocks

Inflation



Unemployment



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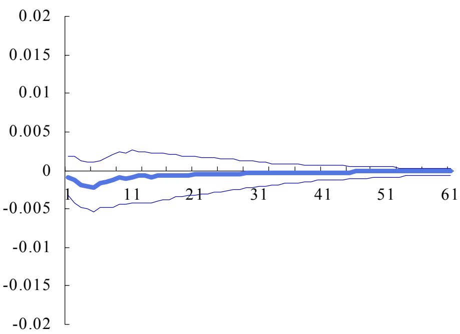

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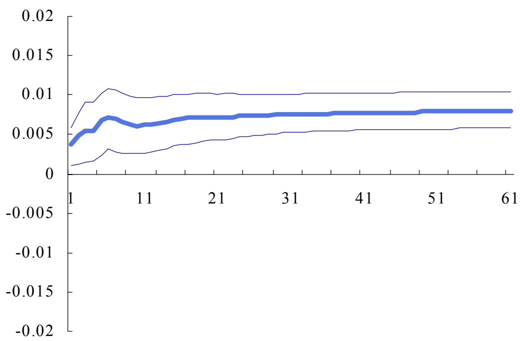
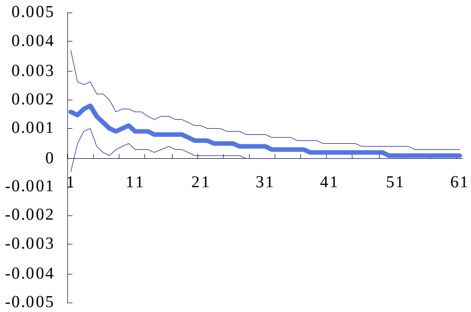


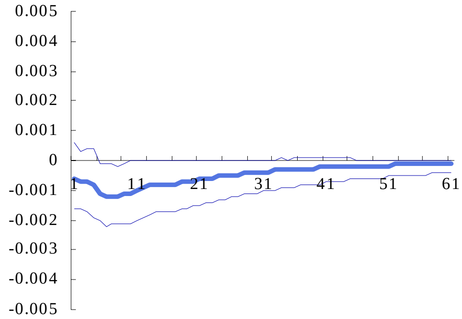
Figure 2 (continued)

Demand shocks

Inflation



Unemployment



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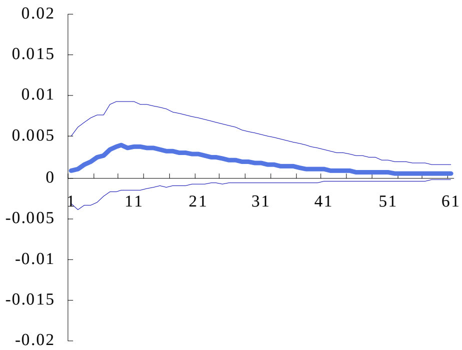

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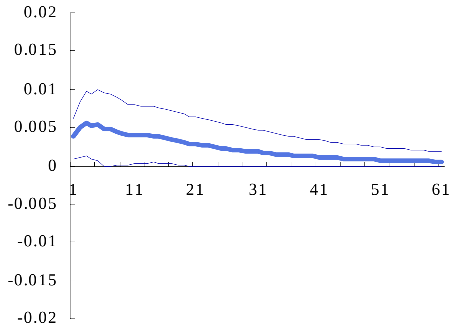
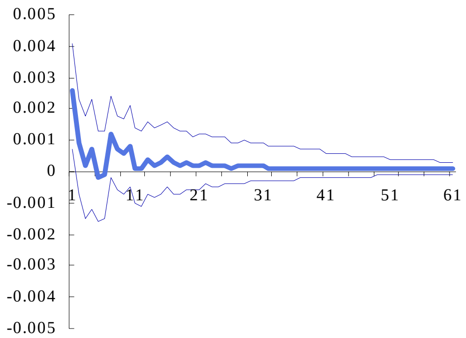
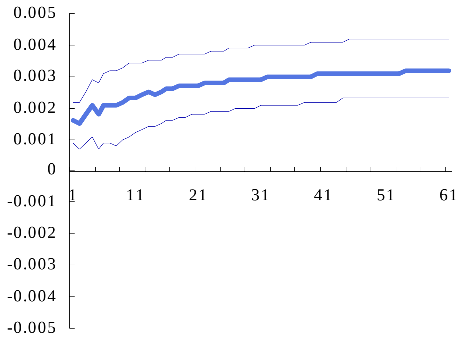


Wage bargaining shocks

Inflation



Unemployment



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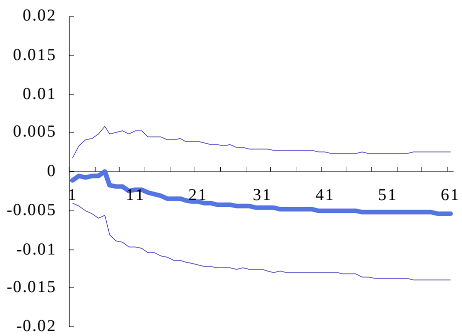

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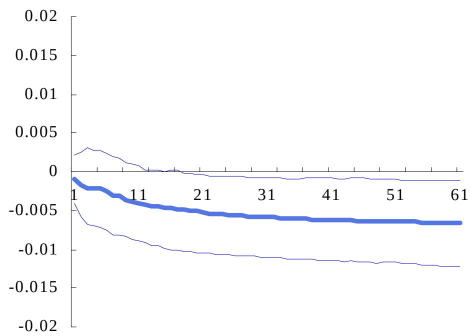
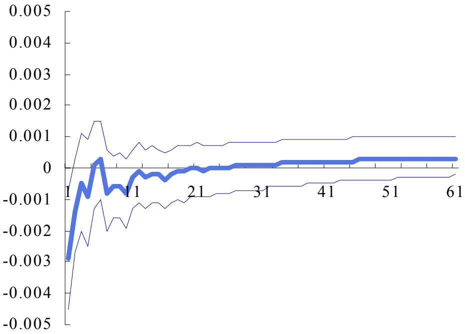


Figure 3

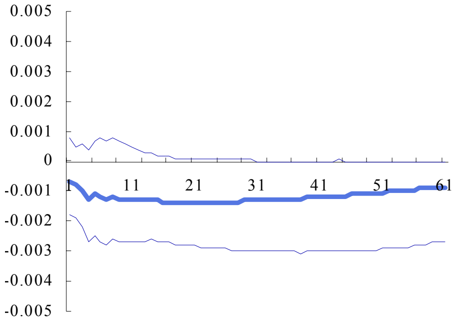
Impulse response functions for the “level” specification

Productivity shocks

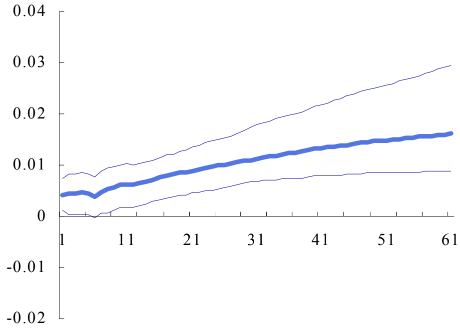
Inflation



Unemployment



Real wage



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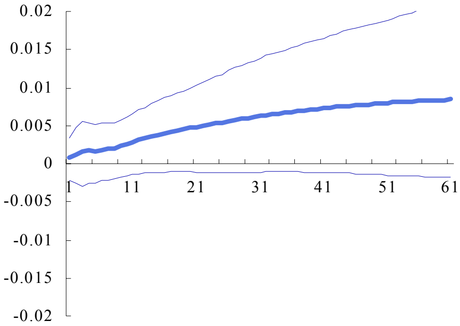
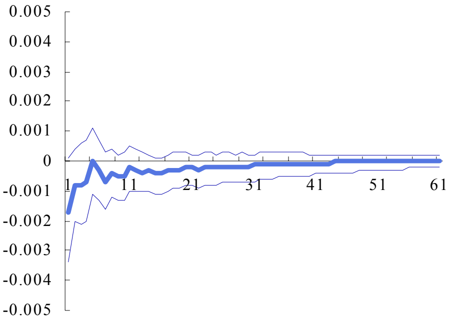
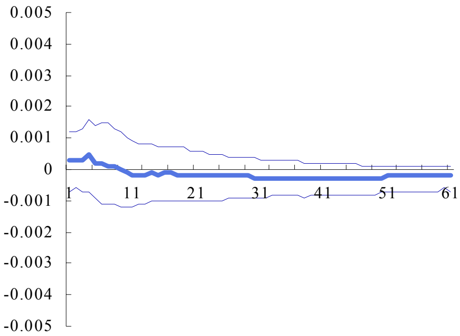


Labour supply shocks

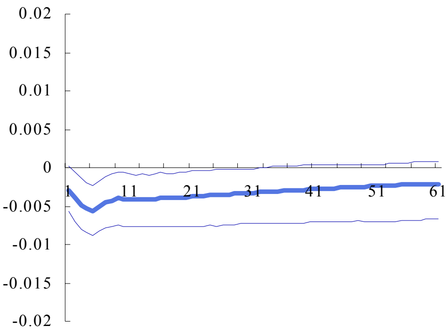
Inflation



Unemployment



Real wage



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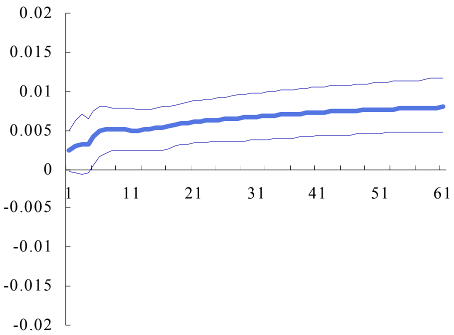
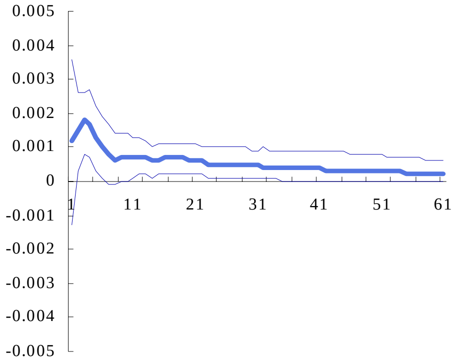


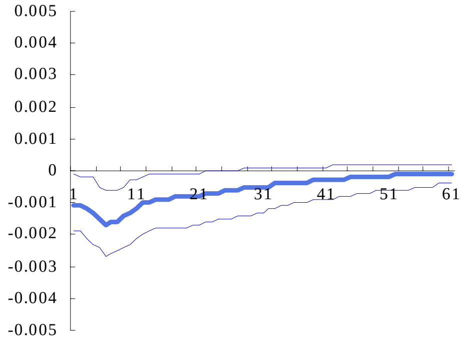
Figure 3 (continued)

Demand shocks

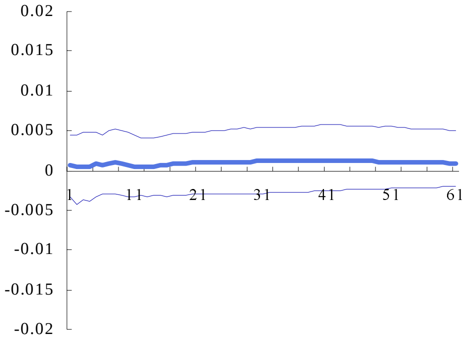
Inflation



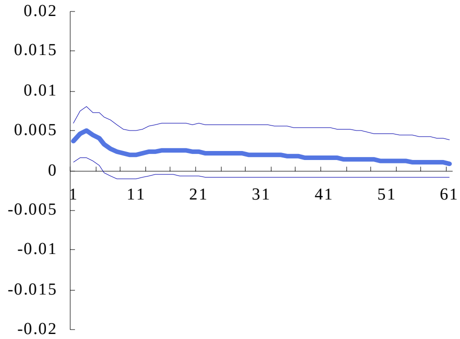
Unemployment



Real wage

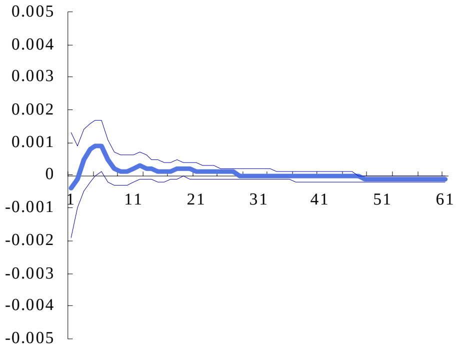


Output

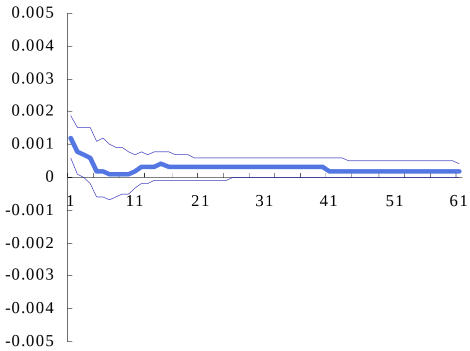


Wage bargaining shocks

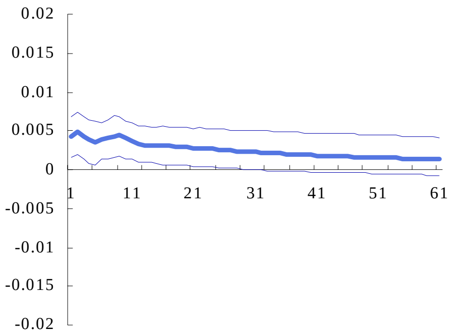
Inflation



Unemployment



Real wage



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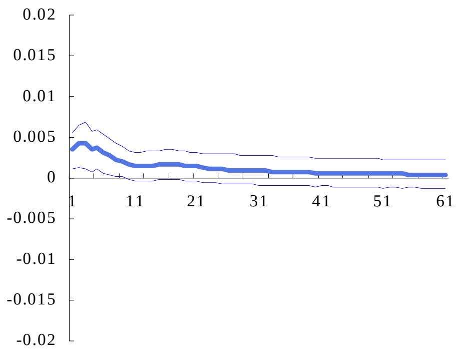


Figure 4

Cyclical component of the unemployment rate

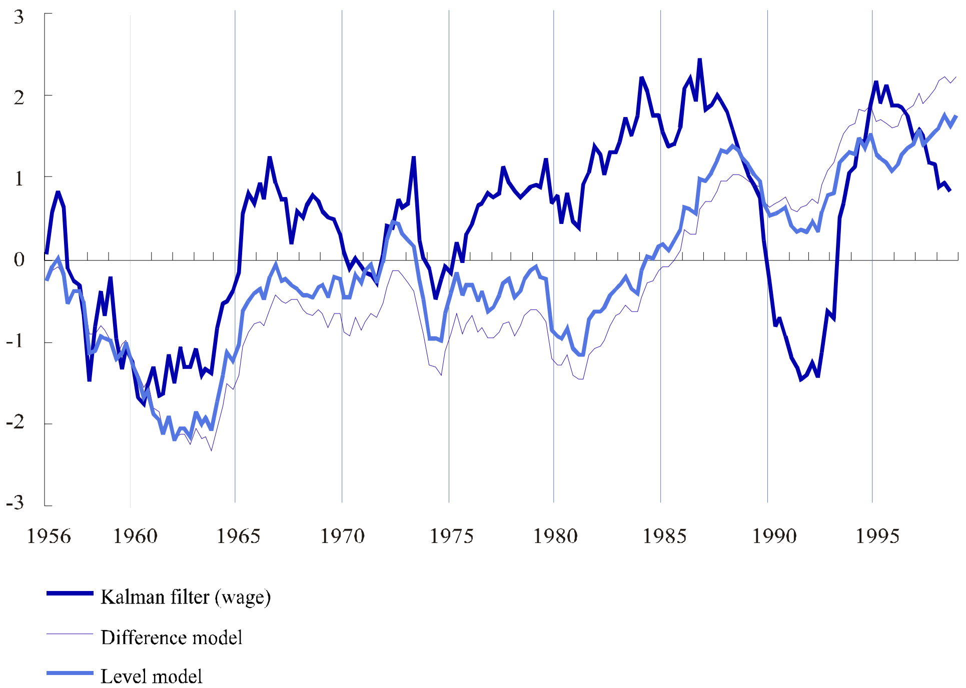


Figure 5

Observed and structural unemployment

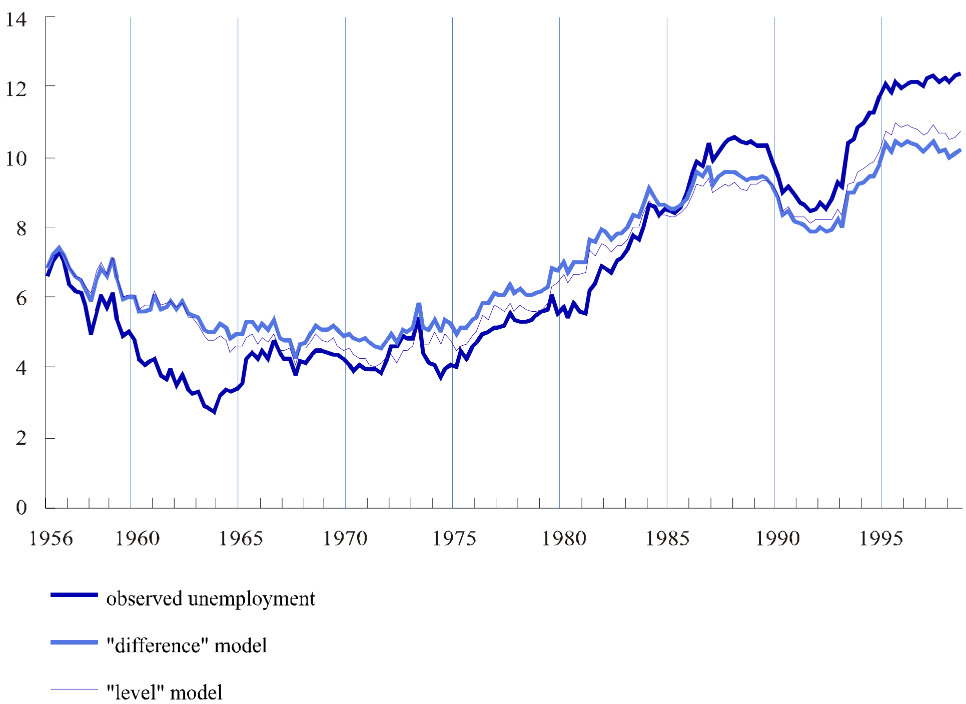
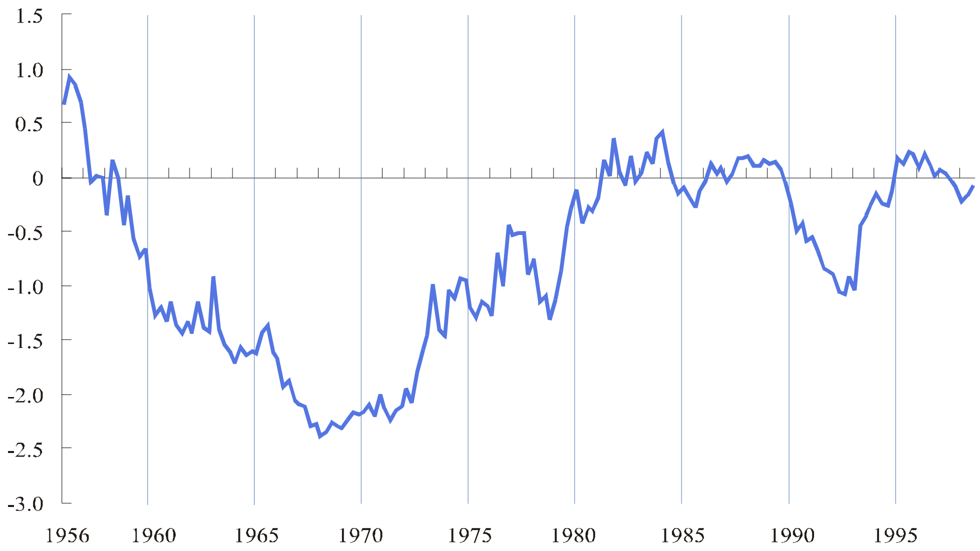


Figure 6

Bargaining shocks component (“difference” model)



Appendix 1 – The solution of the model

The reference model is an extension of the framework set out in Blanchard and Quah (1989), augmented to allow for a richer variety of shocks, and in particular with a wage-price block building upon the Layard-Nickell framework. The model, disregarding constant terms, is described by the following set of equations, where all variables, but the unemployment rate, are in logs and have, unless otherwise specified, standard economic meaning:

$$
\begin{aligned}
&(1) \quad y_t = \phi(d_t - p_t) + a\vartheta_t \\
&(2) \quad y_t = n_t + \vartheta_t \\
&(3) \quad p_t = w_t - \vartheta_t + \beta u_t \\
&(4) \quad l_t = \alpha E_{t-1}(w_t - p_t - \vartheta_t) + \tau_t \\
&(5) \quad w_t = E_{t-1}(p_t + \vartheta_t) + k_t - \sigma E_{t-1} u_t \\
&(6) \quad u_t \equiv l_t - n_t \\
&(7) \quad \vartheta_t = \vartheta_{t-1} + \varepsilon_t^s \\
&(8) \quad \tau_t = \tau_{t-1} + \varepsilon_t^l \\
&(9) \quad k_t = \rho k_{t-1} + \varepsilon_t^w \\
&(10) \quad d_t = d_{t-1} + \varepsilon_t^d
\end{aligned}
$$

Workers are assumed to set wages at the beginning of the period, before all the shocks but ε_t^w are realised, while firms set prices when all the information is revealed. Using equation (3) and (5) it is possible to obtain an expression for $E_{t-1}u_t$:

$$E_{t-1}u_t = \frac{1}{\sigma - \beta} k_t \tag{A1}$$

which, once substituted into (4) provides:

$$l_t = \tau_t - \frac{\alpha\beta}{\sigma - \beta} k_t \tag{A2}$$

In order to solve for the unemployment rate as a function of the exogenous variables only, the following steps are followed. First, the production function (2) is inverted in order to express employment as a function of aggregate demand and productivity. Then equations (1) and (3) are used to substitute out y_t and p_t; this allows to obtain n_t as a function of the exogenous variables and the nominal wage rate. Finally, the expression for n_t, along with the equation for the labour supply, are substituted in equation (6), yielding:

$$u_t = \frac{1}{1 - \phi\beta}\left[\tau_t - \frac{\alpha\beta}{\sigma - \beta} k_t - \phi d_t + \phi w_t - (a + \phi - 1)\vartheta_t\right] \tag{A3}$$

Taking expectations and equating to the RHS of (A1), one can then solve for the wage rate, obtaining:

$$w_t = \frac{1}{\phi}\left[\frac{1 - \phi\beta}{\sigma - \beta} k_t - \tau_{t-1} + \frac{\alpha\beta}{\sigma - \beta} k_t + \phi d_{t-1} + (a + \phi - 1)\vartheta_{t-1}\right] \tag{A4}$$

If one assumes that $|\rho| < 1$, (A4) shows that in the long run the nominal wage is driven by demand, productivity and demographic trends. Note that (A4) obtains because the wage rate is predetermined and is therefore not affected by the expectation operator. Substituting the solution for w_t in (A3), one gets:

$$u_t = \frac{1}{\sigma - \beta} k_t + \frac{1}{1 - \phi\beta}\left[\varepsilon^l{}_t - \phi\varepsilon_t{}^d - (a + \phi - 1)\varepsilon_t{}^s\right] \tag{A5}$$

It follows that the unemployment rate is a stationary process and there are therefore no restrictions on the sum of the moving average parameters for any of the fundamental shocks. Consider now the price index: since u_t is stationary, it follows that in the long run it is driven by ϑ_t and the same stochastic trends affecting w_t. Hence, in the equation for Δp_t, the matrix of the long-run multipliers of the moving average representation will have just one zero, corresponding to the wage-push shock. Since we can also write equation (2) as:

$$y_t = l_t - (l_t - n_t) + \vartheta_t = l_t - u_t + \vartheta_t \tag{A6}$$

it follows that in the long run neither $\varepsilon_t{}^w$ nor $\varepsilon_t{}^d$ affect output. Finally, (3) and (A5) state that the trend real wage responds only to productivity shocks.
For the case $|\rho| < 1$, the identification scheme is hence the following:

$$\begin{bmatrix} \Delta(w_t - p_t) \\ \Delta y_t \\ \Delta p_t \\ u_t \end{bmatrix} = \begin{bmatrix} c_{11}(1) & 0 & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) & 0 \\ c_{41}(1) & c_{42}(1) & c_{43}(1) & c_{44}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_t^s \\ \varepsilon_t^l \\ \varepsilon_t^d \\ \varepsilon_t^w \end{bmatrix} + C^*(L) \begin{bmatrix} \Delta\varepsilon_t^s \\ \Delta\varepsilon_t^l \\ \Delta\varepsilon_t^d \\ \Delta\varepsilon_t^w \end{bmatrix}$$

If one assumes instead that $\rho = 1$, (A5) states that the long-run behaviour of the unemployment rate is entirely determined by wage-push shocks. Rearranging (3), one can see that real wages are driven only by ϑ_t and k_t.

Applying the same procedure as above, one can finally see that trend output does not depend on nominal demand shocks, while prices respond to the whole set of impulses. Identification can therefore be achieved by imposing on the matrix of long-run multipliers the following recursive structure:

$$\begin{bmatrix} \Delta u_t \\ \Delta(w_t - p_t) \\ \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} c_{11}(1) & 0 & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) & 0 \\ c_{41}(1) & c_{42}(1) & c_{43}(1) & c_{44}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_t^w \\ \varepsilon_t^s \\ \varepsilon_t^l \\ \varepsilon_t^d \end{bmatrix} + C^*(L) \begin{bmatrix} \Delta\varepsilon_t^w \\ \Delta\varepsilon_t^s \\ \Delta\varepsilon_t^l \\ \Delta\varepsilon_t^d \end{bmatrix}$$

Appendix 2 – Data sources

The definition of the time series utilised in the paper is as follows:

Unemployment rate: from 1954 to 1959 - authors calculation of annual data based on non periodical labour force surveys carried out by ISTAT (ISTAT, *Rassegna di statistiche del lavoro*, various issues), interpolated at quarterly frequency on the basis of Chow-Lin methodology; from 1959 to 1980 - quarterly labour force survey (QLFS) adjusted to take into account subsequent changes in definition (a break is present at the end of 1969); from 1980 to 1992 - QLFS data corrected as in Casavola (1994); from 1993 - official unemployment rate series. Seasonally adjusted by the authors using the X11 method.

Wages: national account data on gross wages per unit of dependent labour. From 1954 to 1969 - annual series from Golinelli and Monterastelli (1990) "Un metodo per la ricostruzione di serie storiche compatibili con la nuova contabilità nazionale", *Nota di lavoro* n. 9001, Prometeia, interpolated on the basis of Chow-Lin methodology (quarterly interpolators: GDP cyclical component extracted by HP filtering, GDP trend, linear time trend); from 1970 - ISTAT quarterly national account data (seasonally adjusted). Real wages are defined as the ratio of wages to consumer prices (see below).

GDP at constant prices (seasonally adjusted): from 1954 to 1969 - quarterly data published in Golinelli and Monterastelli (1990); from 1970 - ISTAT quarterly national account data (1970q1-1998q3).

Prices: consumer price index for worker and employee households; ISTAT index numbers with different base year linked by Banca d'Italia. Seasonally adjusted by the authors using the X11 method.

Labour share: ratio of the total wage bill (corrected to take into account the share of self-employed) to value added at factors cost. The self-employment correction has been performed separately for agricultural and non-agricultural employment as to avoid the bias due to the steep decline in the number of low-pay agricultural workers experienced in the 1950s and the 1960s. The sources are the same as for wage data. From 1954 to 1969, the yearly series has been interpolated at quarterly frequency on the basis of Chow-Lin methodology.

Appendix 3 – Univariate pre-testing

The specification of the VAR model, its identification and the precision of the estimates rely to a large extent on the maintained assumptions on the statistical properties of the variables of interest: valid estimation requires that the series be differenced the correct number of times to become stationary; the detection of the driving forces of the system of variables under investigation makes necessary to disentangle the number of common trends in the data; the persistence of shocks to the economic environment and the attribution of economic fluctuations to rare large, possibly deterministic, perturbations rather than to the cumulative effect of small and frequent ones requires one to check for the presence of breaks.

Three classes of tests were implemented: (1) unit root tests; (2) cointegration tests; (3) test for the presence of structural breaks. Given that unit root tests generally cannot distinguish between integrated and highly autocorrelated series, the results of such tests are, however, never taken at face value, but interpreted according to our reading of the post war Italian economic history.[29]

Tables A3.1 to A3.3 report the results of the augmented Dickey-Fuller and Phillips-Perron tests for unit roots. They include two variants of both tests, the first based on the distribution of the autoregressive coefficient and the second relying on the most common *t*-test statistic. All series but the unemployment rate and the labour share are in logs. Since the properties of unit root tests are highly dependent on how the autocorrelation structure of the error term is handled[30] and on the deterministic components included in the regression[31], a strategy similar to that suggested by Campbell and Perron (1991) was applied: initially the most general trend specification was considered (namely the one including a constant and a linear trend), then more restricted ones were tested. For choosing the number of autoregressive terms k, an autoregression of order $k=k_{max}$, with k_{max} large and chosen arbitrarily, was estimated. If the last lag was significant, the order $k=k_{max}$ was chosen, while if it was not, a new equation of order k_{max}-1 was estimated and the procedure was iterated. The same value of k was used for the order of the long-run covariance matrix in the Phillips-Perron test.

As Table A3.1 shows, for none of the variables the null of non-stationarity can be rejected. Also the unemployment rate seems to be better approximated by an $I(1)$ process rather than a trend stationary one, although the statistical evidence turns out to be quite sensitive to the sample period.

29 *A vast literature has developed trying to evaluate the contribution to macroeconomics brought about by statistical techniques such as unit root and cointegration theory. The paper by Smith (1999) and the contributions collected in the 1995 (November) and 1997 (January) issues of the Economic Journal are some examples. Smith claims that these techniques have not delivered on the early promises made for economics, not because they proved useless or somehow flawed, but because the promises were unrealistic. Although these techniques were invented to answer statistical questions, they diffused very rapidly through applied economics because they were thought to be able to answer important theoretical questions in macroeconomics. Being aware of the risk of confusing economic importance with statistical significance, the pretesting step is used in this paper only as an additional tool for selecting the most suitable (the least arbitrary) framework among the host of different models and specifications which can be adopted to answer the questions were dealing with.*

30 *Two general results hold. First, if the serial correlation of the error term fails to be accounted properly, the actual and nominal size of unit-root tests largely diverge. Second, the estimation of nuisance parameters describing the short-run dynamics reduces the power of the tests, in some case dramatically. For an exhaustive treatment of the finite-sample properties of unit-root tests, see Stock (1994) and the references therein.*

31 *The issue is to try to nest both the null and the alternative hypothesis within a more general model, which can provide a reasonable account of the data under both assumptions. The general principle is that if the regressions that are used to test the null hypothesis omit a variable appearing in the DGP, the power of the test is reduced and goes to zero as the sample size increases if the omitted variable grows at a rate at least as fast as any of the deterministic component which are included in the estimated model.*

Table A3.1

Unit root tests

		DV={1,T}				DV={1}			
x	*k*	DF(Tρ)	DF(t_ρ)	PP(Tρ)	PP(t_ρ)	DF(Tρ)	DF(t_ρ)	PP(Tρ)	PP(t_ρ)
(1-L)y	8	-0.740	-0.567	-0.877	-0.633	-1.440	-4.019	-1.454	-4.770
(1-L)u	8	-5.537	-1.916	-5.674	-2.129	0.356	0.201	0.524	0.316
(1-L)p	8	-20.00	-2.554	-2.923	-1.579	-2.143	-1.258	0.169	0.421
(1-L)w	6	-5.513	-1.175	-0.718	-0.385	-0.569	-0.935	-0.151	-0.557
(1-L)s	8	-6.963	-1.616	-6.191	-1.624	-7.486	-1.822	-6.571	-1.782
(1-L)y^w	8	-1.754	-0.959	-3.373	-1.530	-1.338	-2.788	-1.572	-2.959
(1-L)p^w	8	-7.232	-1.537	-2.609	-1.523	-0.792	-0.972	0.114	0.378
(1-L)o	6	-3.239	-1.005	-3.239	-1.015	-2.194	-1.256	-2.194	-1.263

Notes:
The model is: $(1-L)x_t = \text{deterministic variables} + \rho x_{t-1} + \sum_{i=1}^{q}\alpha_i(1-L)x_{t-1} + u_{xt}$,
where x represents, in turn, real output (y), the unemployment rate (u), the price level (p), the wage level (w), the labour share (s), world output (y^w), world prices (p^w) and oil prices (o). The DF and PP tests are computed in two versions, the first based on the statistic $T\rho$ and the second on the t-statistic of ρ; DV is the set of deterministic variables included in the model; k is the number of lags of the endogenous variable used to whiten the residual.

Table A3.2

Structural break vs. unit root tests

		DV={1,1(t>1973.4),t}				DV={1,1(t>t-T_b),t,(t-T_b)*1(t>T_b)}			
x	*k*	*DF(T ρ)*	*DF(t_ρ)*	*PP(T ρ)*	*PP(t_ρ)*	*DF(T ρ)*	*DF(t_ρ)*	*PP(T ρ)*	*PP(t_ρ)*
(1-L)u_y	5	-2.545	-1.004	-2.604	-1.300	-17.430	-2.471	-14.330	-2.584
(1-L)u_u	4	-5.899	-1.889	-6.220	-2.238	-19.633	-2.836	-16.106	-2.899
(1-L)u_p	6	-5.367	-1.722	-3.803	-1.695	-5.507	-1.165	-4.319	-1.136
(1-L)u_w	4	-6.037	-1.541	-5.940	-1.660	-5.608	-1.265	-5.659	-1.404
(1-L)u_s	5	-14.233	-2.375	-11.145	-2.327	-40.389	-3.711	-22.510	-3.480
(1-L)u_{yw}	8	-2.506	-1.012	-4.552	-1.742	-55.058	-3.694	-23.994	-3.506
(1-L)u_{pw}	4	-5.983	-1.864	-6.547	-2.136	-7.568	-1.548	-8.639	-1.877
(1-L)u_o	0	-11.380	-2.246	-11.380	-2.260	-11.427	-2.273	-11.427	-2.287

Notes:
The model is: $(1-L)u_{xt} = \rho u_{xt-1} + \sum_{i=1}^{q}\alpha_i(1-L)u_{xt-i} + error$,
where u_{xt} is the residual of the regression of the variable x on the deterministic regressors included in DV and x represents, in turn, real output (y), the unemployment rate (u), the price level (p), the wage level (w), the labour share (s), world output (y^w), world prices (p^w) and oil prices (o). The DF and PP tests are computed in two versions, the first based on the statistic $T\rho$ and the second on the t-statistic of ρ; DV is the set of deterministic variables included in the model; k is the number of lags of the endogenous variable used to whiten the residual.

If we consider the entire post-war period, in which the unemployment rate initially decreases and then starts increasing in the mid-sixties, the p-value of the ADF(4) test is around .2, and a process with a stochastic trend provides a better account of the profile of the series; if we instead consider the last three decades, in which the variable steadily increased, apart from minor cyclical fluctuations, there is not a clear evidence in favour of the null.[32]

[32] *Results concerning unit-root tests on subsets of the sample period are not presented in this Appendix, but are available from the authors on request.*

In both the full sample or in subsets of it, there is no evidence of a double unit root: the test applied to the first difference of the unemployment rate rejects the null even at the 1% significance level.

To test for the presence of structural breaks, the procedure suggested in Perron (1989) was also applied. Model A and C were estimated[33] with three dates selected as candidate break points: {1964:1; 1974:1; 1992:3}. No signs of a shift in the constant or in the slope of the variable are apparent.

Table A3.3

Unit root tests on the first difference

		DV={1,t}								DV={1}							
x	*k*	*DF(Tρ)*		*DF(t_ρ)*		*PP(Tρ)*		*PP(t_ρ)*		*DF(Tρ)*		*DF(t_ρ)*		*PP(Tρ)*		*PP(t_ρ)*	
$(1-L)^2y$	8	4867.608		-4.791	**	-125.065	**	-11.200	**	-27.689	**	-2.859	*	-144.66		-10.247	**
$(1-L)^2u$	8	-100.697	**	-4.105	**	-197.460	**	-13.629	**	-52.317	**	-3.545	**	-205.259		-13.377	**
$(1-L)^2p$	8	-3.738		-1.109		-20.653		-3.310		-4.277		-1.265		-20.601		-3.347	*
$(1-L)^2w$	6	-9.183		-1.917		-146.444	**	-9.619		-8.942		-1.857		-146.029		-9.584	**
$(1-L)^2s$	8	-92.515	**	-3.816	*	-128.425	**	-10.028	**	-82.265	**	-3.767	**	-129.004		-10.029	**
$(1-L)^2y^w$	8	-243.581	**	-5.407	**	-73.365	**	-7.263	**	-506.319	**	-4.672	**	-73.589		-7.003	**
$(1-L)^2p^w$	8	-7.867		-1.754		-11.988		-2.466		-8.905		-1.892		-12.506		-2.565	
$(1-L)^2o$	6	-164.163	**	-4.571	**	-150.997	**	-12.455	**	-152.163	**	-4.504	**	-151.497		-12.396	**

Notes:
The model is: $(1-L)^2 x_t = \text{deterministic variables} + \rho(1-L)x_{t-1} + \sum_{i=1}^{q}\alpha_i(1-L)^2 x_{t-1} + u_{xt}$,
*where x represents, in turn, real output (y), the unemployment rate (u), the price level (p), the wage level (w), the labour share (s), world output (y^w), world prices (p^w) and oil prices (o). The DF and PP tests are computed in two versions, the first based on the statistic Tρ and the second on the t-statistic of ρ; ** means significant at the 1% level; * means significant at the 5% level; DV is the set of deterministic variables included in the model; k is the number of lags of the endogenous variable used to whiten the residual.*

Given that the unemployment rate is a bounded variable, neither of the two assumed generating processes is very appealing, though for modelling purposes it seems to some extent preferable to choose the *I*(1) option, since it allows for a larger role of stochastic elements. In out analysis, we consider both cases, although in the case in which we model the level of the unemployment rate we do not allow for a deterministic trend, in the presumption that the long memory of the series can provide for the trending behaviour of the last three decades.

The other variables deserving some comments are the index of consumer prices and the labour share. There appears to be overwhelming evidence of the presence of a unit root in the DGP for the CPI; the inflation rate as well appears to be non-stationary, though the results are not so clear-cut. In particular, the Phillips-Perron test provides conflicting evidence against the ADF test. Even allowing for a shift in the growth rate of prices does not lead to the rejection of the null hypothesis. The graphical analysis, on the other hand, provides some evidence of mean-reversion in inflation, once we take in due consideration the first oil price shock. Similar evidence is obtained for the labour share: the presence of a unit root in the DGP cannot be excluded, although once we allow for a shift in the level of the series, the assumption of stationarity seems to hold. The qualitative analysis of the evolution through time of the labour share suggests that a temporary rather than a permanent level shift provides a better account of the data: since the break is located at the end of the sixties, this interpretation is justified by the wage-push shock originated in the so-called *autunno caldo* (hot autumn).

[33] *The deterministic variables considered under Model A are: DV={1,t,I(t>TB)}, while those included in Model C are: DV={1,t,I(t>TB),t(I(t>TB)}. I(•) is the indicator function.*

A word of caution is necessary at this point. The tests for detecting structural breaks assume that the dates of the breaks are known and are, therefore, severely biased (in particular they have an actual size much larger than the nominal one) when such dates are obtained through visual inspection of the data. Since our findings in all but one case do not reject the null of no breaks, the size distortion is not likely to affect our results.

The same analysis was replicated on annual data, in order to check that some of the problems encountered are not due to temporal aggregation. There appear not to be remarkable differences once annual series are used, the exception being the labour share, which seems now to be stationary, once a shift in the mean is allowed.

To shed light on the system properties of the data, cointegration analysis was also run. We focused on four cases: the first includes the rate of unemployment, the logarithm of real wages, output and the index of consumer prices; the second considers changes for the latter three variables; the third uses only first differences; the fourth double-differentiates the price index. This multiple-step procedure is due to the uncertainty surrounding the process to be chosen to model the rate of unemployment. Each model is estimated by maximum likelihood, according to the guidelines in Johansen (1988).

Table A3.4

Cointegration tests

Model 1: $\{w_t\text{-}p_t, y_t, p_t, u_t\}$

Ho:rank=p	Tlog(1-λ)	T-nm	95%	TΣ log(1-λ)	T-nm	95%
p == 0	51.38**	43.99**	31.5	100**	85.66**	63.0
p <= 1	25.15	21.54	25.5	48.66*	41.66	42.4
p <= 2	16.89	14.46	19.0	23.51	20.13	25.3
p <= 3	6.619	5.667	12.3	6.619	5.667	12.3

Model 2: $\{\Delta(w_t\text{-}p_t), \Delta y_t, \Delta p_t, u_t\}$

Ho:rank=p	Tlog(1-λ)	T-nm	95%	TΣlog(1-λ)	T-nm	95%
p == 0	50.05**	42.86**	31.5	111.7**	95.61**	63.0
p <= 1	37.71**	32.29**	25.5	61.6**	52.75**	42.4
p <= 2	19.09*	16.35	19.0	23.89	20.45	25.3
p <= 3	4.794	4.105	12.3	4.794	4.105	12.3

Model 3: $\{\Delta u_t, \Delta(w_t\text{-}p_t), \Delta y_t, \Delta p_t\}$

Ho:rank=p	Tlog(1-λ)	T-nm	95%	TΣlog(1-λ)	T-nm	95%
p == 0	48.74**	41.74**	31.5	103.8**	88.85**	63.0
p <= 1	29.25*	25.05	25.5	55.02**	47.11*	42.4
p <= 2	23.08*	19.77*	19.0	25.77*	22.06	25.3
p <= 3	2.684	2.298	12.3	2.684	2.298	12.3

Model 4: $\{\Delta u_t, \Delta(w_t\text{-}p_t), \Delta y_t, \Delta p_t\}$

Ho:rank=p	Tlog(1-λ)	T-nm	95%	TΣlog(1-λ)	T-nm	95%
p == 0	81**	69.36**	31.5	171**	146.4**	63.0
p <= 1	46.56**	39.87**	25.5	89.99**	77.06**	42.4
p <= 2	24.13**	20.66*	19.0	43.43**	37.18**	25.3
p <= 3	19.3**	16.53**	12.3	19.3**	16.53**	12.3

Model 5: $\{\Delta u_t, \Delta(w_t\text{-}p_t), \Delta y_t, \Delta p_t, s_t\}$

Ho:rank=p	Tlog(1-λ)	T-nm	95%	TΣlog(1-λ)	T-nm	95%
p == 0	96.27**	78.98**	37.5	195.2**	160.1**	87.3
p <= 1	51.66**	42.38**	31.5	98.92**	81.15**	63.0
p <= 2	24.72	20.28	25.5	47.25*	38.76	42.4
p <= 3	21.29*	17.47	19.0	22.53	18.49	25.3
p <= 4	1.244	1.02	12.3	1.244	1.02	12.3

Model 6: $\{\Delta u_t, \Delta(w_t\text{-}p_t), \Delta y_t, \Delta\ p_t, \Delta s_t\}$

Ho:rank=p	Tlog(1-λ)	T-nm	95%	TΣlog(1-λ)	T-nm	95%
p == 0	89.01**	73.02**	37.5	227.4**	186.5**	87.3
p <= 1	53.23**	43.67**	31.5	138.4**	113.5**	63.0
p <= 2	43.03**	35.3**	25.5	85.14**	69.85**	42.4
p <= 3	22.89*	18.78	19.0	42.11**	34.55**	25.3
p <= 4	19.22**	15.77**	12.3	19.22**	15.77*	12.3

In case 1, we expect to have one cointegrating relationship.[34] The cointegrating vector should simply pick up the unemployment rate, while the common trends should reflect the absence of any long-run relationship between the remaining variables. If the unemployment rate is not $I(0)$, there should be four rather than three stochastic trends, and it must be first-differenced to ensure that the system is stationary. When we model all variables but the unemployment rate in first difference, we expect to find four cointegrating vectors, in the presumption that the system is $I(0)$, and three if the unemployment rate is in fact $I(1)$.

As Table A3.4 shows, in the first case the rank of the cointegration space is *1*, with a *p*-value less than *.01*. The unemployment rate does not resemble a mean-reverting process, so confirming previous findings. There is some sensitivity with respect to the sample period, but the evidence is quite clear-cut, even once we allow for a small-sample correction. Contrary to expectations, models 2 and 3 turn out not to be stationary systems, the cointegration rank being less than the number of the endogenous variables. Given the evidence provided by unit root tests, the culprit is possibly the inflation rate. Twice differencing the price index indeed succeeds in mapping the data to $I(0)$ series.

Adding the labour share to the list of endogenous variables provides results which are very close to those obtained for the inflation rate.

[34] *In a model with both I(1) and I(0) variables, the term cointegrating vector also applies to vectors with all but one zeros, which select one by one the stationary processes among the set of endogenous variables.*

Appendix 4 – Introducing a fifth shock

The enlargement of the baseline "difference" model to a more complex model including a fifth shock, namely a shock to the mark-up, is implemented by introducing an additional variable, the total wage bill as a share of value added (put in fifth position in the VAR). The difference between this shock and the one to wage bargaining is that the former should increase unemployment and reduce real wages while the latter should increase both (at least temporarily).

In other words, the model presented in Appendix 1 is extended so that equation (3) includes a mark-up (μ_t), which is assumed to be driven by a stochastic shock (defined in equation 11):

$$(3') \quad p_t = \mu_t + w_t - \vartheta_t + \beta u_t$$

$$(11) \quad \mu_t = \lambda \mu_{t-1} + \varepsilon_t^m$$

where $\lambda<1$.[35] The further four restrictions necessary for the identification of the additional structural shock are obtained assuming that no shock, apart from that to the mark-up which has however only temporary features, may affect in the long run the labour share, which is introduced in levels in the fifth position in the VAR. Formally this requires that the price fixing equation is flat in the wage-unemployment space.

The results of the FEV decomposition are satisfactory in many respects but show a crucial problem, as the contribution of wage bargaining shocks to unemployment fluctuations is almost negligible. It is, however, worth highlighting that the role of the additional shock identified in this model (i.e. the shock to the mark-up) is quite plausible, contributing mainly to inflation movements and, in the short run, to the variability of labour share.

Table A4

Forecast error variance decomposition

		Bargaining	Productivity	Labour supply	Demand	Mark-up
Unemployment change	*1*	1.8	28.5	42.4	27.3	0.04
	8	2.3	25.7	42.0	26.3	3.7
	16	2.5	25.7	41.8	26.2	3.9
	∞	3.9	25.3	41.1	25.9	3.8
Real wage growth	*1*	36.5	35.1	17.3	3.2	7.9
	8	33.9	30.2	19.0	8.5	8.2
	16	33.3	29.9	19.0	8.7	8.9
	∞	33.9	29.6	18.8	8.7	8.9
Output growth	*1*	3.4	18.4	4.6	71.5	2.1
	8	4.1	19.9	5.5	66.9	3.6
	16	4.2	20.0	5.5	66.5	3.8
	∞	6.7	19.5	5.4	64.7	3.7
Inflation	*1*	18.5	19.4	6.7	2.9	52.4
	8	29.6	12.4	5.7	18.7	33.5
	16	44.5	9.4	5.5	15.8	24.8
	∞	68.2	4.4	4.1	12.2	11.2
Labour share	*1*	33.5	8.4	0.5	22.2	35.4
	8	51.4	15.9	3.2	11.3	18.1
	16	66.9	10.1	2.9	8.7	11.5
	∞	79.2	4.2	2.9	8.9	4.7

Figure A4 presents the response functions in this set-up. They support the idea that an additional economically meaningful shock is in such a way identified: what we have labelled as mark-up shock, in fact, drives down wages (and the labour share) while increasing unemployment and (albeit not

[35] *Firms' price setting behaviour is not viewed here as a potential source of hysteresis*

immediately) decreasing output (inflation is pushed up). Moreover, the wage bargaining shock temporarily raises real wages. However, there are again cases in which the IRFs appear to be poorly estimated, confirming how over-parameterisation of an enlarged system may lead to excessive statistical noise.

Figure A4.1

Impulse response functions

Productivity shocks

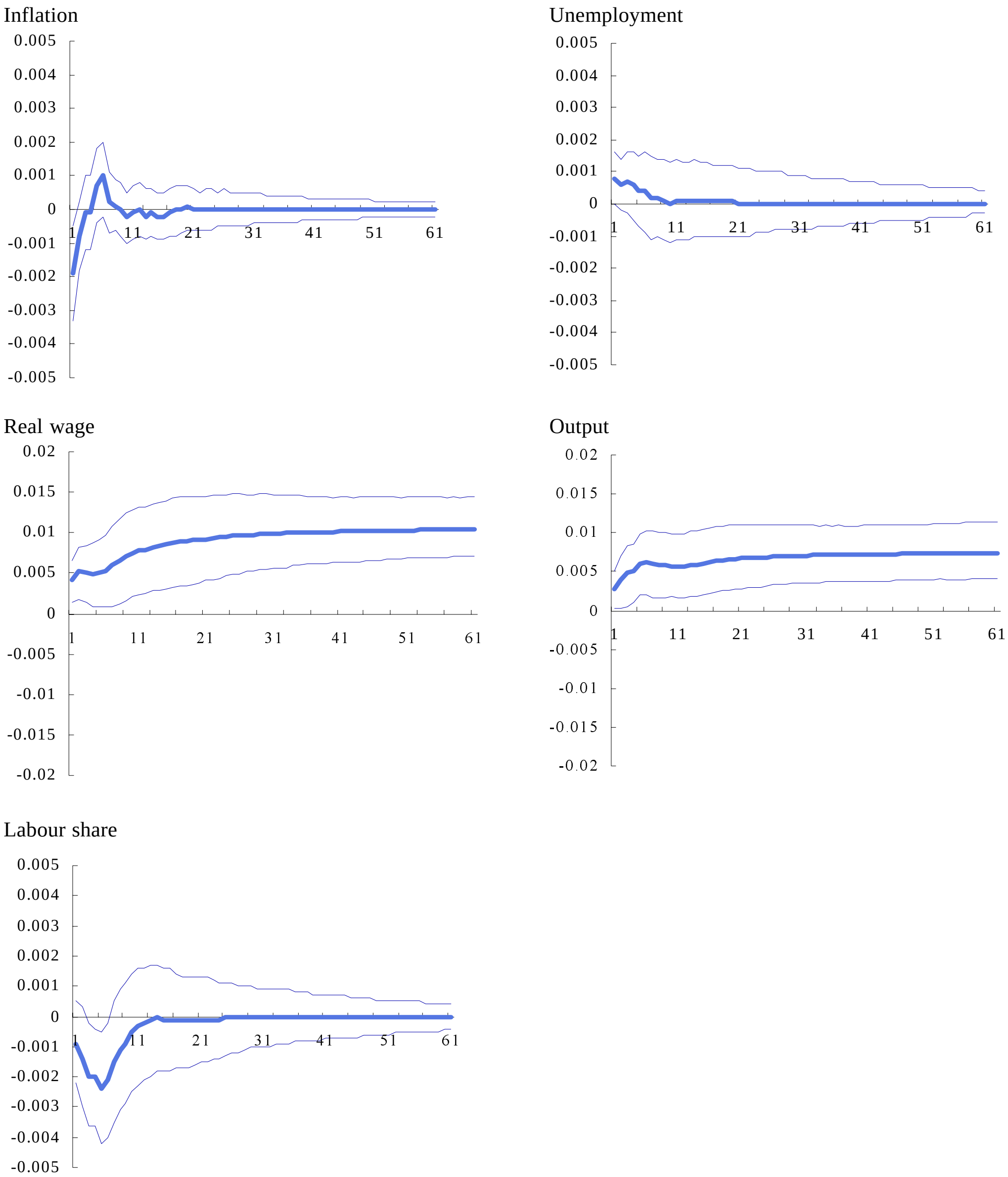


Figure A4.1 (continued)

Labour supply shocks

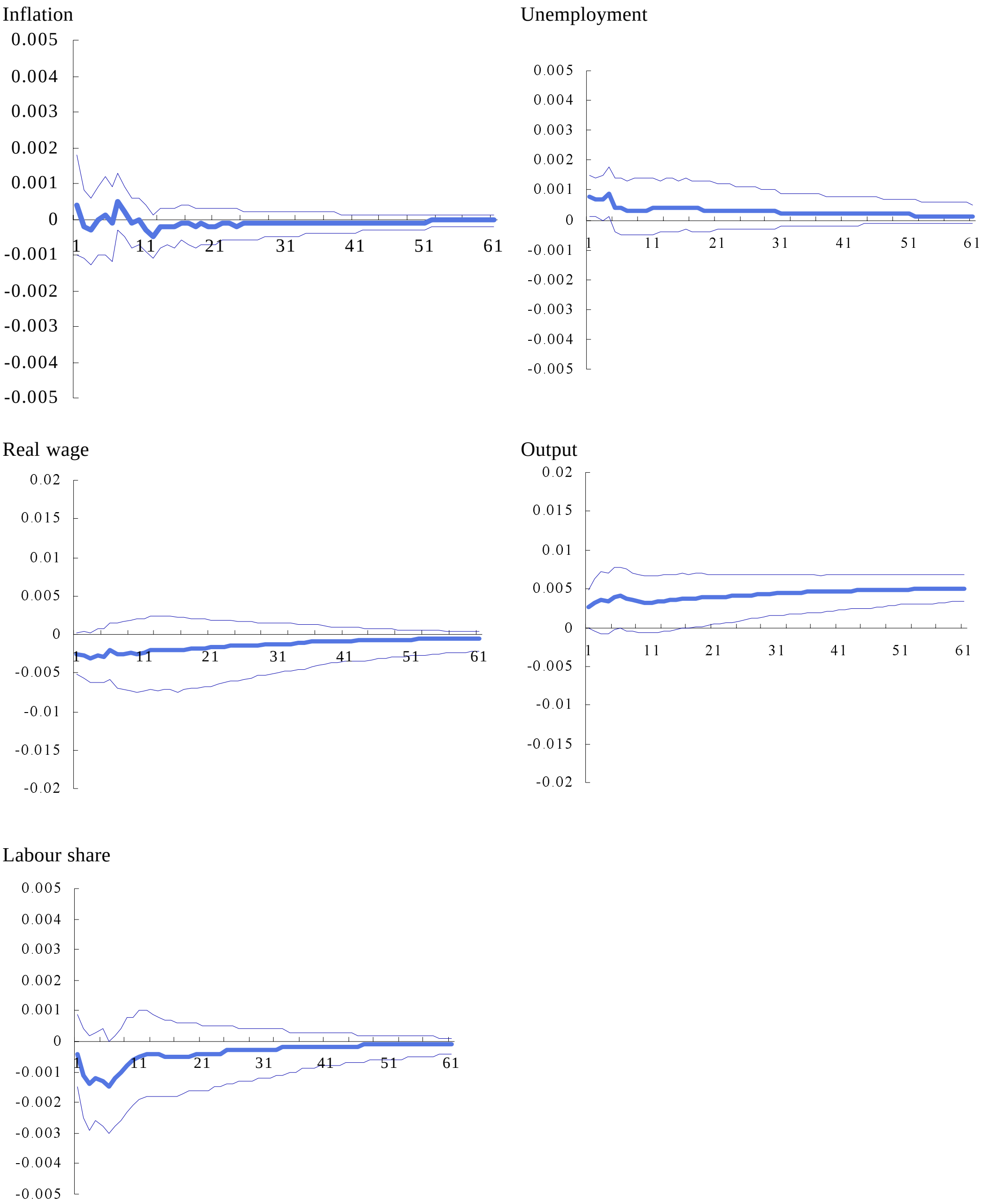
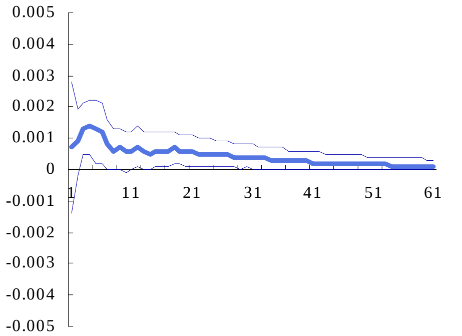


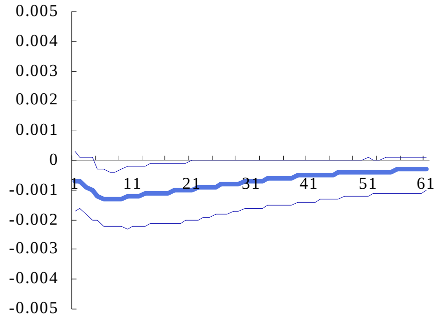
Figure A4.1 (continued)

Demand shocks

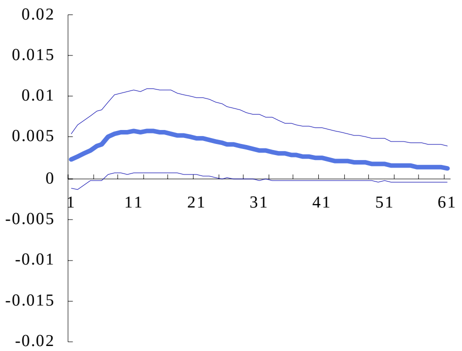
Inflation



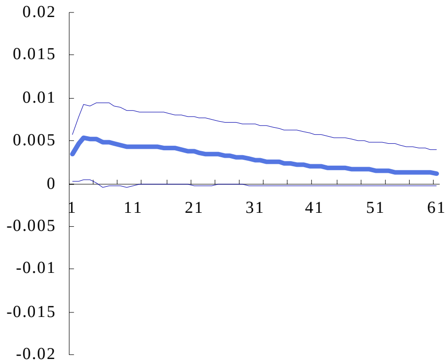
Unemployment



Real wage



Output



Labour share

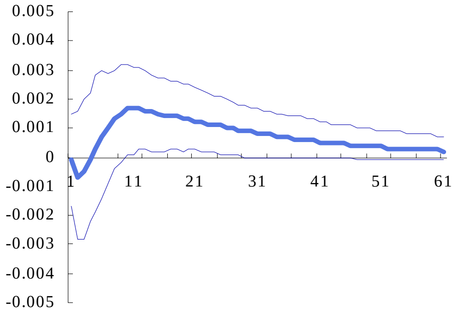
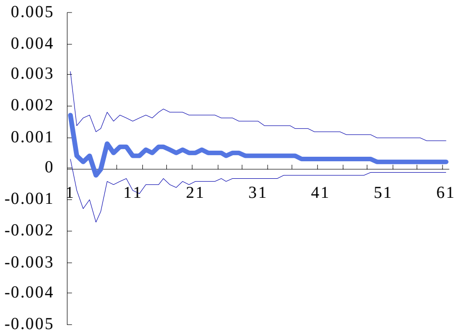


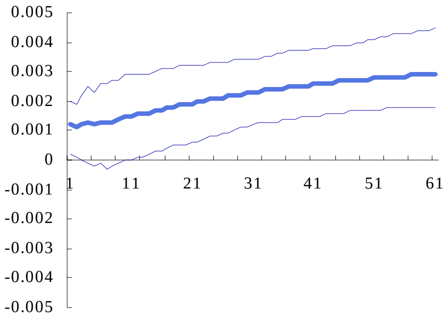
Figure A4.1 (continued)

Wage bargaining shocks

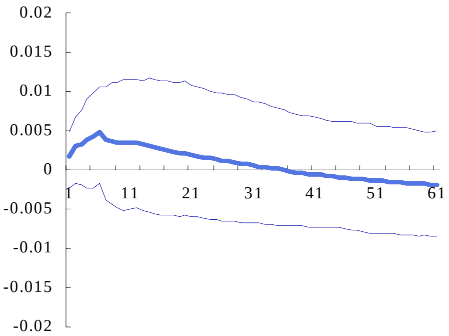
Inflation



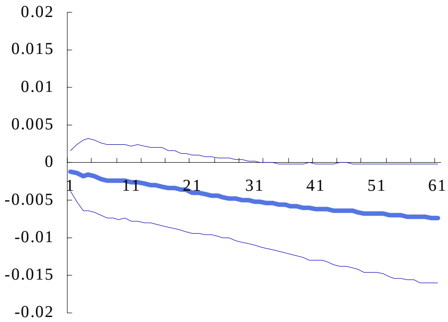
Unemployment



Real wage



Output



Labour share

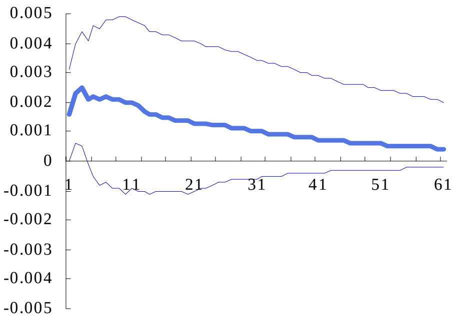
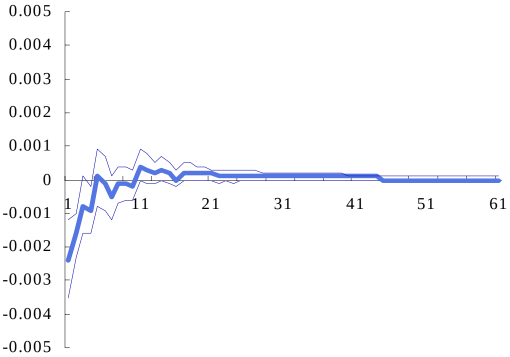


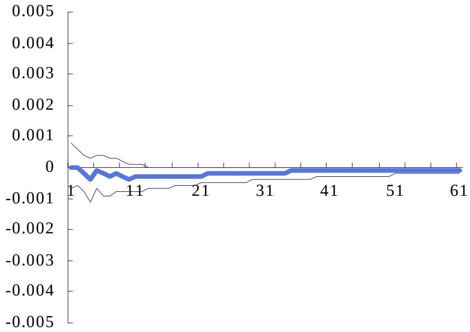
Figure A4.1 (continued)

Mark-up shocks

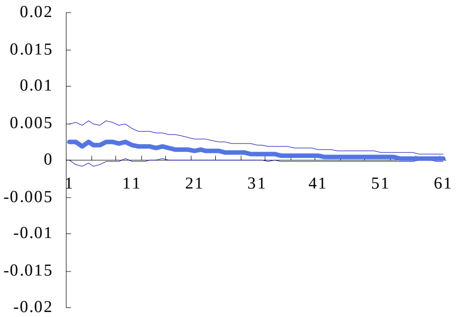
Inflation



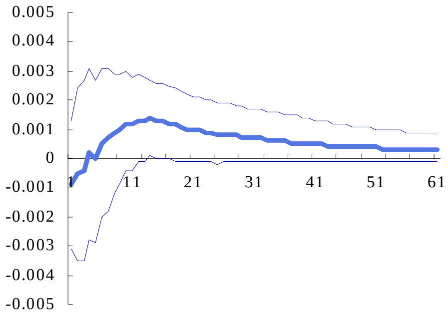
Unemployment



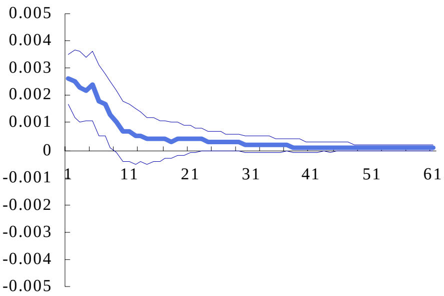
Real wage



Output



Labour share



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