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Martina Jasova, Caterina Mendicino, Dominik Supera

Policy uncertainty, lender of last resort and the real economy

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Abstract

We show that a reduction in lender of last resort (LOLR) policy uncertainty positively affects bank lending and propagates to investment and employment. We exploit a unique policy that reduced uncertainty regarding the availability of future LOLR funding for banks as a quasi-natural experiment. Using micro-level data on banks, firms and loans in Portugal, we generate cross-sectional variation in banks' exposure to uncertainty and find that the size of the *haircut subsidy* - the gap between private market and central bank security valuations - plays a key role in the propagation of the shock to lending and the real economy.

JEL classification: E44, E52, E58, G21, G32

Keywords: Bank Credit, Haircut Subsidy, Central Bank Liquidity, Policy Uncertainty, Firm-level Employment and Investment

Non-technical Summary

How do banks respond to a sudden reduction in uncertainty surrounding the lender of last resort (LOLR) liquidity policy during periods of financial distress? What are the implications for lending and the real economy?

This paper addresses these questions using granular bank-, firm- and loan-level data from Portugal and a unique policy change by the European Central Bank that reduced uncertainty regarding the availability of LOLR funding for euro area banks as a quasi-natural experiment. Our identification strategy relies on exploiting banks' cross-sectional variation in the ex-ante exposure to the LOLR policy uncertainty in a difference-in-differences research design.

On December 8, 2011, the ECB unexpectedly announced a new very Long-Term Refinancing Operation (vLTRO) with an extraordinarily long maturity of 36 months. At the time of the vLTRO banks were facing uncertainty about their ability to fully satisfy their funding needs through the ECB over an extended period of time. Hence, the vLTRO represents a suitable setting to investigate the effects of a reduction in uncertainty surrounding the future availability of central bank liquidity.

Importantly, the vLTRO was introduced when the ECB was providing banks with a haircut subsidy. We define the haircut subsidy as a favorable gap between the central bank and private market haircut on the value of risky securities pledged to obtain repo funding. We argue that the size of the haircut subsidy plays a crucial role in determining the impact of a reduction in LOLR policy uncertainty. In the presence of a substantial haircut subsidy, uncertainty regarding the long-term availability of LOLR funding exposed banks to the risk of having to rely on more costly market funding. The size of the haircut subsidy is our main measure of cross sectional banks' exposure to LOLR policy uncertainty.

We compare the evolution of lending to firms by banks were more exposed to the policy uncertainty relative to banks with less exposure. To isolate the causal effect of the policy,

we compare lending outcomes of the same firm borrowing in the same time from at least two differently exposed banks, i.e. this is implemented by using firm-time fixed effect in line with Khwaja and Mian (2008).

This paper exploits a unique micro-level dataset that links detailed information on banks, firms and loans. First, we match bank security holdings data with the bank pledging of securities both with the ECB and the private repo markets to measure the size of the haircut subsidy. Second, we merge the haircut subsidy measured at the cross-section of banks with the universal credit registry that collects loan-level information for all credit relationships of Portuguese firms to investigate lending outcomes. Finally, we match the data with firm-level balance sheet and linked employee-employer dataset to study the real outcomes of the reduction of policy uncertainty.

We show that a lengthening of the maturity of central bank liquidity by itself is, however, not sufficient to stimulate lending. The size of the haircut subsidy is key in the propagation of a reduction in LOLR policy uncertainty to bank lending and the real economy. In the absence of a high haircut subsidy, uncertainty about the future availability of LOLR liquidity is not expected to have a large effect on the borrowing capacity of banks and thus on their lending behavior. This is because borrowing on the private repo markets is not substantially more costly than borrowing from the central bank. Thus, a high haircut subsidy is a necessary condition for the policy change to have real effects.

We find that a decrease in LOLR policy uncertainty has a positive and economically sizable impact on banks' credit supply to firms both on the intensive and extensive margin. Banks more exposed to the reduction in LOLR policy uncertainty increased their lending to firms and offered loans of longer maturity.

The loan-level results also translate into economically relevant firm-level credit outcomes. We show that the reduction in LOLR policy uncertainty strongly transmitted to firm-level investment and employment during the sovereign debt crisis.

Our focus on the lending and real effects of uncertainty regarding central bank LOLR pol-

icy brings a different perspective to the literature that emphasizes the impact of government, trade and monetary policy uncertainty on the firm-level and aggregate economic outcomes (e.g. Fernández-Villaverde et al., 2015; Baker et al., 2016; Husted et al., 2019; Caldara et al., 2020).

Overall, we provide evidence on the positive impact of a reduction in LOLR policy uncertainty on investment and employment through the bank-lending channel. By showing that a reduction in LOLR policy uncertainty makes banks choose to no longer delay their lending, we document that the real option channel (Bernanke, 1983) is also important for banks.

Our results suggest that in the absence of an explicit commitment to the long-term provision of LOLR funding, a lengthening of the maturity of central bank liquidity can reduce policy uncertainty and be a valid policy tool to stimulate lending. This provides new evidence on the bank lending effects of central bank policies that go beyond those of conventional monetary policy (e.g. Jimenez et al., 2012) and unconventional monetary policies (e.g. Rodnyansky and Darmouni, 2017).

Introduction

Since the start of the Global Financial Crisis, financial sector bailouts and central bank unconventional policies have been surrounded by a great deal of uncertainty. Many central banks revived lender of last resort (LOLR) operations and implemented important temporary changes to their liquidity operations. This, often, generated uncertainty about the circumstances and terms under which they would provide liquidity assistance.[1] While the existing literature has provided important insights on the impact of government, trade and monetary policy uncertainty on the firm-level and aggregate economic outcomes (e.g. Fernández-Villaverde et al., 2015; Baker et al., 2016; Husted et al., 2019; Caldara et al., 2020), evidence on the real effects of uncertainty regarding central bank LOLR policy is still scant.

Banks are at the core of the monetary policy transmission mechanism (e.g. Kashyap and Stein, 2000; Bernanke and Blinder, 1992; Jimenez et al., 2012). Thus, the assessment of how uncertainty regarding central bank policies affects economic outcomes requires to understand its impact on bank lending decisions. Estimating the causal effect of LOLR policy uncertainty on the real economy through its effect on the supply of credit poses important identification challenges. Crucially, uncertainty simultaneously affects the demand and supply of credit. Moreover, it is generally difficult to identify exogenous shocks to policy uncertainty, as well as, to measure the exposure to uncertainty in the cross-section of banks and firms.

We address these challenges by studying the causal effect of a sudden reduction in LOLR policy uncertainty on bank lending and its propagation to the real economy by using a unique policy change and granular micro-level data. We focus on the European Central Bank (ECB)'s 2011 very Long-Term Refinancing Operation (vLTRO) as a quasi-natural experiment of a sudden reduction in LOLR policy uncertainty. The vLTRO extended the maturity of central bank liquidity from short-term to extraordinarily long three years and,

[1] The differential treatment of Bear Stearns, Lehman Brothers and AIG increased uncertainty regarding the availability of the U.S. Federal Reserve liquidity support. Similarly, in the U.K., the Northern Rock crisis increased uncertainty regarding the conduct of LOLR operations by the Bank of England (Hauser, 2014).

thus, reduced uncertainty regarding the future availability of LOLR funding for a prolonged period of time. Importantly, the vLTRO was introduced when the ECB was providing banks with a haircut subsidy, i.e. a favorable gap between the central bank and private market haircut on the value of risky securities pledged to obtain repo funding. In the presence of a substantial haircut subsidy, uncertainty regarding the long-term availability of LOLR funding exposed banks to the risk of having to rely on more costly market funding.

Our identification strategy relies on exploiting banks' cross-sectional variation in the ex-ante exposure to the LOLR policy uncertainty in a difference-in-differences research design. We use the size of the haircut subsidy at the individual bank level as a measure of exposure to the LOLR policy uncertainty. We analyze the credit supply impact of policy uncertainty by comparing the credit outcomes of the same firm borrowing from at least two differently exposed banks (Khwaja and Mian, 2008; Jiménez et al., 2019). We show that during the European sovereign debt crisis, banks more exposed to the reduction in LOLR policy uncertainty provided more credit to firms, in particular of longer maturity. Further, we also document that the loan-level effects are economically sizable and translate in investment and employment effects.

Our paper has several important implications. First, we provide empirical evidence on the impact of policy uncertainty on investment and employment through its effects on the supply of credit. By showing that a reduction in LOLR policy uncertainty makes banks choose to no longer delay their lending, we document that real option channel (Bernanke, 1983; Rodrik, 1991) is also important for banks. We find that banks more exposed to the reduction in policy uncertainty not only started to invest more in credit, but they also granted loans of longer maturities. Second, we uncover new insights into the importance of central bank commitment and forward guidance (e.g. Campbell et al., 2012). Our results suggest that in the absence of an explicit long-horizon commitment to the provision of LOLR funding, a lengthening of the maturity of central bank liquidity reduces uncertainty regarding the availability of central bank funding over an extended period of time and is a valid policy

tool to stimulate lending and the real economy. Thus, central bank commitment or explicit guidance about its future policy intentions is also crucial in the context of lender of last resort policy. Third, the focus on LOLR policy (e.g. Bagehot, 1873; Friedman and Schwartz, 1963; Drechsler et al., 2016), allows us to provide new evidence on the bank lending effects of central bank policies that goes beyond those of conventional and unconventional monetary policies (e.g. Jimenez et al., 2012; Rodnyansky and Darmouni, 2017). Importantly, the size of the haircut subsidy is key in the propagation of LOLR policy to bank lending and the real economy.

This paper exploits a unique micro-level dataset that links detailed information on banks, firms and loans. First, we use the data on banks' security pledging with the ECB and match it with the private repo market haircuts to measure the size of the haircut subsidy. Second, we merge the haircut subsidy measured at the cross-section of banks with the universal credit registry that collects loan-level information for all credit relationships of Portuguese firms to investigate lending outcomes. Finally, we link the data with firm-level balance sheet and employee-employer datasets to study the real effects of the policy. Our paper is, to the best of our knowledge, the first work that examines the transmission of LOLR policy changes on the real economy at this level of coverage, match and granularity.

The 2011 vLTRO represents a suitable setting to investigate the effects of a reduction in uncertainty surrounding the future availability of central bank liquidity. In October 2008, the ECB started to *fully satisfy* the demand for short-term liquidity from Eurozone banks against eligible collateral under fixed rate full allotment policy. However, the ECB never committed to provide unlimited liquidity and, thus, to act as a LOLR, for an extended period of time. The lack of long-horizon guidance about its intentions regarding the provision of liquidity generated uncertainty for banks regarding the future possibility to fully satisfy their funding needs through the central bank for an extended period of time.[2] By extending the maturity

[2]In addition, in April and July 2011 the ECB increased interest rates, after almost two years of interest rate cuts. This created uncertainty regarding the stance of the ECB monetary policy over the medium term,

of available funds to three years, the vLTRO suddenly reduced uncertainty regarding the longer-term availability of LOLR liquidity.[3]

We argue that the size of the haircut subsidy plays a crucial role in determining the impact of a reduction in LOLR policy uncertainty. In case of a withdrawal from the unlimited liquidity policy, banks borrowing from the ECB against securities with a high haircut subsidy would incur a drastic reduction in their borrowing capacity by switching to the private repo market. Using data on private market haircuts, we calculate that the average subsidy for Portuguese banks was around 70 pp before the introduction of the 2011 vLTRO. In the extreme case of a complete reliance on the private market, banks' borrowing capacity would be reduced by 57% of their equity capital (EUR 20 bn). Due to this substantial haircut subsidy, Portuguese banks heavily relied on the LOLR funding and were, largely exposed to uncertainty about its future availability. Thus, banks with ex-ante larger haircut subsidy benefited more from the vLTRO.

Our results highlight that a lengthening of the maturity of central bank liquidity by itself is not sufficient to stimulate lending. Specifically, we argue that the necessary condition for this policy change to work is a sizable exposure of banks to LOLR policy uncertainty, as measured by a large haircut subsidy. We document this by extending our analysis to a similar long-term liquidity operation introduced in 2009. Unlike the 2011 vLTRO, the 2009 policy was implemented in a period of negligible haircut subsidy. As a result, banks were less exposed to LOLR policy uncertainty as they could effectively substitute central bank funding with private market repo financing without suffering from a dramatic reduction in their borrowing capacity due to the haircut differences.[4] Our empirical analysis of the 2009 policy finds no impact of the lengthening of the maturity of central bank liquidity on bank

and raised concerns of a possible tightening cycle.

[3]Based on banks' public announcements, banks reported the reduction in uncertainty regarding the guarantee of long-term funding as the crucial reason for their participation in the vLTRO.

[4]The average subsidy for a Portuguese bank was around 4 pp before the introduction of the 2009 policy compared to 70 pp before 2011 vLTRO.

lending in a period of low haircut subsidy.

Portugal presents an ideal laboratory to investigate the bank lending and real effects of a sudden reduction in LOLR policy uncertainty in times of crisis for at least three reasons. First, the high level of granularity of the data allows us to overcome a number of identification challenges and properly trace the transmission of the policy uncertainty shock to bank lending and its propagation to the firm-level outcomes and the real economy. Second, the Portuguese banking sector was highly exposed to the LOLR policy uncertainty. Due to the fear of contagion from the Greek sovereign debt crisis, in May 2010 Portuguese banks lost access to the international wholesale funding market and increased their reliance on the short-term ECB funding. At the time of the introduction of the vLTRO, Portuguese securities were considered risky and had extremely high haircuts in the private market. Thus, banks were highly exposed to uncertainty regarding the availability of future LOLR liquidity.[5] Third, the focus on Portugal mitigates concerns about confounding effects related to the change of collateral rules for certain types of securities during the vLTRO. Together with the announcement of the vLTRO, the ECB also relaxed collateral rules on risky asset-backed securities and allowed national central banks to temporarily accept non-marketable securities. In sharp contrast with other European countries, the use of these types of securities was very limited in Portugal.[6] Overall, Portugal represents a valuable choice for our analysis as it allows us to overcome important identification challenges.

We formally exploit the variation in banks' exposure to the reduction in LOLR policy uncertainty entailed in the vLTRO using a difference-in-differences framework. To isolate the causal effect of the reduction in policy uncertainty on lending, we compare the credit outcomes of the same firm borrowing from at least two differently exposed banks. Our

[5]Portugal received the second largest uptake of the vLTRO relative to the size of the domestic banking sector among all euro area countries.

[6]In Section 1, we use security-level data to carefully document that the change in collateral rules concomitant with the vLTRO did not affect in a relevant way the composition of pledged securities used by Portuguese banks. In contrast, this increase in the collateral availability had a significant impact on the pledging behaviour of banks during the vLTRO in other European countries.

identifying assumption is that in the absence of the policy, the lending of more and less exposed banks would have followed parallel trends. We measure the exposure to the policy using the size of the haircut subsidy for each bank as the difference between the ECB and the private market haircut-adjusted value of its securities pledged with the ECB to obtain liquidity.

We find that the introduction of long-term operations improves lending outcomes by reducing banks' uncertainty regarding the availability of central bank funding over an extended period of time. This has a positive and economically sizable impact on banks' credit supply to firms both on the intensive and extensive margin. Banks more exposed to the reduction in LOLR policy uncertainty increased their actual lending to firms, allowed borrowers to increase credit line drawdowns and offered loans of longer maturity. In terms of elasticity, one standard deviation increase in bank exposure to the reduction in funding uncertainty is associated with a 3.2 percent increase in lending to non-financial firms in Portugal. The effects are positive and significant not only at the loan-level but importantly also at the firm-level credit. We compare the actual credit development to the counterfactual without the policy intervention and find that although the policy did not stop the ongoing credit contraction, it significantly reduced its pace. The observed credit contraction in the vLTRO period was about 5.75%. We estimate that in the absence of the policy, credit would have reduced by additional 2.15 percentage points (EUR 892 million).

While the reduction in policy uncertainty had a positive impact on lending volumes, it also led to a temporary loosening of lending standards. Specifically, more exposed banks were more likely to establish new relationships with riskier firms and these newly extended loans defaulted more often within the subsequent three years. This provides evidence on the risk-taking channel of LOLR policy and it is in line with the risk-taking channel of monetary policy already documented for both conventional and unconventional monetary policy shocks.

Finally, we explore whether the loan-level results translate into economically relevant

firm-level credit outcomes. A valid concern is that as firms received more funding from more exposed banks, their borrowing from other less exposed banks could have been reduced by the same proportion (a zero-sum outcome). This would imply negligible firm-level credit effects.[7] We show that the reduction in LOLR policy uncertainty strongly transmitted to firm-level investment and employment during the sovereign debt crisis. To this end, we match the credit register data for all non-financial firms in Portugal with granular firm-level census and employer-employee data. While the observed drop in investment in 2011–2012 was about 18.5%, we estimate that without the vLTRO, firms' investment would have contracted by additional 2.2 percentage points. In case of employment, we find that while the year-on-year labor market contacted by 9.7%, in the absence of the vLTRO the employment drop would have been 2.0 percentage points more severe. Thus, the real option channel for banks prove to have important effects not only on bank lending decisions, but also for the real economy.

Literature review. This paper contributes to the growing literature that assesses the real and financial effects of economic policy uncertainty (e.g. Pastor and Veronesi, 2012; Baker et al., 2016; Kelly et al., 2016; Jens, 2017; Husted et al., 2019; Caldara et al., 2020). We add to this literature by examining the effects of uncertainty surrounding LOLR policies. Our results highlight that the real option channel of uncertainty is important for banks and translates into firm real effects.

The paper also relates to the growing strand of the monetary economics literature which has highlighted the importance of commitment and forward guidance for interest rate policies (e.g. Wright, 2012; Campbell et al., 2012) or asset purchases (e.g. Krishnamurthy et al., 2017; Swanson, 2017). The relevance of providing guidance on central bank policy intentions has not been assessed in the realm of lender of last resort policies. Our paper fills this important gap.

By showing that managing the maturity structure of the central bank liquidity is an

[7] See, for instance, Jiménez et al. (2019) for an example of how large loan-level effects of a credit supply shocks in Spain result in close to zero firm-level aggregate effects.

important tool for the lender of last resort, we also contribute to existing work that analyzes banks' borrowing from the central bank during crisis times (e.g. Cassola et al., 2013; Drechsler et al., 2016; Berger et al., 2017). By reducing uncertainty about the availability of future liquidity, the central bank can provide support to banks and stimulate lending. The positive and sizable effects of the LOLR policy uncertainty on bank lending and the real economy are crucially linked to the size of the haircut subsidy.

This paper complements existing work on the effect of central bank policies related to the vLTRO. Existing papers focus on the vLTRO liquidity uptake (Andrade et al., 2018) or on the relaxation of the collateral rules concomitant with the vLTRO (e.g., Cahn et al., 2018; van Bekkum et al., 2018; Carpinelli and Crosignani, 2018) and provide evidence of its effect on the lending in a number of countries.[8] We show that the lengthening of the maturity of central bank liquidity can affect bank lending *independently* of the relaxation of the collateral rules. Importantly, the effects are related to the exposure of banks to uncertainty regarding the long-term provision of LOLR funding. We exploit two distinctive features of our setup that allow us to examine this mechanism. First, we focus on Portugal where, differently from other European countries, the relaxation of collateral rules was very limited.[9] Second, we present a novel measure of the exposure to the policy - *the haircut subsidy* - that allows us to capture ex-ante bank's exposure to the reduction in LOLR policy uncertainty entailed in the vLTRO.[10]

[8] At the time of the vLTRO, the ECB (i) reduced the rating threshold for certain asset-backed securities and (ii) allowed national central banks, as a temporary solution, to accept as collateral additional performing credit claims that satisfy specific eligibility criteria. van Bekkum et al. (2018) exploit the lowering of the rating requirement for eligible residential mortgage-backed securities in the Netherlands. Carpinelli and Crosignani (2018) explore the introduction of a regulatory intervention by the Italian government that allowed banks to "manufacture" collateral by guaranteeing securities, such as retained bank own bonds, otherwise ineligible at the ECB. Andrade et al. (2018) studies the impact of the endogenous vLTRO liquidity uptake in France, while Cahn et al. (2018) exploit the concurrent relaxation of the collateral rules for French banks.

[9] In Section 1, we provide detailed evidence of the negligible role played by these newly eligible securities in the pledging of Portuguese banks during the vLTRO.

[10] In our analysis we also compare the impact of the 2011 vLTRO with that of the 2009 LTRO to further document the importance of the LOLR policy uncertainty channel in explaining the bank lending effects of the lengthening in the maturity of central bank liquidity. To the best of our knowledge, the 2009 LTRO was

Finally, this paper connects to the literature on the bank lending channel of monetary policy (e.g. Jimenez et al., 2012, 2014) and in particular to the latest papers on unconventional monetary policies (e.g. Chakraborty et al., 2018; Rodnyansky and Darmouni, 2017; Altavilla et al., 2018, 2019; Bottero et al., 2019; Heider et al., 2019). We contribute to this strand of the literature by documenting the bank lending channel of LOLR policy. In addition, by showing that policy uncertainty that hits banks propagates to the real economy, we also link to existing work that quantifies the aggregate effects of shocks propagated through the credit channel (see, e.g., Jiménez et al., 2019; Amiti and Weinstein, 2018; Chodorow-Reich, 2014; Huber, 2018; Luck and Zimmermann, 2020).

The rest of the paper is organized as follows. Section 1 shows the institutional background. Section 2 discusses the data. Section 3 presents the empirical strategy. Section 4 reports the loan-level effects, Section 5 presents firm-level credit and real outcomes. Section 6 concludes.

1 LOLR, policy uncertainty and haircut subsidy

1.1 The liquidity framework of the ECB

Until 2008, the ECB provision of liquidity was implemented in the form of repurchase agreements against eligible collateral through auctions at variable rate.[11] As a reaction to the financial crisis, in October 2008, the existing tender procedure was replaced by a *fixed-rate full allotment* (FRFA). With FRFA, all bank bids were *fully satisfied* regardless of bids placed by other banks in the Eurozone as long as the bank could pledge sufficient collateral. Thus, banks could borrow unlimited amounts of liquidity against eligible collateral.[12]

so far unexplored by the literature.

[11] See Cassola et al. (2013) for details on the primary auctions of liquidity before 2008 and for the analysis of banks' bidding behavior under the multiple rate auction during the 2007 sub-prime market crisis.

[12] We focus on regular ECB liquidity operations and abstract from the Emergency Liquidity Assistance program, which is administered by the national central bank to support banks with insufficient eligible

On 8 December 2011, the ECB unexpectedly announced a new very Long-Term Refinancing Operation (vLTRO) with an extraordinarily long maturity of 36 months.[13] The newly available long-term funding was offered at exactly the same conditions as for the existing short-term repo.[14] More than 800 banks participated to the vLTRO and the ECB allotted approximately EUR 1 trillion of funding. To date, this is the largest liquidity provision in the history of modern central banking.

1.2 LOLR policy uncertainty and vLTRO

Why was the vLTRO so popular? We argue that at the time of the vLTRO banks were facing uncertainty about their ability to fully satisfy their funding needs through the ECB over an extended period of time. The ECB only provided short-horizon guidance on the future availability of LOLR funding.[15] In fact, in October 2011 (one and a half months before the vLTRO announcement), the ECB announced to maintain the FRFA policy only until mid-2012. In the absence of a long-horizon commitment to the future course of actions, the introduction of a new long-term operation reduced uncertainty regarding the availability of LOLR funding over an extended period of time.

Banks' public announcements also point towards the reduction in uncertainty regarding the availability of funding over the incoming years as the crucial reason for their participation in the vLTRO. The banks communicated that they took "*the opportunity to borrow from the ECB at three years, which made funding more stable and took pressure off the use of weekly borrowing operations*" (Caixa Economica Monte Pio, Annual Report, 2011), as it

collateral.

[13]Previously, the ECB offered liquidity to banks with a maximum maturity of one year, i.e, weekly main refinancing operations (MRO), and 1-, 3-, 6-month long-term operations (LTRO), and on two special occasions (in 2009 and 2011) the ECB introduced 12-month LTRO.

[14]The vLTRO interest rate was a floating rate computed as an average of the weekly MRO rates set by the ECB over the horizon of three years and was paid at the maturity of the operation. Banks were required to pay a *floating rate* that fully mirrored any changes in the MRO rates over the horizon of three years. Thus, vLTRO was not associated with a reduction in interest rate risk compared to other shorter-term operations.

[15]See Internet A.1 for ECB announcements concerning FRFA.

"*guaranteed the same* [liquidity] *position for the coming two years*" (Banco Carregosa, Report and Accounts, 2011), represented a "*structural improvement in the profile of maturities*" (Caixa Geral de Depositos, Annual Report 2012), "*improved financing structure by replacing short-term maturities by long term funding*" (Santander, Annual Report, 2011) and enabled them "*to stabilize* [the] *structural liquidity profile*" (Banco Popolare, Annual Report, 2012).[16] Thus, the guidance horizon used by the ECB had left a great deal of uncertainty regarding the availability of LOLR funding. The vLTRO clearly contributed to reduce this uncertainty.

In addition, in April and July 2011 (i.e., around six months prior to the vLTRO announcement) the ECB increased interest rates, after almost two years of interest rate decreases. This increased uncertainty regarding the stance of the ECB monetary policy over the medium term, and raised concerns of a possible tightening cycle. This, potentially, also contributed to enhanced uncertainty regarding the future provision of LOLR liquidity.

1.3 vLTRO and the Portuguese banking sector

1.3.1 Liquidity provisions

Figure 1 Panel (a) summarizes the development of ECB liquidity received by Portuguese banks. In May 2010, Portuguese banks lost access to international wholesale markets and increased their dependence on the ECB liquidity operations.[17] Prior to the introduction of the vLTRO, Portuguese banks borrowed from the ECB in short maturities (on average 4 months). The vLTRO allowed banks to costlessly swap their existing short-term funding into a stable and predictable source of financing of three-year maturity. Figure 1 Panel (b) shows that the average maturity of bank debt from the ECB increased from 4 months right before the vLTRO announcement to 32 months in the post- period. In total, the vLTRO provided EUR 20.2bn of long-term liquidity to Portuguese banks in December 2011 and

[16] See Internet A.2 for further details.

[17] Alves et al. (2016) find that the banks did not freeze lending to the real economy as they effectively substituted their source of funding with the ECB liquidity.

an additional EUR 26.8bn in February 2012.[18] Portuguese banks were the second largest recipient of vLTRO relative to the size of banking sector.

1.3.2 Pledged securities

Figure 1 Panel (c) illustrates the main categories of collateral pledged with the ECB by Portuguese banks. While government bonds (red) were always a relevant source of collateral, bank-issued securities (blue) played an increasingly more important role as a collateral for liquidity operations over time. The majority of these bonds are (risky) *domestic* securities issued by Portuguese banks and government and are associated with high haircut subsidy.

Together with the vLTRO the ECB also increased collateral availability by "*(i) reducing the rating threshold for certain asset- backed securities (ABS) and (ii) allowing national central banks, as a temporary solution, to accept as collateral additional performing credit claims (i.e. bank loans) that satisfy specific eligibility criteria.*" (ECB press release 8 December 2011). However, differently from a number of other European countries, Portugal did not take advantage of the relaxation of collateral rules.

Regarding the use of asset-backed securities, Figure 1 Panel (c) illustrates that the share of securitized assets (light grey), pledged by Portuguese banks, did not increase during the period of the vLTRO.[19] As for the additional credit claims, the Bank of Portugal introduced only a very limited set of changes to the existing collateral framework and only for the pledging of collateral in February 2012, i.e. the second allotment date. As a result, the share of non-marketable securities (dark grey), did not exceed 5% of the total collateral pledged and its use did not increase substantially during the vLTRO. Thus, our results are by and large not driven by the relaxation of collateral rules on securitized assets, or by modifications

[18]The policy was administered in two operations on December 21, 2011 and February 29, 2012.

[19]We also do not observe any large movements in pledging of securitized assets in the cross-section of banks. Prior to the vLTRO, the average share of securitized assets to total pledged assets with the ECB was about 23.2% with a 24.8% standard deviation. Following the vLTRO, the importance of securitized assets has slightly decreased (18% average and 21.5% standard deviation). For details see Internet Appendix Figure H2.

of the collateral framework at the national level.

1.3.3 Haircut subsidy

The ECB provides funding against adequate collateral and it applies haircuts, i.e. a reduction to the value of the collateral pledged by banks. The size of the haircuts varies depending on the riskiness and maturity of the underlying collateral. Prior to 2008, the haircuts applied by the ECB were similar to the private market haircuts on repo loans. However, after September 2008, the ECB started offering haircuts on risky securities that were below private market haircuts. We refer to the gap between the private market and central bank haircut on the value of risky securities, as *haircut subsidy*. Drechsler et al. (2016) highlight that the changes in the haircut policy essentially worked as a subsidy for distressed economies in the euro area.

Figure 1 Panel (d) shows the average private market and ECB haircut for securities pledged by Portuguese banks with the ECB.[20] The haircut subsidy for those securities was stable and on average 5 pp between 2007 and 2010 but it increased dramatically during the European sovereign debt crisis and reached 70 pp in 2011. This change was triggered by a rating downgrade of Portuguese sovereign bonds and a subsequent increase in private market haircuts by about 75 pp. While private market repo clearing houses responded by increasing the haircut on the securities issued by peripheral economies, the ECB kept those haircuts at significantly lower levels. In fact, ECB haircuts increased only slightly by about 5 pp.

In the extreme case of a complete reliance of banks on the private repo market, the reduction in the borrowing capacity of the Portuguese banking sector would have been reduced by around EUR 20 billions (57% of their equity capital) at the time of 2011 vLTRO. By extending the maturity of the ECB liquidity operations to three years, the vLTRO significantly reduced uncertainty regarding the long-term availability of LOLR funding and the potential need to rely on private repo financing at higher market haircuts. Thus, the reduction in

[20] Private repo market haircuts are obtained from LCH Clearnet. See Section 2.

uncertainty was particularly strong for banks holding securities with large haircut subsidy.

2 Data

For the purpose of our analysis, we build a novel dataset that matches data from the European Central Bank, private repo markets and the Bank of Portugal. Below we describe the data following a top-down approach:

LOLR data. We use the Eurosystem Collateral Database to extract information on the securities pledged with the ECB to obtain LOLR funding. We observe the following characteristics of the pledged assets at bank-security-month level: ISIN-code, nominal value, ECB haircut adjusted value, haircut category, quantity, issuance date, and maturity date.

We also use data from the private repo market - LCH Clearnet. For each security, we observe monthly series of private market haircuts. We match the ECB and private market data to construct the measure of the banks' haircut subsidy.

Finally, we exploit the ECB monetary policy and market operations database. This data source provides us with detailed information on all ECB liquidity operations split by categories (weekly main refinancing operations (MRO); longer-term refinancing operations with 1, 3, 6, 12 month maturity; 36-month operations (vLTRO)) for all banks on a daily basis. The database allows us to directly observe the exact amount of 36-month vLTRO funding used by each bank.

Bank-level data. We rely on several sources maintained by the Bank of Portugal. The Securities Statistics Integrated System (SIET) contains information on the pool of all marketable securities held by banks such as quantity, book value, and market value at the bank-security-month level. We use SIET to define the two alternative measure of banks' exposure to the LOLR policy uncertainty - (i) holding of eligible securities and (ii) holding of eligible securities that match the maturity profile of the vLTRO operation.[21]

[21] We also use variables from the bank balance sheet and prudential monthly databases to construct controls

Credit register. Central de Responsabilidades de Credito (CRC) provides monthly loan-level information on the universe of outstanding loans to Portuguese firms above the reporting threshold of EUR 50.[22] CRC includes data on loan amounts and key loan characteristics (maturity, currency, type of the loan, and the guarantee/collateral used to secure the loan, if any). CRC allows us to observe both drawn and potential credit (unused credit lines, credit cards, etc.). The analysis uses all outstanding loans granted by banks to non-financial firms residing in Portugal and borrowing in euro currency between June 2011 and June 2012. In the core part of the analysis, we focus on private non-financial firms with multiple bank borrowing relationships. This accounts for almost 1.5 million (bank-firm-month observations) and 116,918 bank-firm relationships (see Internet Appendix Table H1).

Firm-level data. Firm-level annual census contains balance sheet and financial reports as well as regional and sectoral classification of firms. We use this information to control for firm characteristics (total assets, employment, age, industry, and district) as a substitute to firm fixed effects. In addition, we use firm-level investment for the analysis of the real outcomes. Finally, we also use employee-employer (Quadros de Pessoal) data matched with the credit registry to study the effects on employment at the firm-establishment level.

3 Empirical strategy

3.1 Measuring exposure to the reduction in LOLR uncertainty

Haircut subsidy. We use the size of the haircut subsidy to measure banks' exposure to LOLR policy uncertainty. We construct a measure of ECB haircut subsidy at the bank level as a difference between the ECB and the private market valuation of all pledged securities

for observable bank characteristics such as size, equity ratio, capital ratio, liquidity ratio, loan-to-assets ratio, and equity-to-assets ratio. We restrict the analysis to domestic banks and domestic subsidiaries of foreign banks. This leaves us with a final sample of 30 banks.

[22] We exploit the universal coverage of micro-level credit data of firms. This provides an extremely rich data for small and medium enterprises (SMEs) which tend to be underrepresented in other countries.

normalized to bank's total assets:[23]

$$\text{HaircutSubsidy}_i = \frac{\sum_s \Big((\text{ECB valuation}_s - \text{private market valuation}_s) \times Q_{i,s} \Big)}{\text{total assets}_i}.$$

This measure captures bank's total haircut subsidy taking into account the difference in the two valuations of its securities pledged with the ECB. For each security s (reported at ISIN-level), we retrieve the official ECB haircut-adjusted valuation and the private market (LCH-Clearnet) valuation. $Q_{i,s}$ represents the total before-haircut value of the security pledged by bank i with the ECB. To minimize endogeneity, we construct the exposure measure as of September 2011, three months prior to the policy announcement. This measure of exposure captures a hypothetical reduction in borrowing capacity in the extreme case of complete reliance on private repo market. Banks with a larger haircut subsidy are the ones that benefited more from the reduction in policy uncertainty.

Table 1 shows that the average haircut subsidy prior to the vLTRO in 2011 was 2.48% of total assets. Out of a total of 30 banks, 15 banks do not pledge securities with the ECB and we label these banks as control banks. In addition, we observe a large cross-sectional variation in the haircut subsidy at the bank level (standard deviation is 3.91%).[24]

In the baseline analysis we use the exposure measure as a continuous variable as it allows us to capture the fact that the higher the haircut subsidy the stronger the effects for a given bank. As a robustness, we compare lending outcomes using a dummy exposure by splitting banks into exposed (treated) and non-exposed (control). In Internet Appendix Table C1, we also compare averages of bank's observables between these two groups of banks.

We show that exposed banks are on average larger and hold more securities. The two

[23] Our baseline measure of haircut subsidy is constructed using only securities pledged with the ECB. In the Internet Appendix Table B2, we consider an alternative measure of haircut subsidy based on all eligible securities held by each bank (both pledged and not pledged with the ECB). Our results remain robust to this alternative specification.

[24] In Internet Appendix Figure H1 we also illustrate the cross-sectional variation of the haircut subsidy at the bank level as of September 2011.

groups do not differ across other dimensions such as cash holdings, capitalization, profitability or leverage.[25]

Alternative measures of exposure. In addition to the haircut subsidy, we also construct three other measures of banks' exposure to the reduction in LOLR policy uncertainty. First, we measure exposure as the sum of all short-term ECB funding taken up by a bank as of September 2011 and normalized to total assets. This measure captures the fact that banks primarily swapped their existing short-term ECB funding into the newly offered long-term funding. Second, we construct a measure of exposure that captures total bank borrowing capacity with the ECB as the value of total banks' security holdings eligible as collateral with the ECB (scaled to total assets). Third, we consider a more refined measure of the latter exposure by focusing only on bank holdings of eligible securities that mature in an horizon between one and three years. By lengthening the maturity of repo operations to three years, the ECB implicitly decreased rollover risk for the funding backed by securities that matured shortly before the vLTRO expiration. In other words, banks did not need to be concerned about the price volatility of these securities at the time of the vLTRO repayment and as a result, they would not need to face fire-sale risk due to rollover issues.[26] Table 1 contains summary statistics also for these alternative measures of exposure.

3.2 Empirical specification

We use the difference-in-differences (DID) framework to compare lending before and after the policy intervention by exploiting the variation in the cross-section of banks' exposure to the LOLR policy uncertainty. We examine the time series evolution of credit at the

[25]The difference in security holdings confirms the fact that banks must hold securities to be able to benefit from the haircut subsidy. Instead, the difference in bank's size is directly related to the fixed cost of establishing an infrastructure to borrow from the ECB (for example a trading desk). Smaller banks may not find it beneficial to bear this fixed cost. For further discussion of differences in observables see Internet C.

[26]For more details regarding the construction of these measures see Internet B.

bank-firm-month level following the baseline specification:

$$log(credit_{i,j,t}) = \alpha_{jt} + \alpha_{ij} + \beta(\text{HaircutSubsidy}_i \times Post_t) + \epsilon_{i,j,t}, \quad (1)$$

where $log(credit_{i,j,t})$ is log amount of all credit that firm j obtains from bank i at month t. In the main analysis we focus on drawn credit. $HaircutSubsidy_i$ denotes our baseline exposure to LOLR policy uncertainty - i.e. the size of haircut subsidy for a bank i. We analyze a 13-month period: June 2011–June 2012. $Post_t$ is a dummy variable that takes the value of one in the post-period (February–June 2012), and zero otherwise. We end our baseline sample period in June 2012 to avoid the overlap with the announcement of the Outright Monetary Operations (i.e., the "whatever it takes" speech of the president of the ECB Mario Draghi) in July 2012.

We saturate our model with fixed effects to address some of the main empirical challenges. First, a potential bias in estimating the causal effects of the reduction in central bank policy uncertainty can stem from the interaction between credit demand and supply. In line with Khwaja and Mian (2008), we incorporate firm-time fixed effects to absorb time-varying firm-specific changes in credit demand and isolate the causal effect of the policy by comparing lending outcomes of the *same firm* (j) borrowing in the same month (t) from at least two differently exposed banks.

Second, the bank-firm matching is not random as banks choose their borrowers (and vice-versa). Firm borrowing relationships can also be of a different quality across different banks (i.e., due to different lengths of the relationship, existence and quality of collateral). We address the potential bias related to the non-exogenous bank-firm matching by including bank-firm fixed effects that absorb any time-invariant bank-firm variation. Additionally, bank-firm fixed effects nest inside bank fixed effects and absorb any observable and unobservable time-invariant bank characteristics that could be potentially correlated with our exposure measure. To summarize, our empirical specification relies on a combination of

firm-time and *bank-firm* fixed effects (equation (1)). The main results are presented for non-financial firms and non-profits which we denote as *Private NFCs*. We also report results for a larger sample of firms that includes self-employed entrepreneurs and public companies denoted as *All firms*.

We examine the existence of parallel trends by comparing lending dynamics of exposed and non-exposed banks in the period leading up to the policy intervention using a dynamic difference-in-differences specification:

$$log(credit_{i,j,t}) = \alpha_{jt} + \alpha_{ij} + \sum_{k \neq 2011m9} \beta_k (\mathbf{1}_{i=exposed} \times \mathbf{1}_{t=k}) + \epsilon_{i,j,t}, \quad (2)$$

where $\mathbf{1}_{i=exposed}$ is one if banks were exposed to the reduction in LOLR policy uncertainty (i.e. they benefited from a haircut subsidy) and zero otherwise. $\mathbf{1}_{t=k}$ is an indicator that equals one in month t, and zero otherwise. To test for the absence of the pre-trend, estimates of β_k need to be statistically insignificant from zero until the policy announcement.

4 Loan-level results

4.1 Intensive margin: loan quantities

Table 2 presents the main result on the intensive margin using the specification in equation (1). Column (1) shows the results using the full sample of loans (bank-firm pairs). Here, we use bank fixed effects (to absorb any time-invariant bank characteristics) and time fixed effects. From Column (2) onward, we restrict the loan sample to firms that borrow from at least two banks at each month. We denote this as "multiple bank relationships". In Column (3) we replace the time fixed effects with firm-time fixed effects to absorb any variation from firm-level (demand) changes in line with Khwaja and Mian (2008). It is plausible that a firm has a different relationship with different banks. To address this challenge, in Column

(4) we introduce a set of bank-firm control variables. In our preferred specification shown in Column (5) we also saturate the model with bank-firm fixed effects to address any potential threat coming from a non-exogenous matching between banks and firms.

The coefficient estimate of β for all specifications is positive and statistically significant suggesting that the reduction in LOLR policy uncertainty triggered by the vLTRO had a positive impact on bank lending to firms.[27] As aggregate credit to firms in Portugal decreased during the period, we interpret the positive coefficient as a smaller contraction in lending by more exposed banks. In terms of economic significance, the coefficient estimate of 0.824 (Column (5) of Table 2) implies that a one standard deviation increase in bank exposure to the reduction in LOLR policy uncertainty (3.91 percent of total assets from Table 1) is associated with a 3.22 percent increase in lending on the intensive margin.

Our results suggest that a reduction of LOLR policy uncertainty had a positive effect on lending to firms. In particular, more exposed banks (i.e., those benefiting from a larger haircut subsidy) internalized the reduction in policy uncertainty and consequently reduced their lending by less. Our empirical evidence is consistent with the real option channel of policy uncertainty (see e.g. Bernanke, 1983). The option value of delaying banks' illiquid investments is high when uncertainty about the future availability of LOLR funding is high. Due to the lack of commitment by the central bank to provide unlimited liquidity for an extended period of time, banks preferred to wait and be more cautious with their lending. The introduction of the vLTRO reduced this uncertainty, decreased banks' option to wait and as a result incentivized them to no longer postpone their lending.

Comparing the estimates with and without firm-time fixed effects (Table 2 Columns (2) and (3)), we find that not controlling for the overall firm's credit demand overestimates the effect of the policy action on lending. The estimate decreases in magnitude when we introduce the firm-time fixed effects but it remains stable, positive and statistically significant. This

[27] The "Within R-squared" reported in Table 2 suggests that the reduction in LOLR policy uncertainty entailed in the ECB's vLTRO explains around 10% of the within bank-firm credit variation.

suggests that changes in uncertainty simultaneously affected firm demand and bank supply of credit. Thus, it is important to control for time-varying credit demand to disentangle the two forces and estimate the causal impact of uncertainty through the bank-lending channel.[28]

Alternative exposure measures. Internet Appendix Table B1 presents the intensive margin results using the other three alternative measures of exposure discussed in Section 3.1. The results are robust to the use of these alternative measures.

Robustness. We conduct a battery of tests to support our identification. Internet Appendix Table D1 shows the results of the baseline specification in equation (1) rewritten as a collapsed difference-in-differences (comparing average bank-firm credit in the pre- and post- periods) to derive estimates with more conservative standard errors.

Internet Appendix Table E1 presents a number of additional results. First, we show robustness to changes in the credit and firm definitions. Second, our results are unchanged if we only focus on the variation in the cross-section of exposed banks and are also robust when controlling for bank characteristics interacted with the POST dummy. Third, around the time of the vLTRO announcement, four banks were undergoing the stress tests conducted by the European Banking Authority.[29] Our results remain unchanged even when we exclude these banks from the sample. Finally, to corroborate the importance of our ex-ante measure of exposure in capturing the effects of the reduction in LOLR policy uncertainty, we document that estimates using the endogenous *vLTRO uptake* deliver results that are not significantly different from zero. This is because, differently from the haircut subsidy, the endogenous *vLTRO uptake* is not an ex-ante measure of exposure to the reduction in policy uncertainty. Thus, it could reflects a variety of reasons for banks' decisions regarding the newly available long-term liquidity, that are unrelated to the reduction in LOLR policy uncertainty.

[28] We report estimates using two-way clustered standard errors at bank-time and firm level, as it allows us to address the threat that firm-shocks can be serially correlated and also bank-time shocks (our source of variation) can be correlated across firms. Our results are robust to alternative clustering levels and we report these estimates in the Internet Appendix.

[29] A number of papers study the effects of the 2011 EBA shock on banks' balance sheets and the real economy (e.g. Blattner et al., 2019; DeGryse et al., 2019; Gropp et al., 2019).

Dynamic setup. Equation (1) provides a consistent estimate of β under the identifying assumption of parallel trends. In equation (2), we modify the empirical framework into a dynamic setup which allows us to examine the existence of pre-trends. Figure 2 presents the results. Consistent with the parallel trends assumption, the figure clearly displays no relation between haircut subsidy and lending dynamics until November 2011. After the policy announcement (December 2011), we observe statistically significant differences in lending behavior between exposed (treated) and unexposed (control) banks. The positive difference-in-differences coefficients need to be interpreted in the context of the ongoing sovereign debt crisis and financial deleveraging of the Portuguese banking sector. While the credit contraction continued for non-exposed banks, banks exposed to the reduction in LOLR policy uncertainty significantly slowed down the pace of the deleveraging.

Credit lines. One hypothesis that would lend support to the prompt lending response presented in Figure 2 is that exposed banks allowed firms to draw down on their existing credit lines.[30] To test this hypothesis, we extend the specification in equation 1 with a triple interaction term where $CreditLine_j$ takes the value of 1 if a firm had pre-approved potential credit prior to the vLTRO policy announcement and 0 otherwise. Table 3 Panel (a) Column (1) shows a stronger response to the reduction in LOLR policy uncertainty for firms with prior access to credit lines. Furthermore, Column (2) documents a decrease in potential (pre-approved but unused) credit which is consistent with higher draw-downs. This is also reflected in higher utilization rates of credit reported in Column (3).[31]

Placebo test. Were banks more exposed to the 2011 vLTRO generally more prone to react to any bank-specific liquidity shocks? Iyer et al. (2014) show that that banks that relied

[30]In the credit registry data, we observe regular (drawn) credit as well as potential (pre-approved but unused) credit. As a firm draws from its credit line, the amount disappears from the potential credit category and appears in the drawn category. This data structure does not allow us to directly examine the amount and change in the credit line limits but it provides a reliable picture about the total utilization rates, amount of unused credit and overall credit dynamics.

[31]To avoid any confounding effect coming from the fact that as a reaction to the vLTRO banks could also increase the limits on credit lines, we compute the utilization rates as a share of total credit drawn in month t to total available credit in September 2011.

more on the interbank borrowing decreased their credit supply by more, following the sudden freeze of the European interbank market in August 2007. Thus, we use the 2007 liquidity freeze as a placebo sample to investigate whether the banks more exposed to the reduction in LOLR policy uncertainty in 2011 were also more sensitive to the 2007 liquidity dry-up. We follow the dynamic setup specification from equation (2) and replace the left-hand-side lending outcomes in 2011–2012 with the lending outcomes in 2007. Internet Appendix Figure F1 shows no evidence that the banks more exposed to the 2011 reduction in LOLR policy uncertainty are generally more sensitive to liquidity shocks.

4.2 Intensive margin: loan maturities

According to the real option channel, in response to a decrease in LOLR policy uncertainty, banks should invest more in illiquid and irreversible investments. In the previous sections, we have already shown that with the introduction of the vLTRO, more exposed banks extended larger quantities of loans. In this section, we test whether the reduction in LOLR uncertainty also made banks choose to grant loans of longer maturity, i.e. more irreversible.

In the credit registry data, we observe the loan maturities reported using maturity baskets (1–90 days , 90–180 days etc.). We construct a continuous measure of loan maturity in two steps. First, we approximate the maturity of the loan as a mid-point of a basket interval. Second, as a firm may have multiple loans outstanding with the same bank, we compute the weighted average of the loan maturity at the bank-firm-time level using loan sizes as weights.

We estimate the effect of the reduction on LOLR policy uncertainty on loan maturities by modifying the equation (1) in a following way:

$$\text{Loan maturity}_{i,j,t} = \alpha_{jt} + \alpha_{ij} + \beta(\text{HaircutSubsidy}_i \times Post_t) + Q_{i,j,t} + \epsilon_{i,j,t}. \tag{3}$$

where $Q_{i,j,t}$ denotes bank-firm and loan controls. Table 3 Panel (b) displays a positive and statistically significant coefficient β suggesting that the reduction in LOLR policy uncertainty

had a positive effect on the maturity of banks' loans to firms. Consistently with the real option channel, banks more exposed to LOLR uncertainty were more likely to offer longer maturities on their loans in the post period. Thus, as the uncertainty about availability of the future LOLR funding resolves, exposed banks invest more into long-term and irreversible projects.

4.3 vLTRO and LOLR policy uncertainty

In this section, we provide evidence in support of our argument that the vLTRO was associated with a sudden reduction in LOLR policy uncertainty. The vLTRO allowed banks to access LOLR funding of longer maturity in times of a sizable gap between the ECB and private market security haircuts. We argue that the presence of a high haircut subsidy is a necessary condition for changes in the maturity of LOLR funding to reduce uncertainty for banks and have real effects. In the absence of a high haircut subsidy, uncertainty about the future availability of LOLR liquidity is not expected to have a large effect on the borrowing capacity of banks and thus on their lending behavior. This is because borrowing on the private repo markets is not substantially more costly than borrowing from the central bank. Therefore, we argue that the size of the haircut subsidy is a valid measure of bank exposure to LOLR policy uncertainty.

To test this argument, we study the bank-lending response to a long-term liquidity operation (LTRO) introduced in 2009, in a period of low exposure to the LOLR policy uncertainty. Similarly to the vLTRO, the 2009 LTRO offered banks to borrow from the ECB at a long-term (one-year) maturity at the same conditions as if the banks continued to borrow short-term. In 2009, however, the ECB haircuts were closely following the private market haircuts (Figure 1 Panel (d)). The average haircut subsidy of Portuguese banks in 2009 was 0.01% of total assets. This is of a negligible magnitude compared to the average haircut subsidy of 2.48% in 2011. As a result, even in the case of a sudden stop of the LOLR funding

in 2009, banks could switch to borrow from the private market without suffering a large drop in their borrowing capacity. Thus, in 2009 banks were substantially less exposed to LOLR policy uncertainty.

We examine the effects of the policy change on bank lending over the period January 2009–Apr 2010. Table 4 summarizes the results. Column (1) shows that the lending effect of 2009 LTRO is not statistically significant from zero.[32] The lengthening of the maturity of the LOLR funding does not have an effect on bank lending in the 2009 period of low haircut subsidy. This suggests that for a lengthening of the maturity of central bank liquidity to stimulate bank lending, it needs to be associated with a large exposure of banks to LOLR policy uncertainty. Thus, a high haircut subsidy is a necessary condition for the policy change to have real effects.

4.4 Intensive margin and firm characteristics

Is the reduction in the LOLR policy uncertainty transmitted equally across firms? To address this question, we exploit the matching of the credit registry data with the firm census data and introduce firm heterogeneity in the baseline specification. Table 5 displays the estimates of the heterogeneous impact of LOLR uncertainty using a triple interaction specification:

$$log(credit_{i,j,t}) = \alpha_{jt} + \alpha_{ij} + \beta_1(\text{HaircutSubsidy}_i \times Post_t) + \beta_2(\text{HaircutSubsidy}_i \times Post_t \times F_j) + \epsilon_{i,j,t}, \quad (4)$$

where F_j denotes firm characteristics such as size, length of the bank-firm relationship and ex-ante firm riskiness. Column (1) of Table 5 shows a stronger positive effect of the reduction in LOLR policy uncertainty on small firms. This finding is consistent with the existing empirical evidence that emphasizes that small firms are more affected by shocks propagated

[32] For comparison with our baseline, we report our main result in Column (2) and show all estimates re-scaled using the respective standard deviations.

through the bank lending channel (Khwaja and Mian, 2008; Iyer et al., 2014).[33]

Column (2) of Table 5 illustrates a stronger positive effect for firms with a shorter (less than two-year) relationship with a bank. While the stronger results for firms with shorter lending relations mitigates concerns of ever-greening, it does not exclude the possibility that some of the credit went to bad investment projects. Table 5 Column (3) shows stronger lending effects for risky firms. We denote the firm as risky (one) if its z-score is above the median and zero otherwise.[34] Section 4.6 further explores bank risk-taking for new credit.

4.5 Extensive margin

Did the reduction in LOLR policy uncertainty entailed in the vLTRO affect banks' decision to terminate fewer loans? Is there any evidence that more exposed banks started to establish new lending relationships with previously unconnected firms? To address these questions, we study the effects of the policy action on the extensive margin.

Loan termination. To study the impact on loan terminations, we consider a collapsed version of the difference-in-differences framework where we compare bank-firm pairs in the pre-period (2011m6–2011m10) and post-period (2012m2–2012m6):

$$\text{EXIT}_{i,j} = \alpha_j + \beta \text{HaircutSubsidy}_i + \gamma B_i + \epsilon_{i,j}. \tag{5}$$

The sample includes all loans that were outstanding in the period prior to the vLTRO (2011m6–2011m10). EXIT dummy equals one if the loan only appears in the pre-period and

[33] This result is in line with the idea that banks benefiting from the ECB policy change may find it more profitable to loosen their credit standards and extend more credit to smaller borrowers, which are generally riskier and pay higher interest rate on their loan. This is consistent with our result on larger credit flow towards riskier firm and more broadly with the evidence on the risk-taking channel of monetary policy (e.g. Jimenez et al., 2014). In addition, with the intent to rebuild lending relationships, exposed banks may extend more credit to firms to which they had previously cut it by more. This rationale is consistent with the finding of Iyer et al. (2014) who show that Portuguese banks experiencing an interbank liquidity crunch at the onset of the global financial crisis cut lending by more towards small firms compared to large firms.

[34] We utilize the z-score measure for Portuguese firms by Antunes et al. (2016).

it does not exist in the post-period.[35]

Column (1) of Table 6 uses a combination of bank and firm controls. Column (2) replaces firm controls with firm fixed effects to investigate whether the loan exit results continue to hold after we control for firm observable and unobservable characteristics. Both results suggest that a 1 standard deviation increase in the exposure to the vLTRO (3.91 percent) decreases the exit rate by 8.76 percent (3.91×(-2.24)). This confirms the hypothesis that in a period of crisis, banks more exposed to a reduction in LOLR policy uncertainty are less prone to terminate relationships with firms which overall slowed down the pace of deleveraging.

New credit approvals. Were more exposed banks also more likely to start lending to new clients? We address this question by augmenting our dataset with the credit consultation data. Banks obtain records of new firms, by accessing the consultation database upon the firm's consent. We analyze all loan consultations after the policy announcement and match them with the actual entries in the credit registry. We construct a dummy variable $\text{ENTRY}_{i,j}$ which equals one if a bank-firm consultation entry is matched with a new bank-firm record in the credit registry, and zero otherwise.[36]

In the main analysis, we focus on consultations made between December 2011 and April 2012 and we match them with the credit registry outcomes in the period December 2011–June 2012. Roughly 10% of loan consultations are successful and appear in the credit registry as new loans.[37] We estimate the effects on the extensive margin using the following specification:

$$\text{ENTRY}_{i,j} = \alpha_j + \beta \text{HaircutSubsidy}_i + \gamma B_i + \epsilon_{i,j}. \tag{6}$$

Columns (3) and (4) of Table 6 show that the coefficient is very stable with or without firm FE. The results suggest that a 1 standard deviation increase in the exposure to the

[35] We only consider a sample of loans for which the maturity would not naturally end in the post-period.

[36] Our construction of the extensive margin is consistent with Jimenez et al. (2012, 2014) who study loan approvals in Spain. Spanish credit registry (CIR) has a similar data structure to the Portuguese CRC.

[37] If approved, the majority of the loans are granted within two months. We also perform robustness tests for changes in the consultation window and the results are not affected.

reduction in LOLR uncertainty increases the probability of a new relationship by 4.65 percent (3.91×1.19).[38]

4.6 Extensive margin and firm riskiness

New credit and *ex-ante* firm riskiness. How does new lending relate to bank risk-taking? Did risky firms benefit more from the reduction in LOLR policy uncertainty? To this end, we introduce triple interactions that capture differential outcomes for ex-ante risky firms:

$$\text{ENTRY}_{i,j} = \alpha_j + \beta_1 \text{HaircutSubsidy}_i + \beta_2(\text{HaircutSubsidy}_i \times RiskyFirm_j) + \gamma B_i + \epsilon_{i,j}. \quad (7)$$

Columns (5) and (6) of Table 6 show that exposed banks are more likely to establish new relationship with riskier firms. This is true whether we proxy for firm riskiness with z-scores or with firms recent loan delinquencies, measured as loan delinquencies in the past year.

Do these new relationships default more in the following years? To answer this question, we compare loan defaults in a full dynamic framework:

$$\text{loanDefault}_{i,j,t+2Y} = \alpha_i + \alpha_{ind,t} + \alpha_{reg,i} + \sum_{k \neq 2011q4} \beta_k(\text{HaircutSubsidy}_i \times \mathbf{1}_{t=k}) + \gamma Q_{i,j} + \epsilon_{i,j,t}. \quad (8)$$

For identification, we exploit the cross-sectional variation in banks' haircut subsidy and we compare defaults of observationally equivalent loans issued in different quarters. The latter are defined as loans of the same outstanding amount and purpose issued by the same bank to firms of the same size, region and industry. In the baseline, we report loan defaults within two years after the loan origination.

Figure 3 displays the differences in loan default rates between more and less exposed

[38] The main results are based on the linear probability models widely used in the literature (see Khwaja and Mian, 2008; Jimenez et al., 2012). Logit and probit specifications provide very similar results. Results available upon request.

banks. In 2011, there is no relation between exposure and default rates, consistent with parallel trends. In the two quarters following the policy (Q1–Q2 2012), more exposed banks are more likely to grant new credit to firms that default on these loans more within the next two years. This difference dies out already in mid-2012, suggesting that more exposed banks loosened their lending standards only temporarily after the policy action. This finding suggests that the risk-taking channel previously documented for monetary policy (e.g. Jimenez et al., 2014; Heider et al., 2019) is also present in the case of the LOLR policy.

5 Firm-level results

5.1 Credit

In what follows, we explore whether the loan-level results presented above translate into economically relevant firm-level credit outcomes. A valid concern is that as firms received more funding from more exposed banks, their borrowing from other less exposed banks could have been reduced by the same proportion (i.e. a zero-sum outcome). This would imply insignificant firm-level credit effects.

Firm-level credit. In order to measure the net firm-level credit effects, we collapse credit registry loan-level data to the firm level and estimate the following equation:

$$\Delta log(y_j) = \alpha + \beta \overline{\text{HaircutSubsidy}}_j + \gamma \overline{B_j} + \delta \overline{Q_j} + \mu F_j + \epsilon_j. \tag{9}$$

The outcome variable is the change in the log value of total credit received by a firm j from all the banks it borrowed between the pre- and post- period. For each firm, we compute an indirect exposure to the reduction in LOLR uncertainty. The firm's exposure measure is given by the weighted average of the haircuts subsidy of each bank (to which the firm is connected). The weights are based on the firm' credit with each individual bank in the pre-

period:

$$\overline{\text{HaircutSubsidy}_j} = \frac{\sum_i(\text{HaircutSubsidy}_i \times credit_{i,j,t=pre})}{\sum_i(credit_{i,j,t=pre})}.$$

We repeat the same procedure for computing indirect measures of bank and bank-firm control variables (denoted as $\overline{B_j}$ and $\overline{Q_j}$). Finally, equation (9) controls for firm size and industry-district fixed effects. The firm-level estimates are consistent with the results reported on the loan level (see Column (1) of Table 7). Firms borrowing more from exposed banks experienced a less sizable contraction in credit than firms more connected to non-exposed banks. In addition, the reduction in uncertainty had strong credit supply effects on the loan level that translated into positive net effects on firm-level credit.[39]

Are the aggregate credit effects economically relevant? The reduction in LOLR uncertainty reduced the pace of the lending contraction at the aggregate firm-level during the period of the sovereign debt crisis in Portugal. Within the partial equilibrium setting, we plug the bias-corrected credit estimates into equation (9) and compare the predicted aggregate firm-level credit with the policy ($\beta = 0.644$) and without it ($\beta = 0$). The reduction in LOLR policy uncertainty triggered by the vLTRO contributed to approximately EUR 892 mil in lending to firms in Portugal. By comparing the credit dynamics to a counterfactual world without any policy intervention, we can conclude that although the policy did not stop the ongoing credit contraction, it significantly reduced its pace. We estimate that without the policy, the credit would have contracted by additional 2.15 percentage points. This means that while the observed credit contraction in the period after the vLTRO was -5.75%, in the absence of the policy it would have been -7.90%.

[39] Due to the absence of the firm FE, equation (9) does not absorb any firm-specific shocks which can contribute to the bias in β estimate. To address this issue, we compute the bias-corrected coefficient as in Jiménez et al. (2019). The corrections cause the coefficient to drop by 35% but the final β estimate remains positive (0.644), suggesting that the effect of the policy change remains economically relevant also at the firm level.

5.2 Real effects: investment and employment

Are the lending effects to firms substantial enough to impact the real economy? We use the specification in equation (9) to study the capital investment and employment effects.

Investment. We measure $\Delta investment_j$ as the annual log change of investment using the firm census data. Column (2) of Table 7 shows that the average effect of firms' indirect exposure to reduction in LOLR uncertainty ($\overline{HaicutSubsidy_j}$) is positive and statistically significant. Further, Column (3) highlights that the effect on investment is stronger for small firms.

The impact of this policy on investment is economically sizable. While the observed investment between 2011 and 2012 fell by 18.5%, our estimates suggest that without the policy, firms' investment would have contracted by additional 2.2 percentage points.

Employment. Following the literature on employment dynamics (Davis and Haltiwanger, 1999; Chodorow-Reich, 2014), we aggregate the establishment-level data from the employee-employer database to the firm level and create a measure of symmetric growth rate in employment between 2011 and 2012:

$$\Delta employment_j = \frac{(employment_{2012,j} - employment_{2011,j})}{\frac{1}{2}(employment_{2012,j} + employment_{2011,j})}.$$

Column (4) of Table 7 shows that the effect on the employment of an average firm is statistically insignificant. As we however differentiate firms by size in Column (5), we find that the policy had positive effect on the employment in small firms.

In the data, we observe that the year-on-year aggregate employment contacted by 9.7%. Our estimates show that in the absence of the reduction in uncertainty, firms would have reduced their employment by additional 2 percentage points. The real effects on employment are entirely driven by the impact of the policy change on SMEs. Thus, thanks to the low reporting thresholds on loans in the CRC and the granularity of the Portuguese data, we are

able to uncover the real effects of a reduction in central bank policy uncertainty in terms of aggregate employment.[40]

6 Conclusion

This paper provides new empirical evidence in support of the lending and real effects of the sudden reduction in uncertainty regarding central bank liquidity policy. We exploit the ECB's vLTRO as a quasi-natural experiment of a sudden decrease in LOLR policy uncertainty and a novel granular dataset that perfectly matches the ECB monetary policy and market operations data, private repo market haircuts data, firm credit registry and banks' security holdings in Portugal. We find that banks more exposed to the reduction in LOLR policy uncertainty deleveraged at a slower pace. The reduction in policy uncertainty had a positive and economically sizable impact not only on lending but also on real outcomes.

Our results have several interesting policy implications. First, we show that policy aimed at reducing policy uncertainty in times of crisis can be effective in reviving credit and real economy. Second, we highlight the importance of central bank commitment and long-horizon guidance concerning the future course of its policy actions in the context of the LOLR policy. Third, we provide new insights into the transmission channel of LOLR policy to bank lending and real economic outcomes.

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[40] Our results are subject to two caveats. First, our estimates are based on an aggregation of the effects computed at the firm level in the partial equilibrium setup. Consequently, they represent a lower bound on the actual effects. Second, the results may also underestimate the true effects of the reduction in LOLR policy uncertainty as we only consider a period of 1 year after the vLTRO. We used this limited time span due to other policy actions by the ECB post 2012. While it is plausible that the real effects might take more time to materialize, it would be challenging to compute long-term effects that abstract from other confounding factors.

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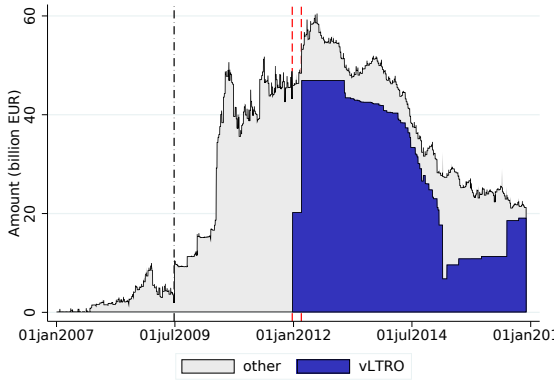
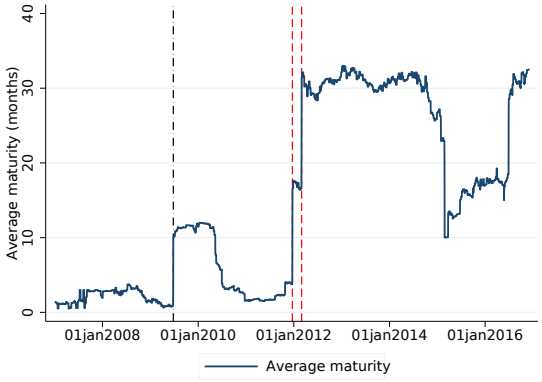
Figure 1: ECB liquidity provisions

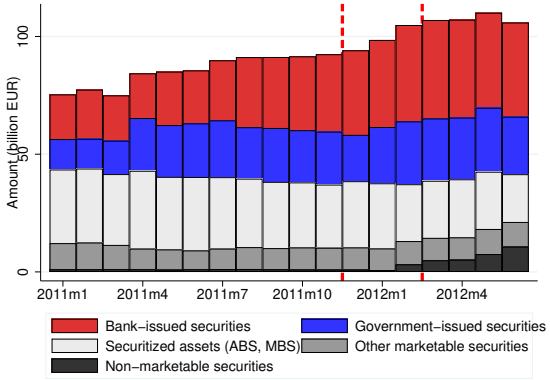
(a) Liquidity provisions (amount)



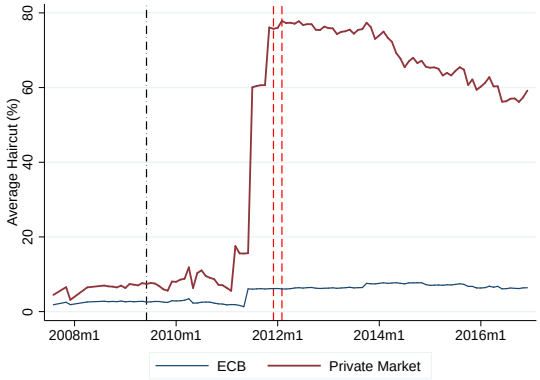
(b) Liquidity provisions (maturity)



(c) Security pledging

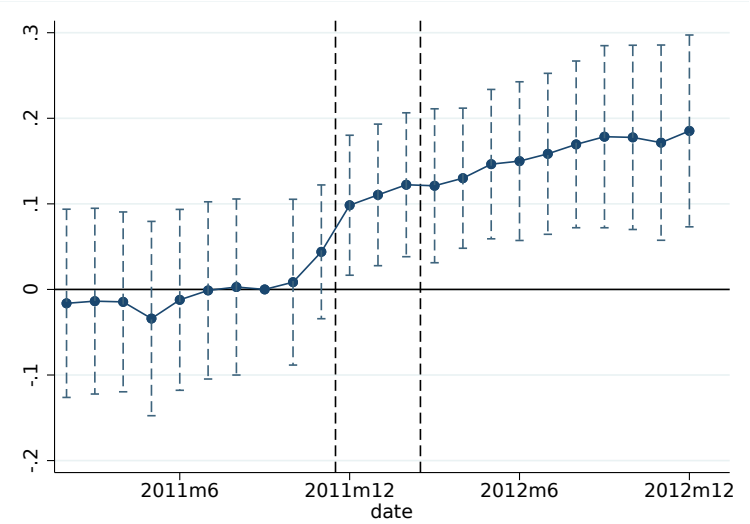


(d) Security haircuts



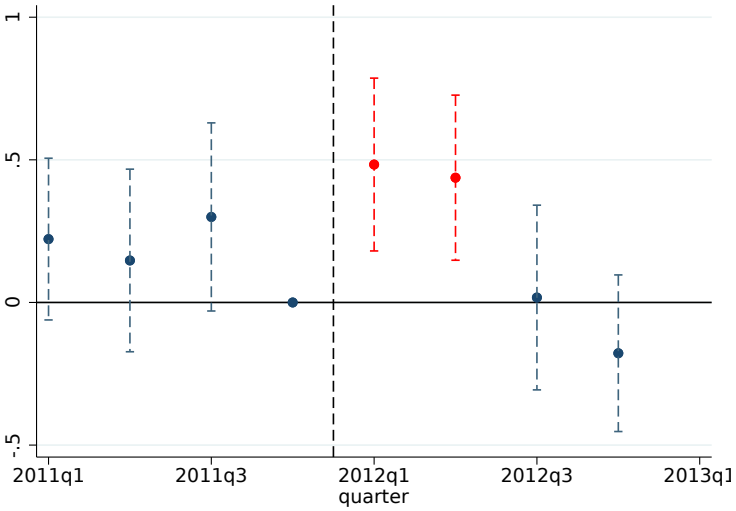
Panel (a) shows the ECB liquidity by maturity. *vLTRO* includes the vLTRO (2011–2014) and T-LTRO (from 2014 onward), *other* denotes liquidity operations with a maturity below 3 years. Panel (b) plots the average maturity of banks' liabilities with the ECB. Panel (c) plots the evolution security pledging with the ECB split by types. All marketable securities are reported in book values. Non-marketable securities use internal ECB valuation. Panel (d) shows the evolution of the average private market and ECB haircuts for securities pledged by Portuguese banks with the ECB. Vertical red (black) dashed lines denote the 2011 vLTRO (2009 LTRO) period.

Figure 2: Lending outcomes using dynamic difference in differences



This figure presents coefficient estimates of β_k for each month from equation (2). Vertical bands represent +/- 1.96 times standard error of each point estimate. Dashed lines indicate the vLTRO period. Standard errors are two-way clustered at the bank-time and firm level.

Figure 3: Defaults of new loans



This figure presents coefficient estimates of β_k for each quarter from equation (8). Estimates in red color refer to the periods of high defaults of new loans following the reduction in LOLR policy uncertainty induced by the vLTRO. Vertical bands represent +/- 1.96 times standard error of each point estimate. The dashed line shows the policy announcement. Standard errors are clustered at the industry level.

Table 1: Summary statistics of bank characteristics

		N	Mean	S.D.	p25	p50	p75
Main exposure measure:							
Haircut subsidy 2011	% Assets	30	2.48	3.91	0	0.05	3.78
Haircut subsidy 2009	% Assets	33	0.01	0.05	0	0	0.001
Alternative exposure measures:							
Total ECB liquidity	% Assets	30	5.9	8.4	0.0	1.1	9.2
Eligible securities	% Assets	30	9.2	11.5	0.0	5.1	13.9
Eligible securities (1-3Y)	% Assets	30	2.2	3.6	0.0	0.1	2.8
Other bank observables (as of September 2011):							
Total Assets	bn EUR	30	16.9	32.7	0.6	1.9	11.1
Cash reserves	% Assets	30	0.7	0.9	0.0	0.5	1.1
Loans	% Assets	30	47.4	27.6	25.5	43.0	69.2
Deposits	% Assets	30	33.3	29.5	4.4	33.6	50.4
Leverage	Liab/Equity	30	13.6	12.1	6.6	11.0	14.6
Capital ratio	Capital/RWA	30	11.2	16.3	8.8	10.3	14.4
ROA	Profit/Assets	30	0.4	2.6	-0.3	0.0	0.4
Equity	% Assets	30	13.8	15.8	6.4	8.4	13.2

Table 2: Intensive margin: baseline version

	$log(credit_{i,j,t})$				
	(1)	(2)	(3)	(4)	(5)
HaircutSubsidy$_i$ × Post$_t$	1.078***	1.188***	0.874***	0.820***	0.824***
	(0.202)	(0.194)	(0.179)	(0.182)	(0.154)
Time FE	Yes	Yes			
Bank FE	Yes	Yes	Yes	Yes	
Firm-Time FE			Yes	Yes	Yes
Bank-Firm controls				Yes	
Bank-Firm FE					Yes
Observations	2,914,218	1,487,089	1,487,089	1,487,089	1,487,089
Overall R^2	0.0674	0.123	0.737	0.916	0.996
Within R^2	0.001	0.001	0.0615	0.609	0.101
Loan Sample	Full	Multiple bank relationships			

This table presents coefficients from regressions related to loan-level intensive margin, as described in equation (1). The dependent variable is log credit drawn by a non-financial firm j from bank i in month t. Bank-firm controls include the length of bank-firm relationship, indicator whether the loan is secured by collateral and share of loan size to total firm credit which controls for the importance of the lending relationship. Standard errors are two-way clustered at the bank-time and firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Intensive margin, credit lines and loan maturities

(a) Credit lines

	Drawn credit (1)	Potential credit (2)	Utilization rates (3)
HaircutSubsidy$_i$× Post$_t$	0.663***	-1.114**	0.694***
	(0.118)	(0.500)	(0.123)
HaircutSubsidy$_i$× Post$_t$× CreditLine$_j$	0.215*		
	(0.120)		
Firm-Time FE	Yes	Yes	Yes
Bank-Firm FE	Yes	Yes	Yes
Observations	1,487,089	1,487,089	1,485,260
Overall R^2	0.996	0.959	0.829
Within R^2	0.103	0.053	0.084

(b) Loan Maturities

	Loan maturity$_{i,j,t}$				
	(1)	(2)	(3)	(4)	(5)
HaircutSubsidy$_i$× Post$_t$	1.061	1.561***	1.005**	1.294***	2.196***
	(0.184)	(0.0889)	(0.403)	(0.378)	(0.299)
Loan controls	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes			
Bank FE	Yes	Yes	Yes	Yes	
Firm-Time FE			Yes	Yes	Yes
Bank-Firm controls				Yes	
Bank-Firm FE					Yes
Observations	2.056,111	968,463	968,463	968,463	967,555
Overall R^2	0.114	0.114	0.556	0.568	0.970
Within R^2	0.062	0.047	0.084	0.122	0.098
Loan Sample	Full	Multiple bank relationships			

Table (a) examines the role of credit lines. The dependent variable *Drawn credit* refers to the main outcome variable in the previous analysis - $log(credit_{i,j,t})$ - the log credit drawn by a non-financial firm j from bank i in month t. *Potential credit* is defined as (log(potential credit$_{i,j,t}$ + 1) where potential credit denotes a sum of all unused credit lines between firm j and bank i at month t. *Utilization rate* is a share of drawn credit to total approved credit (i.e. the sum of potential credit and drawn credit). Total credit in the denominator is expressed as of September 2011. Table (b) presents coefficients from regressions described in equation (3). The dependent variable is the maturity of drawn loans. Loan controls include bank-firm log credit. Bank-firm controls include the length of bank-firm relationship, dummy whether the loan is secured by collateral, and share of loan size to total firm credit. Standard errors are two-way clustered at the bank-time and firm level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Comparison of lending outcomes in the periods of low and high haircut subsidy

	$log(credit_{i,j,t})$	
	Low-haircut subsidy enviroment 2009 LTRO	Main sample 2011 vLTRO
	(1)	(2)
2009 HaircutSubsidy$_i$× Post$_t$	8.795	
	(7.868)	
2011 HaircutSubsidy$_i$× Post$_t$		0.824***
		(0.154)
Effect per one std. deviation	*0.440*	*3.222* ***
Firm-Time FE	Yes	Yes
Bank-Firm FE	Yes	Yes
N	3,414,089	1,487,089
Overall R^2	0.977	0.996
Within R^2	0.006	0.101

This table presents coefficients from equation (1). The dependent variable is log credit granted to private non-financial firms in Portugal around the LTRO periods. Standard errors are two-way clustered at the bank-time and firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Intensive margin: heterogeneous outcomes by firm type

	$log(credit_{i,j,t})$		
	(1)	(2)	(3)
$\text{HaircutSubsidy}_i \times \text{Post}_t$	1.077***	1.309***	0.631***
	(0.192)	(0.236)	(0.183)
$\text{HaircutSubsidy}_i \times \text{Post}_t \times \text{FirmSize}_j$	-0.283**		
	(0.131)		
$\text{HaircutSubsidy}_i \times \text{Post}_t \times \text{RelationFirm}_j$		-0.481**	
		(0.199)	
$\text{HaircutSubsidy}_i \times \text{Post}_t \times \text{RiskyFirm}_j$			0.354***
			(0.107)
Firm-Time FE	Yes	Yes	Yes
Bank-Firm FE	Yes	Yes	Yes
Observations	1,166,299	1,166,299	896,268
Overall R^2	0.995	0.995	0.994
Within R^2	0.120	0.119	0.124

This table presents coefficients from regressions related to loan-level intensive margin and firm heterogeneities, as described in equation (4). All firm heterogeneities are dummy variables: $FimsSize_j$ is one if the firm's size is larger than a median firm, $RelationFirm_j$ takes a value of one if the bank-firm pair exists for at least 24 months prior to the vLTRO, $RiskyFirm_j$ is one if a firm's z-score is above median, $Default_j$ is one if a firm had had any delinquent loan with any bank in the part year, and zero otherwise. Standard errors are two-way clustered at the bank-time and firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Extensive margin: exit and entry

	$\text{EXIT}_{i,j}$		$\text{ENTRY}_{i,j}$			
	(1)	(2)	(3)	(4)	(5)	(6)
HaircutSubsidy_i	-2.45***	-2.24***	1.57*	1.19**	0.91	1.36
	(0.532)	(0.497)	(0.865)	(0.538)	(0.910)	(0.864)
$\text{HaircutSubsidy}_i \times \text{RiskyFirm}_j$					1.05***	
					(0.299)	
$\text{HaircutSubsidy}_i \times \text{DefLoan}_j$						1.77***
						(0.617)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes		Yes		Yes	Yes
Firm FE		Yes		Yes		
Observations	284,179	274,605	49,361	31,873	37,612	49,287
Overall R^2	0.25	0.53	0.06	0.47	0.07	0.07
Within R^2	-	0.24	-	0.02	-	-

This table presents coefficients from regressions related to loan-level extensive margin, as described in equations (5), (6) and (7). For a given loan, EXIT is classified as one if the loan is not renewed and the bank-firm relationship ceases to exist in the post-period. ENTRY equals one if a bank-firm loan consultation entry is matched with the new bank-firm loan in credit registry, and zero otherwise. $RiskyFirm$ takes the value of 1 if the firm's z-score is above the median z-score, and 0 otherwise. $DefLoan$ takes the value of 1 if the firms as defaulted on any loan in the past year, and 0 otherwise. Bank controls include $ln(TA)$, $CapitalRatio$, $LiqRatio$, $Equity/TA$ and $Loans/TA$. Firm controls include log of firm's total assets and industry-district fixed effects. Standard errors clustered at the bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Firm-level credit and real outcomes

	$\Delta log(credit_j)$	$\Delta investment_j$		$\Delta employment_j$	
	(1)	(2)	(3)	(4)	(5)
$\overline{\text{HaircutSubsidy}_j}$	1.031***	0.791**	0.429	-1.365	-6.230*
	(0.114)	(0.320)	(0.393)	(3.458)	(3.353)
$\overline{\text{HaircutSubsidy}_j} \times \text{SmallFirm}_j$			0.774**		11.31**
			(0.394)		(5.032)
Bias corr. $\overline{\text{HaircutSubsidy}_j}$	0.644				
Bank controls	Yes	Yes	Yes	Yes	Yes
Bank-firm controls	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Observations	138,225	73,493	73,493	89,176	89,176
R^2	0.0273	0.0291	0.0291	0.0129	0.0129

This table presents coefficients from regressions related to firm-level intensive margin, as described in equation (9). The dependent variable in Column (1) $\Delta log(credit_j)$ is a log change in total bank lending on the firm level between the pre- and post- period. Following Jiménez et al. (2019), we compute the bias-correct coefficient as :

$$\widehat{\overline{\beta_j}} = \widehat{\overline{\beta}}_{j,OLS} - (\widehat{\beta}_{OLS} - \widehat{\beta}_{FE}) \frac{var(\text{HaicutSubsidy}_i)}{var(\overline{\text{HaicutSubsidy}_j})} = 1.031 - (1.134 - 1.029) \frac{0.0391^2}{0.0204^2} = 0.644$$

Dependent variable in Columns (2)-(3) is an annual log change in firm investment and in Columns (4)-(5) the annual growth rate in employment. $\overline{\text{Bank controls}}$ denote indirect measures of $log(TA)$, $CapitalRatio$, $LiqRatio$, $Equity/TA$, $log(pre - LTROpledging)$ and $Loans/TA$. Firm controls include $log(TA_j)$ and industry-district fixed effects. Standard errors are clustered at the industry-district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Supplementary Material – Internet Appendix

Policy Uncertainty, Lender of Last Resort and the Real Economy

A ECB and Portuguese bank announcements

A.1 ECB speeches and policy announcements related to the uncertain future of fixed rate full allotment

One of the critical institutional aspects why the vLTRO is associated with the reduction in funding uncertainty is that the ECB did not credibly commit to keep the fixed-rate full allotment (FRFA) for longer than eight months in the period between 2008–mid 2012. This list of the ECB speeches and policy announcements shows how the regulators slowly moved the FRFA time horizons. Around the time of the vLTRO announcement, the ECB has *only* committed to keep the FRFA in place until at least the first half of 2012. The first long-term commitment to keep the FRFA in place for more than eight months occurred in July 2012 (half a year after the vLTRO) around the same period as Draghi's "Whatever it takes" speech related to the Outright Monetary Transactions (OMT).

- "The Governing Council decided to conduct them in the second quarter of 2011 on the same conditions as in the first quarter of 2011. This means that we will continue to apply fixed-rate tender procedures with full allotment in all our refinancing operations **at least until mid-July**." (Jean-Claude Trichet, March, 21, 2011)
- "On 6th October the Governing Council, in response to a worsening of liquidity tensions in the market, has committed to maintaining the FRFA policy **until the middle of July 2012**." (Jose Manuel Gonzalez-Paramo, October 21, 2011)
- "These measures address the risk that persistent financial markets tensions could affect the capacity of euro area banks to obtain refinancing over longer horizons. [...] in all refinancing operations until **at least the first half of 2012** all liquidity demand by banks would be fully allotted at fixed rate." (Mario Draghi, **December 19, 2011**)
- "The Eurosystem decided to maintain the FRFA procedure in all refinancing operations until at least **the end of June 2012**." (Vitor Constancio, April 25, 2012)

- "The Governing Council decided in June to continue conducting all refinancing operations as fixed-rate tender procedures with full allotment, **at least until mid-January 2013**." (Mario Draghi, July 9, 2012)
- "The Governing Council decided in December to continue conducting all refinancing operations as fixed rate tender procedures with full allotment, **at least until July 2013**." (Mario Draghi, December 17, 2012)
- "The Governing Council decided in May to continue conducting all refinancing operations as fixed-rate tender procedures with full allotment **at least until mid-July 2014**." (Mario Draghi, July 8, 2013)

A.2 Announcement of Portuguese banks related to the vLTRO

- "We also took the opportunity to borrow from the ECB at three years, which **made funding more stable and took pressure off the use of weekly borrowing operations**." (Caixa Economica Montepio Geral, Annual Report and Accounts, 2011)
- "By transforming the short-term financing with the ECB into 3 years, the Bank not only maintained a very comfortable position regarding permanent liquidity but also guaranteed the same position for the coming 2 years." (Banco Carregosa, Report & Accounts, 2011)
- "New ECB financing significantly increased the liquidity buffer and **improved financing structure** by replacing short-term maturities by long term funding." (Santander, Annual Report, 2011)
- "... **structural improvement in the profile of maturities**, substituting a part of its short term refinancing requirements by resources with a maturity of 3 years." (Caixa Geral de Depositos, Annual Report, 2012)
- "Banco Popolare's adhesion to ECB's three-year LTRO auctions **enabled the Group to stabilise its structural liquidity profile**." (Banco Popolare, Annual Report, 2012)
- "This **enabled the Group a very respectable liquidity profile** able to withstand the most severe stress tests, and made it possible for the LCR (Liquidity Coverage Ratio), envisaged by Basel III for 2015, to record a percentage of over 100%." (Banco Popolare, Annual Report, 2012)
- "This [LTRO] will **allow the cost of financing to be cut by improving its structure**." (CaixaBank, Management Report and Annual Financial Statements, 2011)

B Details about the alternative measures of exposure

The paper exploits the ex-ante variation in banks' exposure to the reduction in LOLR central bank uncertainty. In addition the the baseline exposure to the uncertainty proxied by the size of the haircut subsidy on securities pledged by Portuguese banks with the ECB, we also consider three alternative measures of exposure. Finally, we will also perform a robustness check based on an alternative haircut subsidy measure that takes into account all eligible securities held by banks.

First, we construct a liability-side measure defined as the sum of all the short-term ECB funding taken up by a bank as of September 2011 and normalized to its total assets:

$$\text{Existing ECB liquidity}_i = \frac{\text{total secured ECB borrowing}_{i,Sep2011}}{\text{total assets}_{i,Sep2011}}.$$

This measure captures the fact that the policy allowed banks to swap the existing short-term funding provided by the ECB into the newly available very long-term (three-year) funding while keeping all other margins unchanged (e.g., same eligible collateral, haircuts, interest rates). Thus, banks were able to costlessly increase the maturity of their liabilities and hence lower their uncertainty regarding the future stance of the LOLR policy. In the data, we observe that banks swapped on average 86% of their short-term funding into the three-year funding.

Second, we consider an asset-side measure that captures total bank's holdings of securities eligible as a collateral:

$$\text{EligibleSec Hold.}_i = \frac{\text{holdings of eligible securities (ECB haircut-adjusted value)}_{i,Sep2011}}{\text{total assets}_{i,Sep2011}}.$$

As banks need to pledge eligible collateral to participate in the LOLR funding, this measure directly captures the total borrowing capacity of a bank.[41] Exploiting the matching of the ECB data on collateral and haircuts with the Portuguese data on banks' security holdings, we derive the haircut-adjusted value of *all* eligible securities in bank's portfolio, regardless of whether they had been pledged with the central bank before or not.[42]

Third, while banks can pledge any eligible security as a collateral, the main benefit of the vLTRO is captured by securities that mature in the horizon of one to three years after the policy announcement. By lengthening the maturity of repo operations to three years, ECB implicitly decreased rollover risk for the funding backed by the securities that mature

[41] This approach is related to Rodnyansky2017 who study the lending impact of QE in the US.

[42] We use ISIN-specific haircuts applied by the ECB and compute the haircut-adjusted value of all eligible securities. In the data, we clearly observe over-collateralization. That is, bank utilize around 75% of their borrowing capacity and leave the rest as a buffer against sudden changes in asset prices and related margin calls. Importantly, we do not find any change in the over-collateralization rates around the policy dates.

shortly before the vLTRO expiration. In other words, banks do not need to be concerned about the price volatility of these securities at the time of the vLTRO repayment and as a result, they would not need to face fire-sale risk due to rollover issues.[43] As a result, we narrow down the previous exposure measure to the most relevant group of eligible securities:

$$\text{EligibleSec Hold. (1Y-3Y)}_i = \frac{\text{holdings of eligible securities, maturity} \in (1Y, 3Y)_{i,Sep2011}}{\text{total assets}_{i,Sep2011}}.$$

Table B1 presents the loan-level intensive margin results using three alternative measures of exposure. Figure B1 presents coefficient estimates from the dynamic differences-in-differences described in equation (2) for three alternative exposure measures.

Table B1: Intensive margin: alternative exposure measures

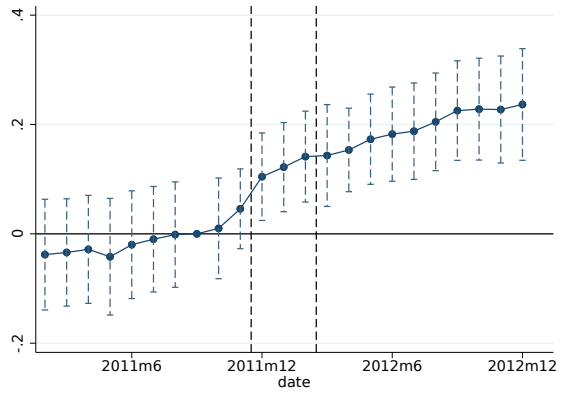
Exposure definitions	$log(credit_{i,j,t})$			
	Haircut Subsidy	Existing ECB Liquidity	EligSec Hold (All matur.)	EligSec Hold (1Y-3Y)
	Baseline		Robustness	
	(1)	(2)	(3)	(4)
$Exposure_i \times Post_t$	0.824***	0.631***	0.521***	0.530***
	(0.154)	(0.063)	(0.053)	(0.147)
Firm-Time FE	Yes	Yes	Yes	Yes
Bank-Firm FE	Yes	Yes	Yes	Yes
Observations	1,487,089	1,487,089	1,487,089	1,487,089
Overall R^2	0.996	0.996	0.996	0.996
Within R^2	0.101	0.106	0.095	0.087

This table presents coefficients from regressions related to loan-level intensive margin, as described in equation (1) for four measures of exposure. The dependent variable is log credit granted to private non-financial corporations in Portugal. Standard errors are two-way clustered at the bank-time and firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

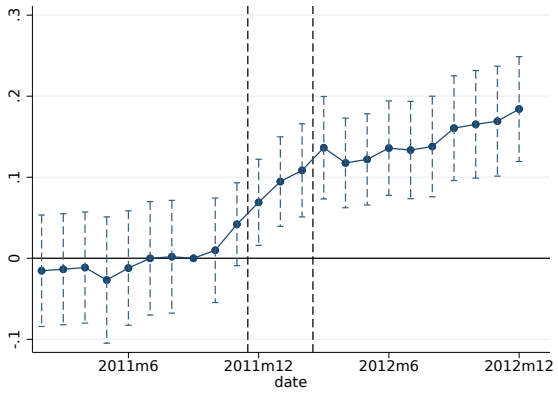
[43] There are three reasons why we focus on securities with remaining maturity of one to three years: (i) until the announcement the longest ECB operation had a maturity of one year, (ii) banks can repay vLTRO early but no sooner than one year after the allotment, and (iii) the full vLTRO maturity is three years.

Figure B1: Lending outcomes: robustness to other measures

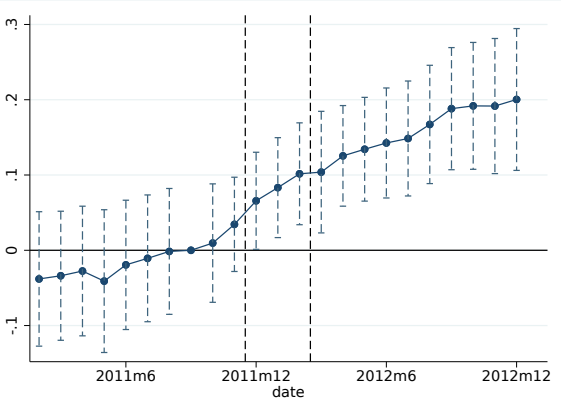
(a) ECB repo funding



(b) All eligible securities



(c) Eligible securities w/o rollover issues (1Y–3Y)



This figure presents coefficient estimates of β_k for each month from equation (2). We divide banks into two groups: exposed and non-exposed. Panel (a) denotes a bank as *exposed* if it was borrowing from the central bank in repo operations prior to the vLTRO announcement, and zero otherwise. Panel (b) defines *exposed* as one if a bank i was holding securities eligible as collateral prior to the policy announcement, and zero otherwise. Panel (c) set *exposed* to one if a bank i was holding securities with that it will not have to fire sell at the repayment date due to rollover issues (the remaining maturity of securities is between 1 and 3 years), and zero otherwise. Vertical bands represent +/- 1.96 times standard error of each point estimate. Dashed lines separate the vLTRO period. Standard errors are two-way clustered at the bank-time and firm level.

Pledged vs Eligible Securities. We also examine an alternative measure of haircut subsidy. While our baseline measure of haircut subsidy was computed for only securities pledged with the ECB, as a robustness we consider a haircut subsidy based on all eligible securities held by a bank (both pledged and not pledged with the ECB). Table B2 presents coefficients from the baseline regressions related to loan-level intensive margin, as described in equation (1), for two alternative measures of haircut subsidy. The results remain robust to the alternative specification of the haircut subsidy.

Table B2: Intensive margin: alternative definition of haircut subsidy

Exposure definitions	$log(credit_{i,j,t})$	
	Haircut Subsidy Securities Pledged with ECB	Haircut Subsidy Eligible Securities Held
	Baseline	Robustness
	(1)	(2)
$Exposure_i \times Post_t$	0.824***	0.871***
	(0.154)	(0.158)
Firm-Time FE	Yes	Yes
Bank-Firm FE	Yes	Yes
Observations	1,487,089	1,487,089
Overall R^2	0.996	0.996
Within R^2	0.101	0.100

This table presents coefficients from regressions related to loan-level intensive margin, as described in equation (1) for two alternative measures of haircut subsidy. Column (1) corresponds to the haircut subsidy computed for securities held by a bank and pledged with the ECB. Column (2) corresponds to the haircut subsidy computed for all *eligible* securities held by a bank (both pledged and not pledged with the ECB). Standard errors are two-way clustered at the bank-time and firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

C Differences in bank observables

Table C1: Comparison exposed and non-exposed banks

		Exposed banks		Non-exposed banks		Diff.
		Mean	S.D.	Mean	S.D.	
Total Assets	bn EUR	28.5	40.0	1.6	2.0	26.87**
Cash reserves	% Assets	0.7	0.5	0.7	1.3	0.0
Capital ratio	Capital/RWA	14.3	7.5	7.2	23.2	7.1
ROA	Profit/Assets	0.0	1.2	0.9	3.8	-0.9
Loans	% Assets	41.4	19.9	55.3	34.5	-13.9
Deposits	% Assets	30.7	17.7	36.8	40.8	-6.1
Leverage	Liab/Equity	13.0	9.4	14.4	15.3	-1.4
Equity	% Assets	11.6	10.8	16.7	20.8	-5.1
Security holdings	% Assets	28.0	15.4	8.1	12.4	19.9***

This table shows the means of the respective variables for the group of exposed and the group of non-exposed banks. We define exposed banks as ones which participated in the three-year vLTRO funding and non-exposed otherwise. All variables expect for are reported as of September 2011. Stars denote p-values for pairwise t-tests that test whether the mean is the same for the two groups of banks. *** p<0.01, ** p<0.05, * p<0.1.

Table C1 compares averages of bank's observable characteristics by splitting banks into two groups: exposed and non-exposed. We find that exposed banks are on average larger and hold more securities while they do not differ across other features such as cash holdings, capitalization, profitability or leverage.

The difference in size highlights that all non-exposed banks are relatively small (mean size is EUR 1.6bn with a standard deviation of EUR 2bn) while exposed banks are very heterogeneous (mean size is EUR 28.5bn with a significant standard deviation equal to EUR 40bn). The size difference is directly related to the fixed cost of establishing an infrastructure to borrow from the ECB (for example a trading desk). Smaller banks may not find it beneficial to bear this fixed cost. Furthermore, it is important to point out that while all large Portuguese banks fall into the exposed category (i.e., the dummy variable of exposed is equal to 1), the actual magnitude of the haircut subsidy (i.e., continuous measure of exposure) does not correlate with bank size.

Table C1 also shows that exposed banks on average hold more securities. The difference in terms of security holdings confirms the fact that banks must hold securities to be able to benefit from the haircut subsidy. In face, we exploit holdings of eligible securities as one of the alternative measure of exposure presented in Internet B and in the robustness exercise in the Internet Appendix Table B1.[44]

[44]Majority of securities holding of banks are in fact securities that are eligible for pledging with the ECB.

D Collapsed difference-in-differences

We collapse the time series information from equation (1) into a *pre-* (June–October 2011) and *post-* (February–June 2012) periods to derive more conservative standard errors :

$$\Delta log(credit_{i,j}) = \alpha_j + \beta \text{HaircutSubsidy}_i + \gamma B_i + \delta Q_{i,j} + \epsilon_{i,j}, \tag{10}$$

where $\Delta log(credit_{i,j})$ denotes the change in average bank-firm credit between the two collapsed periods. Unlike the baseline specification used in the main paper, the collapsed DID does not allow us to implement the rich set of fixed effects as in equation (1) and we therefore include a set of bank controls, B_i, (total assets, capital ratio, liquidity rate, equity/TA, and loans/TA) and bank-firm controls, $Q_{i,j}$, (the length of the bank-firm relationship and information about previous loan delinquencies in this relationship). We use firm fixed effects, α_j, to disentangle credit demand from credit supply and compare change in lending outcomes for a firm borrowing from at least two banks.

Table D1: Intensive margin: collapsed version

	$\Delta log(credit_{i,j})$				
	(1)	(2)	(3)	(4)	(5)
HaircutSubsidy_i	1.202**	1.235**	1.095**	1.134**	1.029***
	(0.499)	(0.480)	(0.506)	(0.477)	(0.348)
Bank Controls	Yes	Yes	Yes	Yes	Yes
Bank-Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Controls		Yes		Yes	
Firm FE					Yes
Observations	203,018	202,920	114,116	114,116	114,116
Overall R^2	0.0283	0.0460	0.0445	0.0650	0.467
Within R^2	-	-	-	-	0.0737
Sample	Full sample		Multiple bank relationships		

This table presents coefficients from collapsed regressions related to loan-level intensive margin, as described in equation (10). The dependent variable is the change in average log credit granted to private non-financial corporations before and after the vLTRO. Bank controls include $ln(TA)$, $CapitalRatio$, $LiqRatio$, $Equity/TA$ and $Loans/TA$. Firm controls include log of total assets of a firm j and industry-district fixed effects. Bank-firm controls include the length of the bank-firm pair and information about previous loan delinquencies in the bank-firm relationship. Standard errors clustered at the bank level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table D1 shows that our findings are robust to the collapsed DID which compares the average lending before and after the policy implementation following equation (10). While the

As are result there is very little difference between all security holding and eligible security holdings.

effects are quantitatively similar, we prefer to use the time-series specification as our baseline estimation since it allows us to absorb any observable and unobservable time-invariant bank-firm characteristics into fixed effects.

E Alternative credit, firms and bank variables

Table E1 shows that our findings are also robust to changes in the credit and firm definitions. Columns (2) and (3) show variations to the baseline. Column (2) reports results for the dependent variable measured as the log of total credit. We define total credit as a sum of drawn credit and potential credit (i.e., unused credit lines which are reported off-balance sheet). Our results are also robust to different definitions of firms. While the baseline results are reported for private non-financial corporations, we also extend the definition of firms to include public firms and individual entrepreneurs which leads to an increase of the sample by 900,000 additional observations (denoted as *All firms* in Column(3)).

A possible concern is that the banks that did not participate in the ECB's open market operations could be significantly different from the exposed banks. As exposed banks are on average larger and hold more securities.[45], In Column (4) of Table E1 we only focus on the variation in the cross-section of exposed banks and the results remain consistent.

Finally, Column (5) shows that results hold robust also when controlling for bank characteristics (i.e., log of total assets, capital ratio, liquidity ratio, equity ratio and loan-to-assets ratio) interacted with the POST dummy.

E.1 EBA stress tests

A potential threat to our identification strategy comes from other concurrent policy actions. Around the time of the vLTRO announcement, four banks were undergoing the stress tests conducted by the European Banking Authority. To examine if our results are robust to this potential confounding factor, we exclude these banks from our sample as a part of the robustness exercise. In Column (6) of Table E1 we drop these banks from our sample and the results remain robust.

[45] See Internet C for more details.

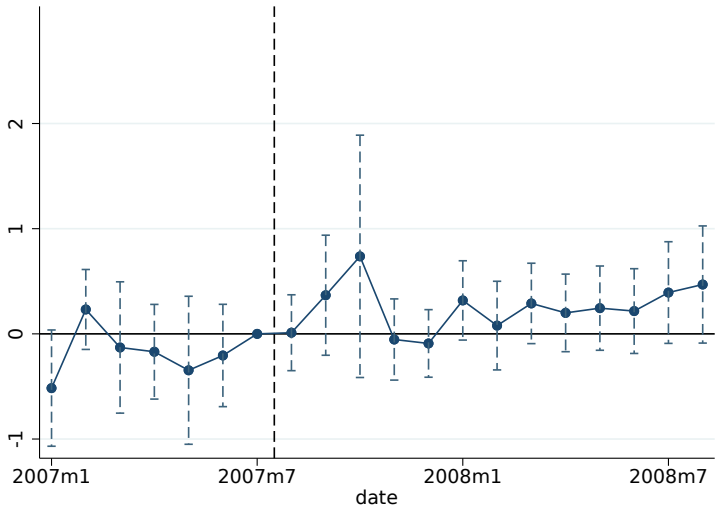
Table E1: Intensive margin: robustness

	Baseline	Total credit	All firms	Exposed banks	Bank Controls	EBA shock	Endogenous uptake
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\text{HaircutSubsidy}_i \times Post_t$	0.824***	0.885***	0.994***	0.610***	0.911***	2.018***	
	(0.154)	(0.146)	(0.130)	(0.222)	(0.258)	(0.243)	
$\text{vLTROuptake}_i \times Post_t$							0.167
							(0.411)
Firm-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,487,089	1,673,619	2,387,616	1,012,225	1,487,089	447,520	1,487,089
Overall R^2	0.996	0.996	0.996	0.996	0.996	0.991	0.936

This table presents coefficients from regressions related to loan-level intensive margin, as described in equation (1). Column (1) represents the baseline specification as shown in the last column of Table 2. The dependent variable is log credit granted to private non-financial corporations in Portugal. The exposure is defined as a sum of all available borrowing from the ECB as a share of total assets prior to the vLTRO. Columns (2)–(6) present variations to the baseline. Column (2) shows results for the dependent variable measured as a log of total credit (a sum of credit granted and potential credit). Column (3) extends the sample to all firms in Portugal, including not only private NFC but also independent entrepreneurs and publicly-owned companies. Column (4) focuses only on the variation across banks that were exposed to the ECB open market operations prior to the vLTRO (in September 2011). Column (5) introduces bank controls interacted with the POST dummy. Column (6) drops four largest banks which were subject to the stress test exercise conducted by the European Banking Association (EBA) around the same time as the vLTRO. Finally, Column (7) illustrates the null effect when using the measure of endogenous uptake of the vLTRO as a source of cross-sectional variation. Standard errors are two-way clustered at the bank-time and firm level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

F Placebo test

Figure F1: Placebo test: freeze of the European interbank market in August 2007



The figure uses an unexpected freeze of the European interbank market in August 2007 as a placebo test. The negative effects of the interbank liquidity crunch on lending in Portugal were previously shown by Iyer2014. This figure presents coefficient estimates of β_k for each month from equation (2). There is no evidence that banks more exposed to the vLTRO in 2011 were generally more sensitive to the liquidity dry-up in 2007 (the plotted estimates of β_k are not significantly different from zero). Vertical bands represent +/- 1.96 times standard error of each point estimate. Dashed line shows the European interbank market in August 2007. Standard errors are two-way clustered at the bank-time and firm level.

Internet Appendix Figure F1 uses the 2007 liquidity freeze as a placebo sample to investigate whether the banks more exposed to the reduction in funding uncertainty induced by the vLTRO policy in 2011 were also more sensitive to the 2007 liquidity dry-up. We follow the dynamic setup specification from equation (2) and replace the left-hand-side lending outcomes in 2011–2012 with the lending outcomes in 2007. If the 2007 and 2011 exposures were spuriously correlated, we would expect negative and statistically significant coefficients β_k after August 2007. Instead, we find that the plotted estimates of β_k are not statistically different from zero throughout 2007. We can conclude that there is no evidence that the banks more exposed to the 2011 reduction in bank funding uncertainty are generally more sensitive to liquidity shocks.

G Standard error clustering

Table G1 documents that our results are robust to alternative clustering either at the bank-time (i.e. unit of variations), bank and time and bank and firm level.

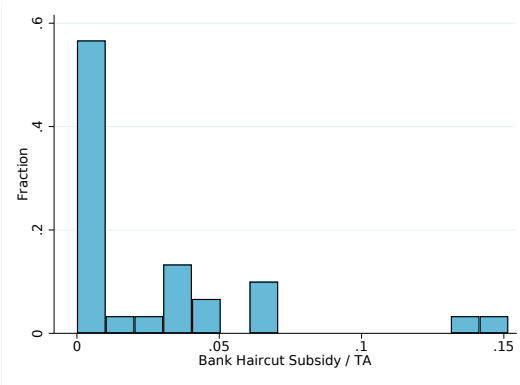
Table G1: Intensive margin: robustness to standard error clustering

S.E. Clustering	$log(credit_{i,j,t})$			
	Bank-Time and Firm	Bank-Time	Bank and Time	Bank and Firm
	(1)	(2)	(3)	(4)
HaircutSubsidy$_i$ × Post$_t$	0.824***	0.824***	0.824*	0.824*
	(0.202)	(0.202)	(0.462)	(0.457)
Bank-Firm FE	Yes	Yes	Yes	Yes
Firm-Time FE	Yes	Yes	Yes	Yes
Observations	1,487,089	1,487,089	1,487,089	1,487,089
Overall R^2	0.996	0.996	0.996	0.996

This table presents coefficients from regressions relating to loan-level intensive margin, as described in equation (1). The dependent variable is log credit granted to private non-financial corporations in Portugal. Clustered standard errors in parentheses. Level of standard error clustering is bank-time and firm, bank-time, bank and time, and and bank and firm, respectively. *** p<0.01, ** p<0.05, * p<0.1.

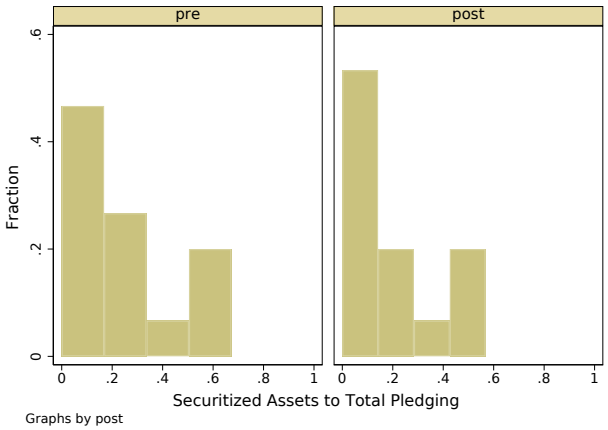
H Additional Figures and Tables

Figure H1: Cross-sectional variation in haircut subsidy at the bank level



This histogram shows the variation of haircut subsidy at the cross-section of banks in September 2011.

Figure H2: Cross-sectional variation in pledging of securitized assets



These histograms show the variation of securitized assets (as a share of total pledging) at the cross-section of exposed banks. 'Pre' denotes average pledging of each bank in the period prior to the vLTRO, i.e. Jun–Oct 2011 and 'Post' denotes average pledging of each bank in the period after to the vLTRO, i.e. Feb–Jun 2012.

Table H1: Summary statistics of loan characteristics

	N	Mean	S.D.	p25	p50	p75
	Baseline sample (Firms with multiple bank relationships)					
Drawn credit (baseline)	1,487,089	452,218	3,878,045	15,008	49,000	186,308
All credit	1,673,619	534,242	4,985,075	13,802	48,214	193,284
	Full sample of all firms					
Drawn credit	2,914,218	349,502	3,413,031	10,143	30,761	118,783
All credit	3,276,700	383,756	4,051,314	8,559	29,062	116,491

This table reports the summary statistics of monthly loan-level credit data for the period June 2011–June 2012 in EUR. Minimum reporting threshold is EUR 50. Drawn credit represents performing regular and renegotiated credit. All credit represents the sum of drawn credit and potential credit (i.e., unused credit lines).

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Martina Jasova
Barnard College, Columbia University, New York, United States; email: mjasova@barnard.edu

Caterina Mendicino
European Central Bank, Frankfurt am Main, Germany; Bank of Portugal, Lisbon, Portugal; email: caterina.mendicino1@ecb.europa.eu

Dominik Supera
Wharton School, University of Pennsylvania, Philadelphia, United States; email: superad@wharton.upenn.edu

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

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