
DOCUMENT
DE TRAVAIL
N° 540

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CAN THE PROVISION OF LONG-TERM LIQUIDITY HELP TO AVOID A CREDIT CRUNCH? EVIDENCE FROM THE EUROSISTEM'S LTRO

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Date: 7 May 2015, revised version (first version: 5 March 2015).

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Abstract: We exploit the Eurosystem's longer-term refinancing operations (LTROs) of 2011-2012 to analyze the effects that a large provision of central bank liquidity to banks has on the credit supply to firms. We control for credit demand by examining firms that borrow from several banks, in addition to controlling for banks' risk. We find that LTROs enhanced loan supply in France. Nevertheless, the transmission took place mostly with the first operation of December 2011, in which constrained banks bid more, and larger borrowers benefited more. The opportunity to substitute long-term central bank borrowing for short-term borrowing was instrumental in this transmission.

Keywords: unconventional monetary policy, bank lending channel, euro area, LTRO, credit supply. *JEL Classification:* C21, E51, G21, G28.

Résumé : Nous utilisons les opérations de refinancement long terme (LTROs) mises en oeuvre par l'Eurosystème en 2011-2012 pour analyser l'impact d'une fourniture large de liquidité banque centrale aux banques sur l'offre de crédit bancaire aux entreprises. Nous contrôlons pour la demande de crédit en conduisant l'analyse au niveau des relations de crédit banques-entreprises pour les entreprises multi-bancarisées et nous contrôlons également les effets d'autres facteurs d'offre de crédit à l'aide de variables de bilans bancaires. Nous trouvons que les LTROs ont eu un impact positif sur l'offre de prêts bancaires aux entreprises en France. Toutefois, la transmission n'a fonctionné qu'à la suite de la première injection de LTROs, à laquelle les banques les plus contraintes financièrement ont davantage soumissionné, et les plus gros emprunteurs en ont davantage bénéficié. La possibilité offerte aux banques d'échanger de la liquidité à court terme contre de la liquidité à plus long terme (3 ans) a joué un rôle clé dans cette transmission.

Mots-clés : politique monétaire non-conventionnelle, canal des prêts bancaires, zone euro, LTRO, offre de crédit. *Classification JEL:* C21, E51, G21, G28.

Non-technical summary

In this paper, we use the Eurosystem's 3-year longer-term refinancing operations (LTROs) to evaluate to what extent a central bank can revive credit by "pushing on the rope" of liquidity injections to the banking system. We build a unique dataset of bank-firm credit linkages as well as bank and firm balance sheet information for France. We show that banks that bid more to the LTROs did use this cheap and potentially unlimited funding source to lend more to non-financial corporations. In addition, taking advantage of a unique feature of this operation, namely the 3-year maturity at which the central bank liquidity was lent, we find that such a quantitative policy is more likely to succeed if the central bank lends at longer horizons.

The Eurosystem's LTROs represented a very large positive funding liquidity shock to the euro area's banking system. They were announced in early December 2011 and implemented in two separate rounds at the end of December 2011 and February 2012. The first round provided EUR 489 billion to 523 banks while the second one allotted EUR 530 billion to 800 institutions. The total liquidity injection increased the size of the Eurosystem's balance sheet by more than a fifth and amounted to 80 percent of the monetary base in the euro area, 20 percent of total bank credit to euro area firms and almost 11 percent of the area's nominal GDP. Furthermore, this money was lent for three years at a very low interest rate compared to the funding terms banks faced in wholesale markets at the time.

The LTROs were implemented in the context of the escalating sovereign debt crisis in the euro area, which dragged down the economic outlook. Against this backdrop, loan demand by firms was indeed likely to be depressed and firms' credit risk increased, even in a core euro area country like France which was not directly under financial stress. As a consequence, controlling adequately for firms' demand and risk is key for our purpose. We solve the usual problem of disentangling the demand for and supply of loans by exploiting the information contained in the French credit register run by the Banque de France, the French national central bank within the Eurosystem, which provides with a quasi-exhaustive sample of bank-firm credit relationships for France. Following the methodology of Khwaja and Mian (2008), we restrict our sample to firms that have credit relationships with at least two banks before the announcement of the policy measure. By including firm fixed effects in our regressions, we then compare the changes in the credit supplied to the same firm by two different banks which received different amounts of money in the Eurosystem's LTROs. This allows us to identify the impact of the LTROs on the supply of credit to non-financial corporations while controlling effectively for firm-specific characteristics that may affect their demand for credit or their intrinsic level of risk.

Another major difficulty in identifying the effect of this unlimited provision of liquidity is that banks were free to choose the amount of central bank liquidity they borrowed from the

Eurosystem. As a consequence, evaluating the causal impact of LTROs on the supply of bank credit also requires controlling for bank-specific factors that are likely to both impinge on their own credit supply to firms and affect their desired bid for central bank liquidity. We control for such factors by merging the detailed dataset obtained from the credit register with information on the balance sheets of banks, including in some specifications measures of the quality of banks' loan portfolios based on the credit ratings of customer firms. Overall, our measure of the effects of the LTROs on credit supply to firms is unlikely to be biased by the endogenous nature of banks' bids.

We first find that this provision of unlimited liquidity had a positive impact on credit supplied to firms. According to our baseline estimates, each EUR 1 billion of central bank money lent to the average bank holding company led to a EUR 95 million increase in the credit made available to the average firm over the 12-month period from September 2011 to September 2012. Importantly, we also find that this effect is almost exclusively associated with the first round of the LTROs, which took place before ECB's President Mario Draghi on 9 February 2012 publicly dismissed fears of any stigma that could be associated with a bank's bidding in these operations.

Second, we provide new insights about the benefits of providing central bank liquidity at longer horizons than what is usual in lender of last resort operations. The Eurosystem had been lending under a full allotment procedure since the subprime crisis intensified in October 2008, but before December 2011 its liquidity had been provided only at relatively short maturities of between one week and six months. What was new about the 2011 LTRO facility was that a potentially unlimited amount of central bank liquidity was for the first time lent at the long horizon of three years, which substantially reduced the uncertainty faced by banks about their ability to withstand future funding stress. It is therefore important to ascertain whether the possibility offered to banks to swap their short-term central bank borrowing for longer-term one mattered or not. We answer this question by disentangling the effects of the maturity swap associated with the LTROs and the effects of the increase in total borrowed reserves over the allotment period. We find confirmation that maturity was indeed important: the bulk of the stimulus to bank lending associated with take-ups in the first LTROs comes from a substitution of longer-term for shorter-term bank borrowing.

Third, we document distributional issues linked with the LTROs. More precisely, we look at the impact of the first LTRO round across firms of different sizes, as measured in terms of their total bank borrowing. We find that the LTROs mostly benefited firms in the upper decile of the borrowing distribution. For large individual firms, i.e., firms in the top 1 percent of the borrowing distribution, the benefit of being linked to a bank that borrowed via the ECB's LTROs is

3.5 times larger than for the average. In addition, we can also address some important distributional issues by interacting the LTRO variable with various firm characteristics other than firm size. We notably find that banking groups that borrowed via the ECB's LTROs tended to increase significantly less their lending to firms with whom they had a longstanding relationship (defined as a credit link that is more than three years old), suggesting that the measure did not predominantly favor ever-greening.

I. Introduction

Can central banks sustain private credit by pumping liquidity onto banks' balance sheets when the economy has slid into a deep recession? Since Keynes (1936) and Samuelson (1948) the conventional answer to this long-standing debate is that such "quantitative easing" (QE) policies become ineffective as the economy approaches a liquidity trap.¹ In the past few years, the effectiveness of such QE policies has started to be debated anew as major central banks implemented them to overcome the zero lower bound (ZLB) on interest rates. In particular, according to the "bank lending channel" view of monetary policy², injections of central bank liquidity into the balance sheets of commercial banks could be an effective substitute to lowering the policy rate when the latter is constrained by its ZLB. As recent theoretical contributions suggest, such unconventional policies can indeed spur the supply of bank loans to the real economy insofar as they help to relieve banks from the frictions they face in their access to external financing.³ However, while a lot of empirical papers document that the recent QE programs of major central banks were successful in re-inflating asset prices, none of these studies investigate whether QE effectively transmitted to the real economy through the bank lending channel.⁴

In this paper, we evaluate to what extent a central bank can sustain credit by "pushing on the rope" of liquidity injections to the banking system while the economy is at the ZLB. We build a unique dataset of bank-firm credit linkages as well as bank and firm balance sheet information for France and assess how banks' credit supply reacted to the Eurosystem's liquidity injections implemented with the 3-year longer-term refinancing operations (LTROs) of 2011–2012.⁵ To our knowledge, this study is the first that relies on micro firm-bank level data to analyze the impact of the recent quantitative easing policies. We find that banks that bid more in the LTROs did use (at least a part of) this cheap and potentially unlimited funding source to lend more to non-financial corporations. Taking advantage of a unique feature of this operation, namely the 3-year maturity at which the central bank liquidity was lent, we also find that such a quantitative

¹As Samuelson puts it in his classic textbook: "By increasing the volume of their government securities and loans and by lowering Member Bank legal reserve requirements, the Reserve Banks can encourage an increase in the supply of money and bank deposits. They can encourage but, without taking drastic action, they cannot compel. For in the middle of a deep depression just when we want Reserve policy to be most effective, the Member Banks are likely to be timid about buying new investments or making loans. If the Reserve authorities buy government bonds in the open market and thereby swell bank reserves, the banks will not put these funds to work but will simply hold reserves.(...) In terms of the quantity theory of money, we may say that the velocity of circulation of money does not remain constant. 'You can lead a horse to water, but you can't make him drink'." (pp. 353-354)

²See notably Bernanke and Blinder (1988) and Bernanke and Blinder (1992).

³See e.g., Gertler and Karadi (2011), Gertler and Kiyotaki (2011), or Benmelech and Bergman (2012).

⁴See, among others, Christensen and Rudebusch (2012), d'Amico et al. (2012), Gagnon et al. (2011), and Krishnamurthy and Vissing-Jorgensen (2011).

⁵The scope of our database is limited to credit supplied to firms operating in France. Nonetheless, France is a particular case of interest as this is the second biggest economy in the euro area and the financing of French firms relies mainly on banks.

policy is more likely to succeed if the central bank lends at longer horizons. In addition, we use detailed information on banks and firms to show that liquidity injections were more efficient for less capitalized banks and benefited more large corporate borrowers. Last, our evidence suggests that the LTROs did not encourage banks to ever-green bad loans to ailing firms.

The Eurosystem's LTROs represented a very large positive funding liquidity shock to the euro area's banking system. They were announced in early December 2011 and implemented in two separate rounds at the end of December 2011 and February 2012. The first round provided EUR 489 billion to 523 banks while the second one allotted EUR 530 billion to 800 institutions. The total liquidity injection increased the size of the Eurosystem's balance sheet by more than a fifth and amounted to 80 percent of the monetary base in the euro area, 20 percent of total bank credit to euro area firms and almost 11 percent of the area's nominal GDP. Furthermore, this money was lent for three years at a very low interest rate compared to the funding terms banks faced in wholesale markets at the time.⁶

The LTROs were implemented in the context of the escalating sovereign debt crisis in the euro area, which dragged down the economic outlook. Against this backdrop, loan demand by firms was indeed likely to be depressed, even in a core euro area country like France which was not directly under financial stress. Also, the risk associated with existing credit to firms may have increased during 2012, which may have led to higher external finance premia faced by firms applying for loans. As a consequence, controlling adequately for firms' demand and risk is key for our purpose. We solve the usual problem of disentangling the demand for and supply of loans by exploiting the information contained in the French credit register run by the Banque de France, the French national central bank within the Eurosystem. This database collects all (on- and off-balance sheet) credit exposures of individual resident banks to non-financial resident firms with outstanding amounts above EUR 25,000 and therefore provides a quasi-exhaustive sample of bank-firm credit relationships for France. Following the methodology of Khwaja and Mian (2008), we restrict our sample to firms that have credit relationships with at least two banks before the announcement of the policy measure. By including firm fixed effects in our regressions, we then compare the change in the credit supplied to the same firm by two different banks which borrowed different amounts of money in the Eurosystem's LTROs. This allows us to identify the impact of the LTROs on the supply of credit to non-financial corporations while controlling effectively for firm-specific characteristics that may affect their demand for credit or their intrinsic level of risk.

Another major difficulty in identifying the effect of this unlimited provision of liquidity is that banks were free to choose the amount of central bank liquidity they borrowed from

⁶Section III provides more details on these operations.

the Eurosystem.⁷ Intuitively, one might expect that banks willing to bid higher amounts in the LTROs would be more stressed than other banks and might therefore want to de-leverage more aggressively than others. As a consequence, in addition to controlling for loan demand, evaluating the causal impact of LTROs on the supply of bank credit also requires controlling for bank-specific factors that are likely to both impinge on their own credit supply to firms and affect their desired bid for central bank liquidity. We control for such factors by merging the detailed dataset obtained from the credit register with information on the balance sheets of banks, including, in some specifications, measures of the quality of banks' loan portfolios based on the credit ratings of customer firms. Overall, our measure of the effects of the LTROs on credit supply to firms is unlikely to be biased by the endogenous nature of banks' bids.

We first find that this measure to provide unlimited longer-term liquidity had a positive impact on credit supplied to firms. According to our baseline estimates, each EUR 1 billion of central bank money lent to the average bank holding company led to a EUR 95 million increase in the credit made available to the average firm over the 12-month period from September 2011 to September 2012. Importantly, we also find that this effect is almost exclusively associated with the first round of LTROs, which took place before the ECB's President Mario Draghi on 9 February 2012 publicly dismissed fears of any stigma that could be associated with a bank's bidding at these operations. Easing the threat of stigma actually encouraged more banks to bid at the second LTRO in late February 2012, but these institutions were likely to be less constrained to roll-over the financing of their existing investments and more eager to exploit an attractive funding opportunity. Indeed, we show that these banks were on average better capitalized. Overall, this confirms that the positive bank funding shock has a stronger impact on bank lending when banks are *ex-ante* financially constrained.

Second, we provide new insights about the benefits of providing central bank liquidity at longer horizons than is usual in lender-of-last-resort operations. The Eurosystem had been lending under a full allotment procedure since the subprime crisis intensified in October 2008, but before December 2011 its liquidity had been provided only at relatively short maturities of between one week and six months.⁸ The novelty of the 2011 LTRO facility was that a potentially unlimited amount of central bank liquidity was lent for the first time at the long horizon of three years, which substantially reduced the uncertainty faced by banks about their ability to withstand future funding stress. It is therefore important to ascertain whether the possibility offered to banks to swap their short-term central bank borrowing for longer-term one mattered or not. We answer this question by disentangling the effects of the *maturity swap* associated with the LTROs and the effects of the *increase in total borrowed reserves* over the

⁷The only limit being set by their access to eligible collateral that they could pledge with the Eurosystem.

⁸An exception were the 1-year LTROs launched in June and December 2009. By construction however, these were fully reimbursed by the end of 2010.

allotment period. We find confirmation that maturity was indeed important: the bulk of the stimulus to bank lending associated with bids in the first LTRO comes from a substitution of long-term for short-term bank borrowing.

Third, we document that the LTROs did not benefit all borrowing firms the same. An often debated question is whether non-standard monetary policy measures helped to limit credit restrictions to smaller firms during the crisis. Small and medium-sized firms (SMEs) are typically more dependent on banks for their funding than larger ones, as small firms generally have more limited access to wholesale funding markets. Due to informational frictions, these firms are also less likely to switch easily from one lender to another in order to smooth out the negative effects of the bank lending channel when financial conditions deteriorate.⁹ Looking at the impact of the LTROs across firms of different sizes as measured in terms of their total bank borrowing, we find that they mostly benefited firms in the upper decile of the borrowing distribution. For large individual firms (that we define as firms in the top 1 percent of the borrowing distribution) the benefit of being linked to a bank that borrowed in the ECB's LTROs is 3.5 times larger than for the average.¹⁰ For the sake of robustness, we also look at the differentiated impact of the LTROs on firms according to the size of their staff. For a sub-sample of firms for which this information is available, we find confirmation that the LTROs had a larger impact on credit provision to larger firms.

In addition, we find that banking groups that borrowed via the ECB's LTROs tended to increase their lending less to firms with whom they had a longstanding relationship (defined as a credit link that is more than three years old), suggesting that the measure did not predominantly favor ever-greening. Likewise, firms' credit risk did not seem to be a key determinant of the increase in loan supply. However, and importantly, fringe firms in terms of credit rating, that is, firms of intermediate credit quality which were not eligible in the Eurosystem's collateral framework before January 2012 but became eligible as a consequence of a temporary extension of the collateral accepted for central banks' refinancing operations (the so-called ACC program of February 2012), benefited more than others from the LTRO borrowing of their lenders. This suggests that at least firms in this risk bucket were facing a form of credit rationing before the extension.

Last but not least, we acknowledge that identifying a positive effect of the LTROs on credit provision by some banks to their borrowing firms is not enough to conclude that this policy was effective in mitigating a credit crunch at a more aggregate level. Indeed, the firms which benefited from a greater supply of credit by some of their lenders thanks to this monetary policy measure may have faced higher restrictions from other relationship lenders, so that the credit

⁹See for instance Chodorow-Reich (2014b) for recent evidence of such frictions in the US.

¹⁰These firms account for nearly 60 percent of total bank credit to non-financial corporations in France.

supply shock brought about by the central bank may not have been enough to compensate for a contraction of credit supply by non-participating banks. Following Khwaja and Mian (2008), we therefore also look at the aggregate effects of the Eurosystem's LTROs by collapsing our dataset of bank-firm exposures at the firm level. We find confirmation of strong significant effects of the first round of the LTROs on the availability of bank credit to non-financial firms, suggesting that within-firm substitution effects played a minor role on average.

The rest of the paper is organized as follows. Section II discusses some related literature. In Section III, we describe the Eurosystem's LTROs in greater depth and detail our identification strategy. Section IV presents the data. We discuss our main results on the bank lending channel in Section V. Additional results regarding the heterogeneous effect of the policy across firms and the overall firm-level impact are discussed in Section VI. Finally, Section VII concludes.

II. Related Literature

Our results are relevant for at least three strands of the recent literature on banking and monetary policy. First, our paper fits into the empirical literature on the bank lending channel and notably relates to the numerous microeconomic studies showing that credit supply is affected by monetary policy (see, e.g. Kashyap and Stein, 1995, 2000; and Jiménez et al., 2012) or other sources of liquidity shocks (see Khwaja and Mian, 2008; Paravisini, 2008; and Schnabl, 2012). A series of recent empirical contributions have shown that this bank lending channel was at play during the recent financial crisis in the US as well as in Europe, so that the negative liquidity supply shock consecutive to the freeze of interbank markets in 2007–2008 explains a substantial part of the observed credit contraction (see for instance Cornett et al., 2011; Chodorow-Reich, 2014b; Iyer et al., 2014; and Puri et al., 2011), with sizeable consequences for real activity and employment (Chodorow-Reich, 2014b). Interestingly, most empirical studies in this literature look at the “negative” side of the bank lending channel, when a tighter policy or increased funding stress entail less lending by financial institution. An exception is Paravisini (2008) who investigates the potential “positive” side of the bank lending channel. He finds evidence that an Argentinian governmental program designed to support bank lending to SMEs in poor areas had a positive impact on loan supply. Beneficiary banks were financially constrained and would have had to forgo profitable investment opportunities were it not for the program. In a similar vein, our results point to a positive side of the bank lending channel associated with an unconventional quantitative monetary policy implemented at the ZLB. These findings are also in line with the theoretical analysis of the macroeconomic impact of a QE policy developed in Gertler and Kiyotaki (2011) and Benmelech and Bergman (2012), who explain how such policy interventions, if massive enough, can help to escape a “credit trap” equilibrium.

Second, our paper also belongs in the burgeoning literature assessing recent QE policies. Most of the existing studies focus on the impact of QE on bond interest rates and other asset prices (see for instance Christensen and Rudebusch, 2012; d'Amico et al., 2012; Gagnon et al., 2011; Li and Wei, 2013; and Krishnamurthy and Vissing-Jorgensen, 2011). Gambacorta et al. (2014) provide an assessment of how QE policies in advanced economies transmit to the real economy. However, they use macro data which does not allow them to isolate the impact on loan supply. Chen et al. (2012), Gertler and Karadi (2011) or Gertler and Karadi (2013) rely on DSGE models featuring imperfect financial intermediation. We also investigate the transmission of QE policies to the real economy. Our specificity is to rely on a rich set of micro data to identify the impact on credit supply. Moreover, most papers in this literature consider QE policies which create reserves and increase the size of the central bank balance sheet through asset purchases. In contrast, the 3-year LTRO is a pure creation of central bank's reserves and we show that such liquidity injections are also efficient in sustaining credit supply.¹¹

Third, and more specifically, our study contributes to on-going efforts to evaluate the effects of the Eurosystem's LTROs. Darracq Pariès and De Santis (2015) look at their macro impact using country level data. Cahn et al. (2014) quantify the effects of the 1-year LTRO using an estimated DSGE model of the euro area which features financial frictions. A recent contribution by García-Posada and Marchetti (2014) applies an approach closer to ours on Spanish micro data. They find that the LTROs had a moderate positive short-term impact on the provision of bank credit to firms in this country. We find that the impact is greater and more significant at a longer horizon. Moreover, we disentangle the maturity swap from the purely quantitative channel and document the heterogeneous effects of the measure on different types of firms. Finally Acharya and Steffen (2015) and Drechsler et al. (2014) argue that the Eurosystem's liquidity operations were used by the weakest European banks and encouraged risk-shifting and opportunistic "carry trade" government bond purchases. We also find that the 3-year LTROs benefited the banks that were the most under stress. However, looking at their supply of loans to firms, i.e. a specific but important class of banks' assets, we do not find any evidence in support of this hypothesis of risk-shifting.

III. Identifying the impact of the LTROs on credit supply

In this section, we first recall the main features of the 3-year LTROs and the economic backdrop against which the operations had been implemented. We then underline some challenges inherent in trying to identify the impact of such a policy on credit supply. Last, we describe the methodology that we implement in order to overcome such challenges.

¹¹Christensen and Krogstrup (2014) look at the asset price impact of similar pure liquidity injections by the Swiss central bank and also find an impact.

A. *The Eurosystem's LTROs of 2011–2012 and its economic background*

The Governing Council of the ECB announced on 8 December 2011 its decision to implement two so-called longer-term refinancing operations (LTROs) with a maturity of three years, with the option of early repayment after one year.¹² The first LTRO operation, which took place on 21 December 2011, provided EUR 489.2 billion to 523 credit institutions in the euro area. The second operation took place on 29 February 2012 and saw the allotment of EUR 529.5 billion to 800 credit institutions. The operation led to huge liquidity injections in the euro area banking system. When taking into account other operations conducted the same weeks (like 3-month operations and regular weekly operations) and operations maturing at these dates, the first round of LTROs amounted to a net injection of EUR 210 billion while the second amounted to a net injection of EUR 311 billion.

The goal of this measure was to “ensure enhanced access of the banking sector to liquidity” and to “support the provision of credit to households and non-financial corporations”. Indeed, the announcement took place against the backdrop of an intensification of the euro area sovereign debt crisis in the second half of 2011. Banks in the eurozone were under heightened funding stress due to their exposure to such sovereigns and prospects for credit and growth were rapidly deteriorating.

Figure 1 illustrates that European banks faced unprecedented levels of funding pressures in the second half of 2011. For each of the four largest economies of the eurozone, it displays the average spread of bonds issued by domestic large banks, as compared to the German government bond, since the inception of the euro.¹³ The figure reveals that the funding stress faced by European banks in the fall of 2011 was even greater than the one they experienced after the failure of Lehman Brothers. Moreover, while bank spreads shot higher in peripheral countries mired in the sovereign debt crisis, spreads paid by French banks also reached historical highs, although these banks were much less exposed to sovereign risk in the GIIPS. The Eurosystem's Bank Lending Survey (BLS) of bank loan officers¹⁴ provides evidence suggesting that this negative funding shock translated into tighter credit conditions offered to bank customers. Figure 2 shows how credit conditions for non-financial firms evolved in France in 2011 and

¹²LTROs were the most salient measure in a larger policy package which also included a reduction of the compulsory reserve ratio from 2 to 1 percent of banks' deposits as well as an extension of the pool of eligible collateral. The latter was obtained by a reduction of the rating threshold for certain types of ABS and the decision to allow national central banks to accept as collateral Additional Credit Claims (ACC), which include bank loans to firms of intermediate credit quality. Measures on collateral took effect only in February 2012.

¹³This measure of bank bond spreads is taken from Gilchrist and Mojon (2014). Country-aggregates are computed as weighted averages of individual bond spreads, where the weights are relative to the outstanding amounts of each issue. Individual spreads compared to the German Bund are computed so as to match corporate and government bonds of similar maturities. See Gilchrist and Mojon (*ibid.*) for more details.

¹⁴The euro area's equivalent for the Fed's SLOOS

2012. The increase in the BLS credit tightening index over the last quarter of the year 2011 points to a rapid contraction in the supply of credit. Importantly, the figure also shows that, at least according to the loan officers' reports, demand for credit from non-financial firms also receded sharply over the course of 2012. This highlights the crucial need to adequately control for demand effects when evaluating the impact of the ECB's measures on credit supply over this period of time.

Banks decided to participate or not in the LTRO program and they determined freely the amount they bid. Reports in the ECB Monthly Bulletins of January and March 2012 suggest that funding considerations played a major role in banks' bidding behavior in the 3-year LTROs. Liquidity-constrained banks were likely to bid more in this new facility than the average bank. At the same time, these stressed banks were probably contracting their loan supply more than the average. This underlines the need to also control for banks' characteristics, and notably those determining their funding stress, when assessing the impact of the measure on credit supply.

B. Empirical strategy

As we describe in details below, our dataset allows us to observe the intensive margin of bank-firm credit relationships before and after the LTROs, i.e. the rate of growth, over a one-year window around the LTROs, of the loans provided by each bank to its pre-LTRO customers. However, as the previous subsection suggests, observing credit growth at the bank level is not enough to identify the impact on credit supply associated with a bank's LTRO uptake. Indeed, proper identification requires that we control both for credit demand and for the banks' characteristics that jointly affect the banks' LTRO uptake and their supply of credit to firms.

Exploiting the very disaggregated nature of our data, we therefore control for changes in loan demand by following the "within-firm" estimation approach of Khwaja and Mian (2008). This approach amounts to testing whether the same firm borrowing from two different banks gets more credit from the bank that took more liquidity at the LTROs. It ensures that all relevant firm characteristics, like their investment opportunities, their credit risk, their financial soundness, etc., that may impinge on their demand for bank credit are controlled for. In addition, we also control for differences in funding stress or risk of insolvency across banks by relying on individual bank balance sheet data.

More specifically, our empirical assessment of the impact of the 3-year LTROs on banks' credit supply to firms revolves around estimating the following regression:

$$\Delta L_{ij} = \beta_j + \beta_1 LTRO_i + Z_i' \gamma + \eta_{ij}, \quad (1)$$

where ΔL_{ij} is the change in credit exposure (expressed as in logarithm) of bank i on firm j between September 2011 (before the LTROs) and September 2012 (after the LTROs), $LTRO_i$ is the amount of the ECB's LTRO taken by bank i expressed as a fraction of its total assets, β_j is a firm fixed effect, and Z_i are standard bank-specific control variables such as liquidity or capital ratios. Details on how we measure these variables are provided in Section A below.

As is often done in similar studies,¹⁵ we choose here to simply consider two dates around the event of interest, instead of collapsing the time dimension by averaging monthly credit levels for each bank-firm pair over one year before and one year after the “event window”. Indeed, as the sovereign debt crisis has been ongoing since early 2010, many other shocks may have affected individual credit exposures over the 12-month period before November 2011 and the 12-month period after mid-2012, therefore possibly blurring the effect we want to identify.¹⁶

This “within-firm” approach is now a standard strategy for identifying credit supply in the empirical banking literature. However, as emphasized recently in Paravisini et al. (2014), one should bear in mind that this approach may fail to control effectively for all demand effects if for some reason borrowing firms are not randomly “assigned” to banks.¹⁷ In our case, this theoretical concern is less of a problem. Indeed, large French banking groups, which make up the bulk of the observations in our dataset, are so-called “universal” banks. These banking groups have on their books very large and diversified portfolios of retail corporate loans, in terms of loan type as well as in terms of the sector and geographical location of their customer firms.

IV. Data

In this section, we describe the various sources of data we merged and how we measure the variables involved in the empirical analysis. We then detail how we select the firm-bank pairs that we use to identify the impact of the LTROs. Finally, we report some salient descriptive statistics for the selected sample.

A. Data sources and definition of variables

We merge several datasets to conduct our empirical exercise.

¹⁵See e.g. Iyer et al. (2014), who work with Portuguese credit data over the two years of the 2007-2009 subprime crisis.

¹⁶Whatever, limiting the information set to two dates around the event at study alleviates the issue related to the autocorrelation of residuals that can bias the estimates of such policy effects in a panel setup (see Bertrand et al., 2004).

¹⁷This can for instance happen when simultaneously (i) the liquidity shock that affects lenders is for some reason correlated either with changes in the demand for a specific type of loan or changes in the demand emanating from a particular sector of the economy and (ii) “treated” banks specialize in issuing this type of loan or supplying credit to this sector.

First, we exploit the French national credit register available at the Banque de France (called “Centrale des risques”). This register collects quasi-exhaustively the bilateral credit exposures of resident financial institutions, or “banks”, to individual firms on a monthly basis.¹⁸ A bank has to report its credit exposure to a given firm as soon as its total exposure on this firm is larger than EUR 25,000.¹⁹ This total exposure includes not only funds effectively granted to the firm (or drawn credit), but also the bank’s commitments on credit lines (or undrawn credits) and guarantees, as well as specific operations (medium and long-term lease with purchase option, factoring, securitized loans, etc...). Firms are defined here as legal units (they are not consolidated under their holding company when they are affiliated with a corporate group) and referenced by a national identification number (called a “SIREN” number). They include single businesses, corporations, and sole proprietors engaged in professional activities²⁰

As Ivashina and Scharfstein (2010) show in their analysis of the dynamics of credit lines drawdowns during the US subprime crisis, firms’ drawing on their pre-committed credit lines with banks can result in an apparent increase in the availability of bank credit even though the economic outlook deteriorates. However, this increase may be only apparent as banks simultaneously try to contract their off-balance sheet exposure to firms and to cut the provision of new, not-precommitted, loans. To avoid this measurement problem, we focus in the remainder of the paper on the evolution of total credit, which we define as the sum of effectively drawn credit and of still undrawn, but available, credit lines. For convenience, we will refer below to total credit indifferently as loans or credit, unless otherwise specified. We assess in our exercise the intensive margin of the growth of bank credit to firm between September 2011 and September 2012, i.e. roughly two months before the announcement of the 3-year LTROs and about seven months after the implementation of the second round. For each loan exposure of a bank i to a firm j that appears in the dataset both in September 2011 and in September 2012, we can calculate a loan growth rate ΔL_{ij} (in logs).

To conclude with this first data source, note that the credit register also provides information on the credit risk of borrowing firms. Indeed, the Banque de France estimates internally its

¹⁸Financial institutions include all resident credit institutions, investment firms, and other public institutions.

¹⁹In practice, a significant methodological change regarding the scope of this reporting threshold happened in April 2012. Before this date, a bank had to report its bilateral exposures larger than EUR 25,000, as measured at the level of its local branches. After this date, a bank has to report any bilateral exposure that is greater than EUR 25,000 as measured at the level of the whole bank. Intuitively, the new rule is more inclusive than the old one: imagine a bank with two branches, whose branch A lends EUR 10,000 to a firm and branch B lends EUR 15,000 to the same firm. This bilateral bank-firm relationship would go unnoticed under the old rule, while it would be duly reported under the new one. We corrected for this break by looking at the information available at the bank branch-firm level. We dropped all bilateral branch-firm links with a total exposure smaller than EUR 25,000, then collapsed this homogenized database at the bank-firm level.

²⁰Note that individual entrepreneurs are dropped from the dataset, as their reporting also underwent a methodological break in April 2012. We also exclude observations relating to firms that are incorporated abroad.

own credit ratings for a large population of resident firms. These ratings are used by banks to evaluate whether loans to firms are eligible as collateral to the refinancing operations with the Eurosystem. We use this information to calculate for each bank the share of its portfolio of loans to firms that is eligible, i.e. highly rated. This provides us with a measure of the risk of each bank's loan portfolio.

Second, we use an exhaustive record of the access of French banks to the Eurosystem's refinancing operations.²¹ The dataset covers all the operations of individual credit institutions located in France (both domestic and foreign-owned) with the Eurosystem at weekly frequency. We first use this information to reconstruct for each individual institution the total end-of-month outstanding amount of liquidity borrowed from all types of operations, net of repayments. We also measure the LTRO uptakes of resident institutions (at the first and the second round of the program). However, because of internal capital markets within large banking groups, the right level of analysis of net borrowing with the Eurosystem is not the individual credit institution, but the banking group.

Indeed, we observe that in most major French banking groups, only a few subsidiaries bid in the Eurosystem's operations. We infer that they borrow for the benefit of their whole group and that the liquidity is dispatched within the group structure. We deal with this issue by aggregating the data at the banking group level.²² We then use this group level information to compute changes in total borrowed liquidity from all Eurosystem facilities over the period of implementation of the LTROs.²³ Note that, for consistency, we also sum in the credit register database the bilateral exposures of all individual institutions belonging to a given banking group in order to measure linkages at the banking group-firm level.²⁴ We thus calculate a change in credit exposure of bank group i to firm j , ΔL_{ij} . We can then merge these two datasets for a given banking group i . For simplicity, we nevertheless use the term "bank" for banking group in the remainder of the paper, .

Third, we take bank-level balance-sheet information from the regulatory reporting of banks to the French Supervisory Authority. All balance sheet variables of French groups are measured as of June 2011 and refer to consolidated group statements. Balance sheet items of subsidiaries of foreign groups are however reported on an unconsolidated basis. We use this information, as well as the data from the refinancing operations, to compute our main variable of interest, which

²¹These include the main refinancing operations, 3-month to 3-year longer-term operations, fine-tuning operations, etc.).

²²We identify the boundaries of groups using the Supervisor's mapping of individual credit institutions into so-called *Groupes économiques d'appartenance*, or "GEA")

²³Namely September 2011 to December 2012 as regards the first LTRO round, December 2011 to March 2012 as regards the second, and the six months from September 2011 to March 2012 when considering both rounds.

²⁴Note that in the case of foreign banking groups, of which we can just observe the local subsidiaries registered in France, the GEA is the sum of these local subsidiaries and not the whole group

is, for each bank i , the ratio of its LTRO uptake to its total assets, $LTRO_i$.²⁵ We also compute standard ratios, such as a capital ratio (Tier 1 capital to unweighted total assets), a liquidity ratio (cash and interbank loans to total assets), and an interbank liability ratio (total interbank liabilities, net of Eurosystem's ones, to total assets) as indicators of the financial soundness of each banking group. For French banks, we can also complete balance sheet information with detailed data on outstanding bond issues from the SNL database. This information allows us to compute for each French bank the amount of outstanding bonds maturing over the three-year period covered by the LTROs. Such expected refinancing needs are often considered as an important determinant of the LTRO uptakes. All these variables are included in our set of banking group controls Z_i .

Fourth, we merge the previous datasets with firm-level accounting information available from the Banque de France's "FIBEN" database. Firm balance sheets and income statements are available only for a subsample of the whole population of firms which are present in the national credit register, but this sample is nevertheless sizeable.²⁶ A firm's financial statements are collected in so far as its turnover exceeds EUR 0.75 million. As this information is annual, we compute the relevant firm accounting ratios by using the average of accounting variables observed in the end-of-year 2010 and 2011 reports. As we detail below, this information can be used to investigate whether the response of bank loan supply to the LTROs differed depending on the characteristics of customer firms.

B. Sample selection

We describe here the selection filters we apply to the original dataset in order to get rid of outliers. We proceed in four steps.

First, we discard banks that do almost not lend to firms. A total of 200 banking groups or stand-alone banks were registered as active lenders in complete credit register dataset of September 2011. We calculate the share of each group in total lending to domestic firms. The distribution of these groups' market share of corporate credits is very skewed to the left, with 170 banks holding less than 0.1 percent of total credit to firms. This reflects the strong concentration of the French banking industry. We discard these "small" lenders, which collectively account for only 2.4 percent of total credit to firms.

Second, among the remaining 30 banking groups, we also eliminate 5 banking groups whose total assets jump by more than 50% in absolute value terms over the 12-month period from September 2011 to September 2012. These are likely to have merged with other institutions or to

²⁵Note that we compute for each bank ratios relating to both the total uptake and the uptake at each round of the LTROs

²⁶For instance, the database includes the balance sheets of more than 160,000 firms in their legal unit form (i.e., unconsolidated balance sheets) as of the end of 2011.

have been restructured over this time period. Keeping them would blur our measure of changes in their credit supply. These 5 banks make up less than 2 percent of total drawn credit offered to domestic firms. We also drop the Belgian-French banking group Dexia. Indeed, it nearly went bankrupt in early October 2011, was bailed out by the French and Belgian Governments and then had to undergo a long process of restructuring.²⁷ This leaves us with a sample of 24 banks, which we list in Appendix A. It includes all major French private banking groups, a handful of public credit institutions which are active lenders to firms (notably to SMEs, like OSEO/Bpifrance), as well as 13 French subsidiaries of foreign banking groups. Discarding credit links which do not involve any of these 24 selected banks leaves us with a set of bilateral credit exposures which accounts for more than 88 percent of total bank credit to domestic corporations. The selected banking groups also account for 91% of the total 3-year LTROs amounts allotted in France over the two rounds.

Third, we drop very small credit exposures, which tend to be very volatile and are often associated with very small borrowers. Namely we delete bilateral observations for firms borrowing less than a total (over the 24 selected banks) of EUR 25,000 in September 2011.²⁸ Applying this filter amounts to dropping 48 061 firms which account for 0.15 percent of total banks credit. We end up with a large selection of 1,360,000 firms borrowing to 24 banking groups.

Finally, we also drop bilateral credit exposures with extreme growth rates over the period of study. Namely, we excluded every firm-bank pair with a September 2011-September 2012 loan growth rate that is below the 2nd percentile or above the 98th percentile in the whole distribution of loan growth rates. The observations deleted account for a bit less than 9 percent of total bank credit to domestic firms.

Overall, we end up with a sample of 1,390,270 bank-firm credit links (involving some 1,172,000 firms), which represent 79 percent of the total amount of bank credit to firms located in France. The sub-sample of multi-bank firms, which we use for our baseline regressions, is of course smaller. Nevertheless, it still includes 211,209 firms with 428,594 bank-firm relationships and accounts for 57 percent of total bank credit to French firms.

C. Descriptive statistics

Our final sample of banks is quite representative of credit provision to non-financial firms in France. It covers more than 89 percent of loans to firms in Fall 2011. Table 1 presents some descriptive statistics. The average bank is relatively large, with total assets at EUR 494 billion, but the sample ranges from quite small institutions (mostly foreign subsidiaries) to the

²⁷In September 2011 Dexia accounted for a significant 6.5 percent of drawn bank credit to firms in France. We checked that our main results are robust to the inclusion of this bank in the sample.

²⁸Note that this threshold is slightly more restrictive than the official reporting threshold, as we define it in terms of loans and undrawn credit lines, which does not include guarantees and other exposures.

big players of the French banking sector (groups with total assets of the order of magnitude of France's nominal GDP). Although the total assets of these banks increases over the 12-month period of study, their total supply of credit to firms decreases by 1.43 percent on average. The average bank is well capitalized, with a (Tier 1) capital to total assets leverage ratio of roughly 8 percent.

Table 2 compares the profiles of banks according to whether they bid or not in the 3-year LTRO facility, and whether they bid in the first or the second round. All banks did not participate: among the 24 French banking groups and foreign subsidiaries in our sample, only 10 borrowed from the LTROs; 6 participated in the first round; 8 in the second and 4 in both. For the banks which bid in the operations, the average uptake was significant as it amounted to some 2.8% of total assets. Interestingly, participants in the first round differ from participants in the second round. On average, bidders in the first round were smaller than bidders in the second one, they de-leveraged less over 2011-2012, they were more capitalized, and they relied more on interbank market and deposits for funding. This in turn suggests that they were, at this stage of the crisis, on average less dependent than other banks from Eurosystem financing.

Table 3 presents descriptive statistics for the selected firms in September 2011, that is before the ECB announced the LTROs. The upper panel presents statistics for all firms, while the next two panels contrast single-bank firms with multi-bank firms. The last panel relates to the subsample of firms for which we have access to balance sheet information from the FIBEN database. As intuition would suggest, multi-bank firms are larger borrowers than mono-bank ones. However, they are also very heterogeneous as the difference between the average and the median of total credit borrowed by these firms (EUR 4.6 million and EUR 0.4 million respectively) indicates. While, on average, mono-bank firms experienced a contraction of credit between September 2011 and September 2012, multi-bank firms did not. Multi-bank firms are relatively well rated: 14 percent have a Banque de France rating that makes their bank debt eligible as collateral to the Eurosystem's operations (high quality firms). They also have relatively long-lasting relationships with their lenders: 76 percent of their credit relationships have an average duration of more than three years. Firms for which we have complete balance sheet information in the FIBEN database account for some 17 percent of the selected multi-bank firms. These multi-bank FIBEN firms are even larger, better rated and have an even higher probability of maintaining a long-term relationship with their lenders. The average size of their assets is EUR 43 millions and they employ an average of 85 staff. Their low average profitability reflects the weak macroeconomic situation that was prevalent in September 2011.

Table 4 illustrates further the heterogeneity of borrowers. It provides descriptive statistics for four categories of firms sorted according to their borrowing size (as observed in September 2011). Not surprisingly, this distribution is very skewed to the left. The first grouping, that

we call “very small borrowers”, is made of firms with total bank credit below the median of the borrowing distribution (EUR 136,000). Their average total borrowing²⁹ is indeed quite small and stands at around EUR 70,000. Consequently, these more than 682,000 firms account for only 3.4 percent of total bank credit to firms. The second grouping, which we call “small borrowers”, includes the 542,000 firms between the sixth and the ninth deciles of the borrowing distribution. They make up about 11 percent of banks’ credit to firms and their average amount of credit is about four times larger than the amount granted to a very small borrower, with about EUR 295,000. The third grouping of “intermediate borrowers” includes the 122,000 firms in the last decile of the distribution, with the exception of the last percentile. They account for about 15 percent of banks’ credit to firms and their average amount of credit is six times larger than for “small borrowers”, at about EUR 1.83 million. Lastly, “large borrowers” are the 13,600 firms in the last percentile of the distribution. They account for 58 percent of the total quantity of bank credit received by domestic firms and each of them benefits on average from nearly EUR 69 million of bank credit.

The LTRO were in part targeted towards small firms, because such firms tend to rely more on banks to fund their activity and are less able than large firms to tap wholesale financial markets. Table 4 reveals that indeed, smaller borrowing firms are more exposed to a credit crunch. They are connected to a smaller number of banks on average, which implies that they have less opportunities to substitute between lenders. They also face a sharper contraction of credit over the period of study. Looking at the sub-sample of firms for which we have access to balance sheet information reveals that smaller borrowers are also on average smaller firms. For this subsample of firms, we find that total borrowing size has a strong positive correlation (of about 0.74) with total asset size. Borrowing size is also positively correlated with the number of employees although the correlation is lower (about 0.20).³⁰

V. Did the 3-year LTROs increase loan supply to firms?

This section reports our estimates of the impact of LTROs on bank credit supplied to firms located in France. We first analyze the impact of the operation as a whole. We then distinguish between the effects of the first round (implemented in December 2011) and of the second round (implemented in February 2012). We also disentangle the *quantitative* impact of these massive long-term liquidity injections from the *qualitative* impact associated with the longer maturity

²⁹Including credits granted by banks that we do not keep in the sample.

³⁰This lower correlation may be due to the fact that our firm data are not consolidated. Holding companies may for instance be large in terms of their bank debt, as they may borrow on behalf of their whole network of affiliates, but they may be small in terms of staff employed. Conversely, subsidiaries employing a relatively large number of staff may be small in terms of relative debt as they draw part of their funding from the holding company they belong to.

of the facility. Finally we provide a set of robustness checks of our baseline results. Remember that we measure the LTRO uptake of a given bank as a fraction of its total assets and look at its impact on the growth rate of loans (expressed in log difference) distributed to firms by this bank between September 2011 and September 2012.

A. Overall impact

The first four columns in Table 5 provide estimates of the combined impact of the two rounds of LTROs on bank credit supply to firms. Columns (1) and (2) show the results when neither firm characteristics, the firm-fixed effects β_j , nor bank characteristics, Z_i , are controlled for. Column (1) refers to the whole population of selected firms while Column (2) stands for multi-bank firms only. Both show a non-significant impact of the 3-year LTROs on loans distributed to firms.

Column (3) shows the results when we control for firm's loan demand using firm-fixed effects, but not for bank-specific risk factors. The impact of the LTROs is now positive and significant, but somehow smaller than in column (2). This suggests that not controlling for firms' demand would lead to overestimate the impact of the policy. Indeed, as shown in Table 3, credit increased for all multibank firms on average over the period of study, and (a small) part of the increase in credit provided by LTRO bidders may then be accounted for by a surge in the demand for loans of their borrowers.

Column (4) provides our baseline estimate of the impact of the LTROs when we also control for the key balance sheet characteristics of banks, hence their degree of financial stress before the measure. We find that the 3-year LTROs had an overall positive and significant impact on loans distributed to firms. Controlling for banks' characteristics reveals a positive impact that is more than twice as large as before. This confirms the intuition that the banks that were more financially constrained bid more in the LTROs while they also deleveraged more than the average bank. As a consequence, not controlling for bank characteristics would lead us to severely underestimate the impact of the policy measure on loan growth over 2012. The amount of credit supplied to firms by stressed banks would have been lower in 2012 in France, had this unconventional policy measure not been implemented.

Column (4) also shows the impact of the characteristics of banks on their loan supply. Banks with higher capital ratios and an easier access to funds on the interbank market offered more loans than others. Banks with more liquid assets supplied marginally less loans to firms than the average, probably reflecting different business models. Regular bidders in the central bank's

standard refinancing operations (MROs) showed a relatively more dynamic credit supply.³¹ Finally, (French) state-owned (or public) banks offered much less credit to firms than private banks, while foreign banks behaved roughly like their French counterparts.

We can easily get a sense of the economic significance of our baseline result. Let δ_i denote the growth rate of loans supplied by bank i to all its customer firms. An estimate of this growth rate can be derived from the LTRO uptake of bank i and our estimate of the LTRO elasticity of credit supply: $\widehat{\delta}_i = 0.60 \times LTRO_i$. The change in loans supplied by bank i , knowing its pre-LTRO stock of loans L_i , is then: $\Delta \widehat{L}_i = \widehat{\delta}_i \times L_i$. Summing over all banks, one gets an increase of EUR 14.6 billion in credit supply. This is to be compared with the total LTRO take-up by the banks in our sample, which amounts to EUR 153 billion. Put differently, everything else being constant, we find that EUR 1 billion injected by the Eurosystem led the average bank to supply EUR 95 million in supplementary loans and credit lines to firms.

B. First vs second LTRO rounds

So far, we have analyzed the total impact of the two 3-year LTROs as a whole. However, it is worth investigating whether the first and the second rounds had different effects on the supply of bank credit to firms. Indeed a striking feature of the operations is the surge in the number of participating banks as well as in the quantities borrowed between the two rounds.

Banks were incentivized to use the facility because of the low cost involved, even banks that could have been able to obtain longer-term funds in the bond market. Why did less banks participate in the first round although both rounds were announced at the same time in early December 2011? One explanation is the fear of stigma: banks in relatively good shape may have refrained from tapping the facility during the first round as they did not urgently need this liquidity and might not have wished to send out bad signals about their financial situation.³² By contrast, banks who participated in the first round may have been under high pressure to find liquidity to fund their existing assets. The surge in the number of participating banks as well as in the quantities borrowed between the two rounds may then reflect an opportunistic behavior of second round bidders. Such a behavior would have been motivated by official ECB statements,

³¹This “MRO user” dummy variable equals one for banking groups which took part in at least one of the ordinary weekly refinancing operations over the years 2006–2011. This variable thus singles out groups that are sophisticated enough to bid in regular operations, and thus have the technology to also easily bid in the 3-year LTROs in the winter of 2011–2012.

³²Armantier et al. (2015) provide striking evidence of such stigma for the US. More specifically, they show that during the 2007–08 crisis, US banks were ready to pay a premium of about 44 bps to avoid borrowing at the Fed’s Discount Window.

made between the two rounds, which aimed at dismissing such fears of stigma being associated with bidding in the operations and thereby at encouraging participation.³³

This assumption gains some empirical support if one looks at the descriptive statistics shown in Table 2. Notably, bidders in the first LTRO have a capital ratio that is twice as small as the capital ratio of bidders in the second round. Table 6 provides a more formal assessment of the case for a stigma effect. Columns (1) and (2) report the probit regression results of the bank's decision to bid in the first and the second round respectively, as a function of its capital ratio. The coefficient on capital is significantly negative for the first round but not significant for the second round. Columns (3) and (4) report similar evidence from Tobit regressions of banks' LTRO uptake on bank capital in the first and the second round respectively.³⁴

Columns (5) and (6) in Table 5 then report estimation results of regression (1), that we run for respectively the first and the second round of LTROs. It turns out that the impact of the first LTRO round is much bigger than estimates obtained for the two rounds as a whole. By contrast, the impact of the second round is much smaller and even non-significant. LTRO liquidity injections had a positive impact on loan supply when they relieved stressed banks from their funding constraints. The results are in line with the bank lending channel view of credit supply: the provision of liquidity has a greater impact on banks that are the most constrained in their access to funding.

C. Quantity and maturity effects

The 3-year LTROs were not the first unlimited liquidity operations conducted in the euro area. They came after similar refinancing operations with maturities of 3 months, 6 months or even 1 year, which the Eurosystem had conducted since it switched to full allotment procedures in October 2008. As regards the 3-year LTROs, the total amount of liquidity borrowed from the central bank by euro area banks was quite substantial (above one trillion euros) and larger than what banks had borrowed at past or still existing liquidity facilities since 2008. So, like other operations that lead to an increase of the central bank's balance sheet, a first direct consequence of the operations was to increase the amount of liquidity in the financial system.

This *quantitative easing* feature of the operation was not specific to the 3-year LTROs. In contrast, the *extension of the maturity* at which the liquidity could be secured was new. An important question is therefore whether this long maturity of the operation mattered and to what extent. To investigate the issue, we first calculate the increase in a bank's total borrowing from the central bank over the period of implementation of the 3-year LTRO. Some banks

³³In a press conference following the Governing Council of 9 February 2012, ECB's President Mario Draghi stressed very explicitly that there was and should be "no stigma whatsoever attached to these facilities."

³⁴Comparable results can be found in Drechsler et al. (2014). They find that less capitalized banks bid more than the average in the euro-system liquidity facilities that were put in place before the 3-year LTROs.

which tapped the 3-year operations added this longer-term borrowing to their existing shorter-term central bank borrowing. Others used the proceeds of the LTROs to reimburse central money bank previously borrowed for shorter horizons. So the amount of *quantitative easing* associated with the 3-year LTROs, that we denote ΔQ_i for bank i , is given by the increase in total borrowed liquidity net of such substitution. We also construct a *maturity swap* variable for each bank, MS_i , which measures the amount of shorter-term central bank liquidity that has been swapped by bank i for 3-year borrowing from the central bank. More specifically, we define $MS_i = 0$ if $LTRO_i = 0$ and $MS_i = \min(LTRO_i - \Delta Q_i, 0)$ if $LTRO_i > 0$. We then estimate the following regression:

$$\Delta L_{ij} = \beta_j + \beta_{qe}\Delta Q_i + \beta_{ms}MS_i + Z_i'\gamma + \eta_{ij}. \quad (2)$$

Column (7) in Table 5 shows the results for the first round of 3-year-LTROs (which is the round that had a positive impact on loan supply to firms). We find that the impact of the quantitative easing part of the measure drops to almost zero and becomes non-significant once we control for the impact of the maturity swap associated with the operation. By contrast, the swap of short-term for long-term borrowing has a strong positive and significant impact on banks' lending to firms. We can thus conclude that the positive impact of the liquidity provision on bank loan supply mostly resulted from the long maturity of the operations.

D. Robustness

We provide here evidence that our main results are robust to a variety of tests. First we run *placebo* regressions over a period prior to the LTROs in order to ascertain that the standard assumption of *ex ante* “parallel trends” does hold in the baseline. Second, we check that our baseline results are not quantitatively affected by the inclusion of additional controls for the *ex ante* situation of selected banks. Last, we also provide evidence that our findings still hold when we restrict the sample to French banking groups only.

We first check that the previous results do not stem from pre-existing different loan dynamics between the group of banks which bid a lot in the LTROs and the others. To do so, we run a so-called *placebo* regression version of equation (1) where (i) the dependent variable ΔL_{ij} is the growth rate of total credit of bank i to firms j over the year before the announcement of the 3-year LTRO, i.e. from September 2010 to September 2011, (ii) bank balance sheet ratios, Z_i , are measured as of June 2010 instead of June 2011, while (iii) the variable of interest $LTRO_i$ is kept the same. For the purpose of comparison, the sample of multi-bank firms and of banks is

kept the same as before.³⁵ Table 7 shows that neither the LTRO uptakes of the winter of 2011-2012, nor the associated maturity swaps of central bank borrowing, had any significant impact on bank lending to firms over the year *before* the announcement of the LTROs. Our main findings therefore do not reflect a correlation of banks' LTRO uptakes with pre-existing credit growth trends.

Another potential concern with our baseline results is that the set of bank level variables we consider may imperfectly capture important factors that are correlated with both a bank's credit growth and its LTRO uptake. Table 8 reports the estimation results of regression (1) while we include some additional banks' controls in Z_i . These additional regressors aim at capturing (i) banks' business model (in terms of orientation towards more retail banking or more investment banking) through either the ratio of corporate loans or the ratio of debt securities to total assets (Column 1) or the ratio of undrawn corporate credit commitments to total assets (Column 2); (ii) the risk of banks' portfolio of loans to firms through the share of loans eligible as collateral for the refinancing operations of the Eurosystem (i.e., high quality loans) to total loans (Column 3); banks' access to stable sources of funding through the deposits-to-assets ratio (Column 4). Results show that the baseline results are not qualitatively affected by any of these additional controls and that the estimates of the impact get in any case (but one) larger. In particular, the propensity of a bank bidding in the first LTRO to pass on to its customer firms the liquidity received is not affected by the fact that this bank holds a loan portfolio of lower quality (cf. column 3). We also consider below the banks' need for bonds refinancing over the 3-year horizon of the LTRO measure as an additional control. Unfortunately, we only have access to this variable for the French banking groups. So we postpone the discussion of this last robustness check to a further subsection where we assess whether our results hold for such mere French banks.

The forced recapitalization of major European banking groups engineered by the European Banking Authority (EBA) as part of its 2011 Capital Exercise was another important event that happened around the same period than the 3-year LTRO. The EBA announcements about the capital shortfall of individual banking groups were released just before the first round of LTROs. One may therefore worry that this information may have also influenced banks' bid in the LTROs and that not accounting for it could induce some omitted variable bias. Banks identified by the EBA as facing a capital shortfall were compelled to make it up before June 2012. As Mésonnier and Monks (2015) show, this exercise impinged on the dynamics of credit supplied by shortfall banks, which lent less in 2012 than the average. Moreover, banks declared

³⁵Some bank-firm links drop out from the sample as they are not observed over this different period. In addition, one balance sheet ratio is not available for one small foreign bank subsidiary in June 2010, which limits the sample of banks to 23 when bank controls are included as regressors.

in shortfall presumably faced a higher level of funding stress. So they were likely to bid more in the LTROs while at the same time de-leveraging more. In sum, not accounting for this EBA Capital Exercise could lead us to underestimate the impact of LTRO on credit supply. We therefore check what happens when we include the level of the EBA capital shortfall among the variables measuring the financial strength of a bank.³⁶

Columns (1) and (2) in Table 9 report the results. We find confirmation that banking groups with a capital shortfall to make up in the first half of 2012 tend to lend less in 2011-2012. Moreover, the estimates lead to an impact of the LTRO that is in between 1.5 and 2 times larger than what we get compared to the baseline estimate. Our baseline results are therefore conservative in comparison.

Foreign subsidiaries of European groups in our sample may have benefited from the LTRO uptakes of their parent company located in other euro area countries. Ignoring this potential liquidity spill-overs within foreign banking groups can potentially bias the estimate of the impact of the policy on credit supply. Such a bias can go in either directions. On the one hand, most foreign subsidiaries did not borrow at the LTRO in France, so they are considered as non-participating banks in our sample. However, they might have benefited from the (unobserved) LTRO uptake of their parent company outside of France and hence supply more credit than the banks which really chose not to participate. This would bias our estimate downward. On the other hand, one foreign bank in our sample is not headquartered in the euro area but bid in the LTROs in France so that it is considered as participating to the program. However, in addition to its LTRO uptakes in France, this bank may also have benefited from some other uptakes of parent institutions located elsewhere in the euro area and therefore supply more credit than banks benefiting only from the LTRO uptake that we observe. This can potentially bias our estimate upward.

To assess the extent of such bias, we run the same regressions than before on a sample restricted to French banking groups only. The results are presented in columns (3-4) of Table 9. They show that our baseline results remain qualitatively unaffected. If anything, the estimated impact is even stronger when limiting the analysis to such restricted sample. Again our baseline estimate are conservative in comparison.

Interestingly, for these French banking group, we can also control for another potential determinant of the LTROs uptakes, namely the amount of banks bond maturing over the next 3

³⁶We use the detailed bank capital information released by the EBA. The EBA calculation is based on balance sheet information and sovereign bond market prices as of September 2011. The shortfall variable is truncated at zero: banking groups with a capital surplus according to the EBA, as well as banks which are not monitored by the EBA, are considered unconstrained by the Capital Exercise. Note also that foreign subsidiaries belonging to European groups monitored by the EBA are assumed here to face the same constraint as their parent company. As non-EU banks are not supervised by the EBA, their EBA shortfall is by definition zero.

years.³⁷ The last two columns illustrate that the previous results are preserved once bonds that banks had to roll over the next 3 year is controlled for.

VI. Additional results

In this section, we first investigate whether the impact of the LTROs on loan supply differs across firms. This is interesting for several reasons. Firstly, the LTROs was in part put in place in order to avoid a credit crunch affecting relatively small firms, which are supposed to rely more on bank credit.³⁸ Secondly, bidding in the LTROs may have been associated with risk shifting strategies as banks choose to lend to riskier firms.³⁹ Thirdly, the LTROs may have encouraged some form of “zombie lending” or “ever-greening”. This happens when banks roll-over credit to customer firms with non-viable activity in order notably to avoid writing down these loans and post corresponding provisions that dent their capital position.⁴⁰ We address these issues by looking at the differentiated effect of LTROs on firms of different size (in terms of their total bank borrowing), credit risk, eligibility of their bank debt as collateral to central bank liquidity operations, number of banks serving a firm, and length of the average relationship with its banks. Moreover, for a subset of firms for which we have balance-sheet information, we also look at differences in terms of firms’ size (i.e. total assets) as well as firms’ profitability and financial soundness.

Last, we investigate whether the positive impact of the LTROs on loan supply that we identified at the firm-bank level results in more credit supplied to a firm overall or whether the benefits of the measure vanish at the firm level due to a substitution of funding between a firm’s lenders. Checking that this “firm-borrowing channel” is active matters as this increases the odds that the measure had a positive impact on aggregate loan supply at the macroeconomic level and thus was effectively funneled to the real economy.

A. Differentiated effects of the LTROs according to firms’ characteristics

We assess whether the impact of the LTROs on credit supply to firms differs with various firm characteristics such as size, risk and strength of the relationship with a firm’s banks. We

³⁷We do not have access to such information for foreign groups.

³⁸Chodorow-Reich (2014b) for the US and Iyer et al. (2014) for one euro-area country (Portugal) show that the 2007-09 banking crisis hit small and young firms more severely than large ones.

³⁹Drechsler et al. (2014) find evidence of such risk-shifting strategies for European banks bidding in Eurosystem’s liquidity facilities. They focus on changes in sovereign bond portfolios. Chodorow-Reich (2014a) find no evidence of an aggregate risk shifting impact of the Fed’s unconventional monetary policies implemented after the Great Recession.

⁴⁰See e.g. Caballero et al. (2008) provide evidence in support of such “zombie lending” during the Japanese “lost decade”.

focus on the first LTRO round since we showed that the second one had not any significant impact on bank loan supply.

Table 10 presents results on the differentiated impact of the first LTRO round when firms are sorted according to their borrowing size.⁴¹ For comparison, the results obtained for the first LTRO round and the whole population of multi-bank firms are repeated in column (1) of the Table. Columns (2) to (5) then present the results obtained for the four sub-samples of firms ranked by increasing borrowing size as detailed in the data section above.

The results underline that the first LTRO had a significant positive impact on credit supply to intermediate and large borrowers, i.e., firms which are in the top decile of the borrowing distribution. By contrast it did not feed through into more credit granted to smaller firms. Moreover, the largest borrowers, i.e., the top 1 percent of firms in terms of total borrowing size, benefited more than three times as much as firms in the rest of the top decile from this increased supply of bank credit.

For the sake of robustness, we also present in Table 11 alternative results with firms now ranked on the basis of their total number of employees. We find qualitatively similar results: the impact of the LTRO is much stronger on credit provided to firms employing more than 250 staff than for firms employing 50 staff or less.

As is visible in column (2) of Table 10, our sample includes relatively few links between banks and “very small” firms. This is not surprising given that we dropped firms with very small total credit exposure because the associated credit growth is often too volatile. However, a legitimate concern could be that our sample may not be suited for estimating the impact of LTROs on credit supply to very small firms. To address this concern, we run additional linear probability regressions, where we test whether the first round of the LTROs contributed to maintaining existing credit relationships. The sample now includes all multi-bank firms with active credit relationships in September 2011. Our dependent variable at the bank-firm level is then a dummy variable which equals one if a pre-existing credit link is still active in September 2012, i.e., after the LTROs, and zero otherwise. Table 12 shows that our previous findings remain qualitatively unchanged: the LTROs significantly contributed to maintaining firm-bank credit links active over this 12-months period, but this mainly benefited intermediate and large borrowers. Note that the number of links accounted for by “very small” firms becomes larger than before, which was our objective with this regression, but only by one half. This suggests that the main reason why the presence of very small borrowers in our baseline sample is limited

⁴¹More precisely, we rank firms according to their total amount of outstanding credit with all their banks. As noted in Section C, firms’ borrowing size is a good proxy of firms’ total balance sheet size. Note however that, since our firm dataset is not consolidated, we cannot distinguish between firms that are independent SMEs and firms that belong to large corporations.

is that the majority of small borrowers borrow funds from only one bank. Unfortunately, we are bound to exclude these mono-bank firms if we want to control properly for loan demand.

All in all, the results reported in this section suggest that the LTROs were more effective in sustaining credit supply to large firms rather than to small ones.

Table 13 provides further evidence on how firms' characteristics, and in particular risk, may affect banks' loan supply. Specifically we estimate the following, augmented, version of equation (1) where the LTRO uptake of bank i is interacted with characteristics of its customer firm j , denoted here X_j :

$$\Delta L_{ij} = \beta_j + \beta_1 LTRO_i + \beta_2 (X_j \times LTRO_i) + Z_i' \gamma + \varepsilon_{ij}, \quad (3)$$

We first investigate whether riskier firms received less funds than others from their lenders' LTRO uptake. Indeed, as discussed above in the data section, the credit register includes credit-risk ratings, which are computed by the Banque de France for a large number of firms in the sample. Loans to the firms which get a rating above a certain threshold are eligible as collateral for the refinancing operations of banks with the Eurosystem. Low rated firms, or firms without any rating, are gauged as much riskier and are not eligible. We use this information to distinguish between low risk (eligible) and high risk (non-eligible) firms as of September 2011. The estimates presented in column (1) of Table 13 show that low rated, i.e. riskier, firms did not benefit more from their lenders' uptake in the (first) LTRO.

An interesting special case in terms of firms' credit risk is the bucket of firms which were not eligible prior to the LTROs, but became eligible in February 2012. At this date, the Eurosystem implemented an extension of the pool of eligible collateral and included loans to firms with a rating just a notch below the previous threshold. These firms are denoted "ACC" firms (which stands for *Additional Credit Claims*) in what follows. As shown in column (2) of Table 13, firms belonging to the newly eligible credit category indeed benefited from a stronger transmission of the LTRO liquidity borrowed by their lenders.⁴² We read this as suggesting that (i) some of the bidding banks were constrained in terms of available collateral and (ii) ACC firms faced some credit rationing on the part of these banks. As the extension of collateral eligibility to this firm bucket lowered the opportunity cost of funding them, banks were more willing to pour some of the liquidity borrowed into these firms of relatively high credit quality.

We then ask whether the strength of the borrower-lender relationship helps to explain the transmission of the LTROs to firms. We show in column (3) of Table 13 that firms with more bank relationships fared better overall: the higher the number of banks lending *ex-ante* to a given firm, the more this firm benefited from an increase in credit supply associated with the

⁴²We also ran additional regressions on sub-sample of firms sorted by borrowing size as previously and find that this result holds for all categories of firms' size.

LTROs. However, this effect disappears when the regression is run separately for each size bucket.⁴³ As the number of lenders for a given firm is strongly correlated with its borrowing size, the effect of multiple banking may be difficult to disentangle from the effect of firm size. By contrast, firms with an older (longer than 3-year) relationship with their bank received fewer loans from the LTROs than the average.⁴⁴ We interpret this result as suggesting that little, if any, ever-greening of existing bad loans took place over this period. Indeed, incentives to roll-over credit to “zombie” firms are likely to be stronger in the presence of a long relationship.

Finally columns (5) and (6) of Table 13 provide additional results for the sub-sample of firms for which complete balance sheet information is available. For this sub-sample of some 37,000 multi-bank firms, we find that the financial soundness of the firm – measured as the ratio of earnings before tax to earnings before net interest payments and tax – does not matter in the allocation of credit supply induced by the LTROs. By contrast, the past profitability of a firm – measured as the ratio of net operating profits to net turnover – has a positive impact. This last finding is consistent with our diagnosis that the LTROs did not encourage “zombie lending”.

B. Looking for aggregate effects

So far, we have presented evidence that banks which borrowed in the LTROs tended to subsequently supply more credit to their customer firms. An important issue is then to assess to what extent this means that these firms received more credit overall. Indeed, it may be the case that the credit surplus obtained by a firm from one bank which borrowed relatively more in the LTROs replaces existing credit supplied by other lenders.⁴⁵ In other words, it is necessary to check whether the so-called “firm borrowing channel” was operating in order to be able to conclude that the LTROs had a positive impact on aggregate credit supply.

We test for this firm-borrowing channel by running similar regressions as before, but at the level of the firm instead of credit exposures. Namely we estimate the following regression:

$$\Delta L_j = \beta_s + \beta LTRO_j + Z_j' \gamma + X_j' \delta + \varepsilon_j, \quad (4)$$

where ΔL_j is now the growth rate of the sum of all bank loans to firm j , β_s is a sectoral dummy, $LTRO_j$ is the weighted average of the LTRO uptakes of firms j 's lenders (the weights being the volumes of credit obtained from each of its lenders before the LTROs), Z_j is the

⁴³Detailed results are not shown here for brevity, but available upon request.

⁴⁴Unreported results show that this finding holds for the whole sample of firms as well as within each size bucket.

⁴⁵This may happen if the firm's credit demand was not rationed ex-ante or if the firm does not want to increase its total indebtedness for some reason in spite of suddenly more attractive offers by one of its relationship banks.

weighted average of the characteristics of these lenders (we consider the same bank characteristics than in the baseline bank-firm level regressions presented in Table 5) and X_j are firm j characteristics.⁴⁶

The results of these firm-level regressions are presented in Table 14. Column (1) shows the total impact of the two LTRO rounds when we only control for the size of the firm (in terms of its total bank debt). In column (2) we include industry-specific fixed effects in order to better control for credit demand while in column (3) we also include some additional firm controls measuring its credit risk and the average length of its relationship with its banks. For these two specifications, the coefficient associated with the averaged LTRO bid variable is significant and of similar magnitude than the coefficient we estimated using bank-firm exposure data.

Column (4) shows the results obtained when we also control for the characteristics of the average bank lending to a given firm. The total effect of LTROs on lending to firms is then marginally smaller and no longer significant. However, a closer look reveals that this dampening of the total effect is mainly due to the lack of impact of the second LTRO round. Indeed, columns (5) and (6) present the results of the same regression when we consider as an explanatory variable the LTRO uptake in the first and second rounds of the liquidity injection respectively. The coefficient associated with the first round is stronger than before and highly significant, while the coefficient associated with the second round is close to zero and not significant.

All in all, the results presented in this section confirm the previous results obtained at the firm-bank pair level. The LTROS have also had a positive impact on bank credit distributed to non-financial firms at the level of the firm, which suggests that within-firm substitution effects played only a minor role, if any.

VII. Conclusion

In this paper, we use the Eurosystem's LTROs of end 2011-early 2012 to test whether a central bank can successfully push on the rope of huge increases in bank reserves in order to stimulate the provision of bank credit to the economy during a financial crisis and when conventional monetary policy has reached its lower bound. We base our investigation on a very rich dataset of bank-firm credit exposures in France, which allows us to control effectively for credit demand by individual firms as well as for characteristics of banks. We find robust evidence that a quantitative monetary policy can work via the bank lending channel when banks are financially constrained and the policy measure relieves this constraint. Banks did on average use their LTROs uptake to increase their lending to firms on the intensive margin. Moreover,

⁴⁶We consider a sample of 182,000 multi-bank firms made of the set of firms belonging to the previous regressions from which we drop the bottom and top 5% of firms in terms of total credit growth over the period to limit the effect of outliers.

this effect was mostly associated with the first round of the LTRO, before the ECB officially removed the stigma potentially associated with participating in the operation. This suggests that the transmission of the monetary stimulus is stronger when bidding banks face high funding strains and have strong incentives to borrow from the central bank despite the possible stigma. Importantly, given that the Eurosystem was at the time of the LTROs already lending without limit at a weekly maturity against good collateral, we show that what mattered most was the possibility offered to banks to swap their existing short-term borrowing at the central bank for long-term borrowing. Furthermore, we find that the increased supply of credit was not evenly distributed across firms. In particular, larger corporate borrowers, firms with greater bargaining power (such as firms with a higher number of lenders *ex ante*) and more profitable firms received more funding than the average. Lastly, our results do not support the claim that the LTROs may have encouraged the ever-greening of existing bad loans on banks' books.

That said, a final note to caution is warranted in interpreting our results. Whereas we find robust evidence that the Eurosystem's LTROs indeed helped to sustain the provision of bank credit to firms in France, we think that our results may understate the true impact. First of all, we investigate here changes to bank credit supply along the *intensive* margin only. Since the French credit register does not record loan applications, properly measuring the effects of the LTROs on the *extensive* margin of credit provision (e.g., on a higher probability for a treated bank to accept a loan application, *mutatis mutandis*) remains out of our reach. In any case, this massive injection of liquidity into the Eurosystem's banking system was obviously instrumental in improving market sentiment in Europe and alleviating the degree of stress in various market segments. The resulting overall improvement of funding terms for banks also benefited, directly and indirectly, governments and non-financial firms. However, while our results should reflect the direct quantitative impact of the LTROs, our within-firm methodology by construction ignores other indirect consequences on banks' total ability to lend.

Lastly, our results suggest that the LTROs were not very effective in shielding small firms, which are deemed to be more dependent on banks than large firms to fund their working capital and investments, from the heightened risk of a credit crunch. This finding can be interpreted as an argument for more targeted forms of quantitative policies, such as the "funding-for-lending" scheme implemented by the Bank of England over 2012-2014 or the "Targeted-LTROs" announced by the Eurosystem in June 2014. To date, the success of these recent experiments is largely perceived as mixed. The relevance of more sophisticated forms of large injections of central bank liquidity that aim to stimulate the provision of credit to some groups of borrowers thus remains a largely unsettled issue, which we leave for further research.

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TABLE 1. Descriptive statistics for the selected banking groups

	mean	p50	sd	p10	p90
<i>All banks</i>					
Total Assets (bns)	494.44	27.01	1,059.08	1.62	1,918.24
Total Assets Growth	2.31	3.01	15.59	-13.89	20.18
Loans	37.47	16.18	37.97	5.12	96.93
Total Credit Growth	-1.43	1.75	14.11	-22.24	12.68
Drawn Credit Growth	-3.90	0.19	17.48	-26.22	14.86
Interbank Assets	18.90	13.58	20.38	1.82	51.46
Securities Portfolio	16.05	4.58	19.88	0.00	44.30
Capital	8.01	6.40	5.99	2.33	16.68
Interbank Liabilities	31.58	17.50	30.58	1.73	83.14
Deposits	24.20	21.86	23.68	1.09	62.80
Provisions	0.83	0.28	1.73	0.05	1.72
MRO User	0.58	1.00	0.50	0.00	1.00
LTRO	1.15	0.00	2.27	0.00	2.31
LTRO Maturity Swap	0.29	0.00	0.59	0.00	1.07
Quant. Easing	1.09	0.00	2.32	0.00	3.40
Nb of indiv. banks included	13.04	2.50	22.36	1.00	34.00
<i>French banking groups only</i>					
Bond Rollover	4.64	1.54	8.91	0.00	14.54
MRO User	0.82	1.00	0.40	0.00	1.00

Note. This table presents descriptive statistics for the 24 selected banking groups in our sample (thereafter banks). Bank total assets are expressed in billions of euros. Total assets and credit growth are given as a percentage and are defined in terms of logarithm difference of the corresponding variable. Unless otherwise stated, the other rows refer to ratios of the mentioned balance sheet item to the banks total assets (as a percentage). All balance sheet variables are measured as of June 2011 in terms of a ratio to their total assets and refer to consolidated banking group statements in the case of French groups. Balance sheet items of subsidiaries of foreign groups are measured on an unconsolidated basis. *Bank loans* is the ratio of drawn credit to firms to the bank's total assets. *Bank Capital* is the unweighted Tier 1 capital-to-assets ratio. *Bank Liquid Assets* and *Bank Interbank Liabilities* are, respectively, the ratios of cash and interbank loans, and of total interbank liabilities (excluding liabilities vis-à-vis the Eurosystem) to total assets. *MRO User* is a dummy variable indicating participation in the Eurosystem's regular refinancing operations before the LTROs. *LTRO Maturity Swap* measures the substitution of 3-year LTRO funding for ECB funding of shorter maturity (as a proportion of total assets), while *Quant. Easing* measures the overall increase of ECB borrowing by the banking group (as a proportion of total assets). *Nb of banks* refers to the number of subsidiaries of each banking group for which we observe bank-firm credit linkages in September 2011. *Bank Bond Rollover* is the ratio (as a percentage) of the total bond issues of the group that are expected to mature over the years 2012-2014, to total assets as of June 2011.

TABLE 2. Characteristics of banking groups in the sample by LTRO bidding behaviour

	No LTRO <i>N</i> = 14	LTROs <i>N</i> = 10	LTRO 1 <i>N</i> = 6	LTRO 2 <i>N</i> = 8
Total Assets (bns)	11.72	1,170.24	1,908.57	1,105.63
Total Assets Growth	2.30	2.31	-0.77	1.84
Loans	51.52	17.79	8.04	19.87
Total Credit Growth	-3.36	1.27	-3.77	2.08
Drawn Credit Growth	-7.14	0.63	-3.92	1.12
Interbank Assets	25.05	10.29	14.24	8.30
Securities Portfolio	6.18	29.88	31.61	28.13
Capital	7.94	8.11	4.83	9.20
Interbank Liabilities	43.70	14.62	13.58	14.86
Deposits	22.94	25.95	35.11	24.66
Provisions	0.62	1.12	0.32	1.35
LTRO	0.00	2.76	1.47	2.97
LTRO Maturity Swap	0.00	0.69	1.16	0.49
Quant. Easing	0.24	2.28	0.68	2.47
Nb of indiv. banks included	2.57	27.70	43.00	22.38

Note. This table presents the mean of selected characteristics of the 24 selected banking groups (thereafter banks), sorted by their LTRO bidding behavior. Column (1) refers to banks that did not bid in the LTROs, column (2) to LTRO bidders, columns (3-4) to banks that bid in the first LTRO round, or in the second round respectively (note that some groups bid in both). Bank total assets, total credit to firms (incl. credit lines) and drawn credit to firms (the latter two aggregated from credit register information) are expressed in billions of euros. Total credit growth is given as a percentage. Unless otherwise stated, the other rows refer to ratios of the mentioned balance sheet item to total assets of the bank (as a percentage). All balance sheet variables are measured as of June 2011 and refer to consolidated banking group statements in the case of French groups. Balance sheet items of subsidiaries of foreign groups are measured on an unconsolidated basis. See the note of Table 1 for more details on the definition of the variables.

TABLE 3. Descriptive statistics for firms in the sample

	N	mean	p50	sd	p10	p90
<i>All firms</i>						
Total Credit Growth	1.17e+06	-5.71	-8.00	30.21	-31.30	21.55
Total Credit	1.17e+06	1,093.05	153.00	41,997.11	46.00	780.00
ECB Eligibility Status	1.17e+06	0.05	0.00	0.21	0.00	0.00
Relationship Age	1.17e+06	0.67	1.00	0.47	0.00	1.00
Nb of Banks	1.17e+06	1.25	1.00	0.64	1.00	2.00
with BS info	1.17e+06	0.06	0.00	0.23	0.00	0.00
<i>Monobank firms</i>						
Total Credit Growth	960,494	-7.58	-8.34	26.62	-31.51	13.63
Total Credit	960,494	330.36	128.00	7,733.52	43.00	493.00
ECB Eligibility Status	960,494	0.03	0.00	0.17	0.00	0.00
Relationship Age	960,494	0.64	1.00	0.48	0.00	1.00
Nb of Banks	960,494	1.00	1.00	0.00	1.00	1.00
with BS info	960,494	0.03	0.00	0.17	0.00	0.00
<i>Multi-bank firms</i>						
Total Credit Growth	211,209	2.82	-5.94	41.85	-30.54	44.63
Total Credit	211,209	4,561.44	417.00	97,457.69	116.00	3,242.00
ECB Eligibility Status	211,209	0.14	0.00	0.34	0.00	1.00
Relationship Age	211,209	0.76	1.00	0.43	0.00	1.00
Nb of Banks	211,209	2.41	2.00	0.82	2.00	3.00
with BS info	211,209	0.17	0.00	0.38	0.00	1.00
<i>Subsample of multi-bank firms with balance sheet information</i>						
Total Credit Growth	36,750	10.07	-0.98	51.59	-35.03	66.01
Total Credit	36,750	7,434.00	664.00	111,428.99	145.00	5,330.50
ECB Eligibility Status	36,750	0.40	0.00	0.49	0.00	1.00
Relationship Age	36,750	0.82	1.00	0.38	0.00	1.00
Nb of Banks	36,750	2.80	2.00	1.10	2.00	4.00
Nb Employees	36,750	85.24	20.00	1,362.68	4.50	115.50
Size	36,750	42,986.64	2,872.29	1.15e+06	770.64	23,291.50
Profitability	36,750	-0.14	0.04	20.31	-0.01	0.15
Financial Soundness	36,750	0.59	0.77	15.22	0.11	1.03

Note. This table presents descriptive statistics for firms in our sample. Multi-bank firms refer to firms that received credit from at least two different banks in September 2011. In contrast, monobank firms are defined as firms that have a credit relationship with only one banking group. *Total credit* includes undrawn credit lines and is expressed in thousands of euros. Growth rates are given as a percentage. *ECB Eligibility Status* is a dummy variable that takes the value of one if the firm's rating makes loans to this firm eligible as collateral for refinancing operations with the Eurosystem. *Relationship Age* is a dummy that takes the value of one if the average length of a firm's credit relationship with its lenders is above three years. *Nb of Banks* stands for the number of lenders to which a given firm is connected. *Firm with BS info* denotes firms for which detailed balance sheet information is available (from the FIBEN database). All firms' balance sheet and structural variables are averages over the 2010 and 2011 year-end values. *Size* is the firm's total asset size in thousands of euro. *Profitability* is the ratio of net operating profits to net turnover (as a percentage). *Financial Soundness* is the ratio of earnings before tax to earnings before net interest payments and tax (as a percentage).

TABLE 4. Descriptive statistics for multi-bank firms in the sample, sorted by borrower size

	Very Small	Small	Interm.	Large
<i>All multi-bank firms</i>				
Nb of firms	29,325	110,374	61,307	10,203
Total Credit	100	311	1,451	16,844
Total Credit Growth	-6.56	-6.73	-5.34	-0.98
Nb of Banks (incl. non-selected)	2.00	2.00	3.00	4.00
<i>multi-bank firms with balance sheet information</i>				
Nb of firms	3,366	15,861	14,988	2,641
Total Credit	97.00	347.00	1,605.00	15,885.00
Size	954.25	1,519.99	5,724.39	58,221.50
Nb Employees	12.00	15.50	33.50	102.00

Note. This table reports the median of listed variables across multi-bank firms in our sample (unless otherwise stated), sorted by the size of their total bank borrowings in September 2011. Multi-bank firms refer to firms that received credit from at least two different banking groups. *Total credit* includes undrawn credit lines and is expressed in thousands of euro, as is *firm size* (which is measured with total assets). Growth rates are given as a percentage. *Nb of Banks* stands for the number of lenders to which a given firm is connected. Firm with balance sheet information are firms for which detailed balance sheet information is available from the FIBEN database. *Nb Employees* refers to the size of staff in units.

TABLE 5. Impact of the 3-year LTROs on bank lending to firms

	Total LTROs		Round 1 Round 2 Round 1				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank LTRO	-0.16 (0.46)	0.34 (0.25)	0.28* (0.14)	0.60** (0.26)	0.93*** (0.34)	0.05 (0.33)	
Maturity Swap							3.23*** (0.93)
Quantitative Easing							-0.07 (0.46)
Bank Size				0.03 (0.33)	-0.28 (0.32)	-0.17 (0.41)	-0.15 (0.31)
Bank Liquid Assets				-0.12* (0.07)	-0.04 (0.06)	-0.07 (0.07)	-0.05 (0.06)
Bank Capital				0.35*** (0.10)	0.46*** (0.10)	0.38*** (0.10)	0.61*** (0.12)
Bank Interbank Liabilities				0.29*** (0.07)	0.23*** (0.05)	0.21*** (0.08)	0.30*** (0.06)
ECB MRO User				7.28*** (2.05)	8.36*** (1.97)	8.84*** (2.28)	5.83*** (1.69)
Foreign Bank				-0.36 (1.54)	-2.43* (1.44)	-1.47 (1.95)	-3.85*** (1.41)
Public Bank				-9.69*** (2.48)	-7.79*** (2.09)	-7.85*** (2.53)	-9.00*** (2.03)
Multi-bank firms	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	Yes	Yes	Yes
N	1,390,270	428,594	428,594	428,594	428,594	428,594	428,594
R ²	0.00	0.00	0.53	0.54	0.54	0.54	0.54

Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of credit volume for each selected firm-bank pair over the period from September 2011 to September 2012 (as a percentage). Credit is defined as total committed credit (drawn and undrawn) in all columns. The sample is restricted in all regressions to firms that have at least two banking relationships, except in column (1) which provides with results on all firms. *Bank LTRO* measures the ratio of the total amounts borrowed in the two 3-year LTROs by the lending bank, to this bank's total assets (as a percentage). In columns (5) and (6), this refers to the uptake in the first and second rounds of the LTROs respectively. *LTRO Maturity Swap* measures the substitution of 3-year LTRO funding for ECB funding of shorter maturity (as a proportion to total assets), while *Quant. Easing* measures the overall increase of ECB borrowing by the banking group (as a proportion to total assets). In column (7), this refers to the same measures as derived from the first round of LTROs. Bank controls are consolidated balance sheet variables and ratios (as of June 2011) and dummy variables for participation in standard refinancing operations, state-owned institutions and foreign subsidiaries. See the note in Table 1 for more details. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level (210 clusters). The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 6. Determinants of LTRO bids by selected banks, first vs second round.

	Prob. of bid		LTRO/A.	
	LTRO1 (1)	LTRO2 (2)	LTRO1 (3)	LTRO2 (4)
Bank Capital	-0.17* (0.09)	0.03 (0.04)	-0.28* (0.14)	0.30* (0.16)
N	24	24	24	24
Pseudo R^2	0.15	0.02	0.12	0.05

Note. Columns (1-2) of this table present the results of a Probit regression, where the dependent variable is a dummy variable indicating whether a bank bid or not in the specified LTRO round, while columns (3-4) present the results of Tobit regressions, where the dependent variable is a bank's uptake of the specified LTRO round to this bank's total assets (as a percentage). Bank-specific regressors are defined in Table 1 above. A constant is included but not shown. Robust standard errors are shown in brackets. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 7. Placebo regressions: “impact” of the 3-year LTROs on bank lending to firms one year before (over Sept. 2010-Sept. 2011)

	Total LTROs			Round 1	Round 2	Round 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank LTRO	-0.43 (0.55)	-0.31 (0.40)	-0.52 (0.42)	-0.03 (0.84)	0.09 (1.56)	-0.14 (0.47)	
Maturity Swap							2.00 (1.59)
Quantitative Easing							-0.64 (1.79)
Bank Size				0.02 (0.55)	0.03 (0.59)	-0.04 (0.64)	0.16 (0.57)
Bank Liquid Assets				-0.14 (0.09)	-0.14** (0.06)	-0.13** (0.06)	-0.10 (0.07)
Bank Capital				0.08 (0.29)	0.09 (0.33)	0.12 (0.31)	0.27 (0.34)
Bank Interbank Liabilities				0.15 (0.13)	0.16*** (0.05)	0.14* (0.08)	0.19*** (0.05)
ECB MRO User				3.49 (2.81)	3.36 (2.76)	3.78 (3.25)	3.33 (2.67)
Foreign Bank				-1.25 (2.29)	-1.28 (2.65)	-1.57 (2.32)	-2.04 (3.67)
Public Bank				-6.64* (3.89)	-6.60*** (2.00)	-6.32** (2.92)	-6.36*** (2.24)
Multi-bank firms	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	Yes	Yes	Yes
N	1,150,864	360,836	360,836	357,311	357,311	357,311	357,311
R ²	0.00	0.00	0.59	0.59	0.59	0.59	0.59

Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of credit volume for each selected firm-bank pair over the period from September 2010 to September 2011 (as a percentage). Credit is defined as total committed credit (drawn and undrawn) in all columns. The sample is restricted in all regressions to firms that have at least two banking relationships, except in column (1) which provides with results on all firms. *Bank LTRO* measures the ratio of total amounts borrowed in the two 3-year LTROs by the lending bank to this bank’s total assets (as a percentage). In columns (5) and (6), this refers to the uptake in the first and second rounds of LTROs, respectively. *LTRO Maturity Swap* measures the substitution of 3-year LTRO funding for ECB funding of shorter maturity (as a proportion of total assets), while *Quant. Easing* measures the overall increase of ECB borrowing by the banking group (as a proportion of total assets). In column (7), this refers to the same measures as derived from the first round of LTROs. Bank controls are consolidated balance sheet variables and ratios (as of June 2010) and dummy variables for participation in standard refinancing operations, state-owned institutions and foreign subsidiaries. See the note in Table 1 for more details. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 8. Impact of the first round of 3-year LTROs on bank lending to firms. Adding bank balance sheet controls.

	(1)	(2)	(3)	(4)	(5)
Bank LTRO Round 1	0.98*** (0.34)	0.94*** (0.34)	0.91** (0.35)	1.16*** (0.37)	1.10*** (0.39)
Bank Size	-0.27 (0.31)	-0.33 (0.33)	-0.39 (0.32)	0.07 (0.37)	-0.38 (0.34)
Bank Liquid Assets	-0.05 (0.06)	-0.04 (0.06)	-0.03 (0.06)	-0.02 (0.06)	-0.02 (0.06)
Bank Capital	0.50*** (0.10)	0.47*** (0.10)	0.48*** (0.11)	0.38*** (0.10)	0.44*** (0.10)
Bank Interbank Liabilities	0.21*** (0.05)	0.23*** (0.05)	0.21*** (0.06)	0.15*** (0.06)	0.23*** (0.05)
ECB MRO User	6.54*** (1.90)	8.06*** (1.82)	8.28*** (1.91)	7.54*** (2.00)	8.58*** (2.06)
Foreign Bank	-2.00 (1.45)	-2.30 (1.45)	-2.77* (1.45)	-1.91 (1.46)	-3.16* (1.65)
Public Bank	-6.71*** (2.22)	-7.95*** (2.11)	-7.53*** (2.10)	-3.15 (2.89)	-7.03*** (1.79)
Bank Loans	-0.03* (0.02)				
Bank Undrawn Commit.		-0.03 (0.02)			
Bank Eligib. Loans			-0.03 (0.03)		
Bank Securities Portfolio				-0.06 (0.04)	
Bank Deposits					0.03 (0.03)
N	428,594	428,594	428,594	428,594	428,594
R ²	0.54	0.54	0.54	0.54	0.54

Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of credit volume for each selected firm-bank pair over the period from September 2011 to September 2012 (as a percentage). Credit is defined as total committed credit (drawn and undrawn) in all columns. The sample is restricted in all regressions to firms that have at least two banking relationships. *Bank LTRO Round 1* measures the ratio of amounts borrowed in the first 3-year LTRO by the lending bank, to this bank's total assets (as a percentage). *Loans*, *Undrawn* are the ratios of loans and undrawn credit lines for all resident entities of a group to the consolidated assets of this group. *Eligible loans* is the ratio of ECB eligible loans to loans for all resident entities of the group. Other bank variables are as defined in the note of Table 1 above. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 9. Impact of the first round of 3-year LTROs on bank lending to firms. Controlling for the EBA Capital exercise of 2011 and sample limited to French groups.

	All banks			French banks		
Bank LTRO Round 1	2.27***		0.60*		1.29***	
	(0.64)		(0.36)		(0.41)	
Maturity Swap		3.16***		6.61*		5.88**
		(0.92)		(3.40)		(2.94)
Quant. Easing		0.27		-0.61		0.43
		(0.56)		(0.75)		(0.71)
Bank Size	-0.35	-0.15	-0.09	-1.59	-5.76**	-6.72***
	(0.31)	(0.31)	(0.72)	(1.20)	(2.24)	(1.82)
Bank Liquid Assets	-0.04	-0.06	-0.19	0.33	0.69*	1.05***
	(0.06)	(0.06)	(0.19)	(0.36)	(0.37)	(0.37)
Bank Capital	0.51***	0.61***	0.62***	0.68***	0.58***	0.62***
	(0.10)	(0.12)	(0.19)	(0.19)	(0.17)	(0.17)
EBA Capital Shortfall	-2.23**	-0.51				
	(0.88)	(0.54)				
Bank Interbank Liabilities	0.25***	0.30***	0.30***	0.34***	0.17*	0.20**
	(0.05)	(0.06)	(0.11)	(0.10)	(0.09)	(0.09)
ECB MRO User	7.28***	5.59***	8.37**	9.24***	27.00***	26.97***
	(1.70)	(1.73)	(3.24)	(2.96)	(7.70)	(6.14)
Foreign Bank	-3.90**	-4.27***				
	(1.52)	(1.54)				
Public Bank	-8.37***	-9.15***	-11.69***	-9.31**	-19.81***	-17.54***
	(2.00)	(2.05)	(4.27)	(3.71)	(5.30)	(4.55)
Bank Bond Rollover					-0.86***	-0.86***
					(0.29)	(0.22)
N	428,594	428,594	405,509	405,509	405,509	405,509
R ²	0.54	0.54	0.56	0.56	0.56	0.56

Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of credit volume for each selected firm-bank pair over the period from September 2011 to September 2012 (as a percentage). Credit is defined as total committed credit (drawn and undrawn) in all columns. The sample is restricted in all regressions to firms that have at least two banking relationships. Columns (1-2) refer to all selected banks, while columns (3-6) refer to French banking groups only. *Bank LTRO Round 1* measures the ratio of amounts borrowed in the first 3-year LTRO by the lending bank to this bank's total assets (as a percentage). *LTRO Maturity Swap* measures the substitution of 3-year LTRO funding for ECB funding of shorter maturity (as a proportion of total assets), while *Quant. Easing* measures the overall increase of ECB borrowing by the banking group (as a proportion of total assets). *EBA Capital Shortfall* is the capital shortfall of a banking group in terms of its ratio of Core equity Tier 1 to RWA, as measured by the EBA in October 2011 as part of their 2011 Capital Exercise (ratio measured as of September 2011). Negative shortfalls, i.e., capital surplus positions, are set to zero. Other bank variables are as defined in the note of Table 1 above. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 10. Impact of the first round of LTROs on bank lending to firms, by size of borrowers

	(1) All	(2) Very Small	(3) Small	(4) Interm.	(5) Large
Bank LTRO Round 1	0.93*** (0.34)	0.41 (0.52)	0.31 (0.40)	0.99** (0.40)	3.30*** (0.51)
Bank Size	-0.28 (0.32)	-0.17 (0.54)	-0.33 (0.34)	-0.48 (0.43)	1.08** (0.51)
Bank Liquid Assets	-0.04 (0.06)	-0.14 (0.12)	-0.11 (0.06)	-0.11 (0.08)	-0.03 (0.06)
Bank Capital	0.46*** (0.10)	0.57** (0.22)	0.42*** (0.13)	0.36*** (0.13)	0.63*** (0.12)
Bank Interbank Liabilities	0.23*** (0.05)	0.35** (0.15)	0.26*** (0.08)	0.25*** (0.07)	0.28*** (0.05)
ECB MRO User	8.36*** (1.97)	10.75*** (3.66)	10.86*** (2.41)	7.69*** (2.14)	-1.93 (2.77)
Foreign Bank	-2.43* (1.44)	-3.19 (2.58)	-1.48 (1.57)	-1.67 (1.85)	-1.25 (2.12)
Public Bank	-7.79*** (2.09)	-14.31*** (4.85)	-10.48*** (2.91)	-9.85*** (2.99)	1.19 (2.02)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
N	428,594	44,372	208,630	143,749	31,843
R ²	0.54	0.71	0.56	0.46	0.40

Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of committed credit volume for each selected firm-bank pair over the period from September 2011 to September 2012 (as a percentage). The sample is restricted in all regressions to firms that have at least two banking relationships. Firms are sorted into size buckets according to the distribution of total bank credit across firms in September 2011. Column (1) repeats the results for all multi-bank firms, while columns (2-5) present the results of separate regressions run on sub-samples of firms sorted by borrowing size. *Very Small* firms are below the median, *Small* in the 6th to 9th deciles, *Intermediate* in the 90th to 99th percentiles, *Large* in the top percentile of the credit size distribution. *Bank LTRO Round 1* measures the ratio of total amounts borrowed in the first 3-year LTRO by the lending bank, to this bank's total assets (as a percentage). Bank controls are consolidated balance sheet variables and ratios (as of June 2011) and dummy variables for participation in standard refinancing operations, state-owned institutions and foreign subsidiaries. See the note in Table 1 for more details. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 11. Impact of the first round of LTROs on bank lending to firms, firms sorted by number of employees

	(1) All	(2) $N < 10$	(3) $10 < N < 50$	(4) $50 < N < 250$	(5) $N > 250$
Bank LTRO Round 1	0.93*** (0.34)	0.71** (0.32)	2.25*** (0.51)	2.73*** (0.83)	3.08*** (1.12)
Bank Size	-0.28 (0.32)	-0.35 (0.33)	-0.27 (0.69)	-0.07 (0.55)	-0.87 (1.05)
Bank Liquid Assets	-0.04 (0.06)	-0.01 (0.06)	-0.21 (0.14)	-0.10 (0.11)	-0.08 (0.11)
Bank Capital	0.46*** (0.10)	0.44*** (0.11)	0.46 (0.29)	0.74*** (0.18)	0.93*** (0.33)
Bank Interbank Liabilities	0.23*** (0.05)	0.21*** (0.05)	0.40*** (0.13)	0.23*** (0.08)	0.26*** (0.08)
ECB MRO User	8.36*** (1.98)	8.42*** (2.19)	8.41** (3.55)	8.83** (3.45)	5.97 (5.61)
Foreign Bank	-2.43* (1.43)	-2.77* (1.52)	-0.56 (3.02)	-3.56 (2.64)	-5.59 (4.74)
Public Bank	-7.79*** (2.09)	-7.38*** (2.09)	-13.91** (5.49)	-6.92** (3.38)	-6.29 (4.18)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
N	428,594	367,634	40,611	15,911	4,438
R^2	0.54	0.55	0.51	0.46	0.46

Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of committed credit volume for each selected firm-bank pair over the period from September 2011 to September 2012 (as a percentage). The sample is restricted in all regressions to firms that have at least two banking relationships. Firms are sorted into size buckets according to their number of employees as of end 2010 (below 10, between 10 and 50, between 50 and 250, above 250). *Bank LTRO Round 1* measures the ratio of total amounts borrowed in the first 3-year LTRO by the lending bank, to this bank's total assets (as a percentage). Bank controls are consolidated balance sheet variables and ratios (as of June 2011) and dummy variables for participation in standard refinancing operations, state-owned institutions and foreign subsidiaries. See the note in Table 1 for more details. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 12. Impact of the first round of LTROs on the probability of maintaining an existing bank-firm credit exposure, by size of borrower

	(1) All	(2) Very Small	(3) Small	(4) Interm.	(5) Large
Bank LTRO Round 1	0.01 (0.01)	-0.00 (0.01)	0.00 (0.01)	0.01** (0.00)	0.01** (0.01)
Bank Size	0.03*** (0.01)	0.05*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.02*** (0.01)
Bank Liquid Assets	-0.00* (0.00)	-0.00** (0.00)	-0.00 (0.00)	-0.00** (0.00)	-0.00 (0.00)
Bank Capital	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)
Bank Interbank Liabilities	0.00** (0.00)	0.00** (0.00)	0.00 (0.00)	0.00** (0.00)	0.00** (0.00)
ECB MRO User	-0.01 (0.04)	0.01 (0.04)	0.01 (0.05)	-0.02 (0.03)	-0.05* (0.03)
Foreign Bank	0.04 (0.03)	0.09** (0.04)	0.07 (0.04)	0.02 (0.02)	-0.05 (0.03)
Public Bank	0.05* (0.03)	0.05 (0.07)	0.04 (0.05)	0.03 (0.03)	0.06** (0.02)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
N	526,672	67,778	252,489	168,643	37,212
R ²	0.52	0.54	0.50	0.45	0.43

Note. This table presents the results of linear probability regressions, where the dependent variable is a dummy variable taking the value of one if the level of committed credit volume for a selected firm-bank pair is strictly positive in September 2012. The sample is restricted in all regressions to firms that have at least two active banking relationships in September 2011. Firms are sorted into size buckets according to the distribution of total bank credit across firms in September 2011. Column (1) shows the results for all multi-bank firms, while columns (2-5) present the results of separate regressions run on sub-samples of firms sorted by borrowing size. *Very Small* firms are below the median, *Small* in the 6th to 9th deciles, *Intermediate* in the 90th to 99th percentiles, and *Large* in the top percentile of the credit size distribution. *Bank LTRO Round 1* measures the ratio of total amounts borrowed in the first 3-year LTRO by the lending bank to this bank's total assets (as a percentage). Bank controls are consolidated balance sheet variables and ratios (as of June 2011) and dummy variables for participation in standard refinancing operations, state-owned institutions and foreign subsidiaries. See the note in Table 1 for more details. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 13. First LTRO round and credit supply to firms: non-linear firm effects

Interaction term (<i>X</i>)	(1) Eligible	(2) ACC	(3) Nb Bk	(4) Relation.	(5) Profitab.	(6) Fin. Sound.
	<i>All firms</i>			<i>Firms with BS info</i>		
Bank LTRO Round 1	0.93** (0.38)	0.72** (0.31)	-0.45 (0.50)	2.99*** (0.45)	2.24*** (0.37)	2.23*** (0.36)
X*LTRO Round 1	-0.01 (0.53)	1.89*** (0.45)	0.47*** (0.15)	-2.91*** (0.33)	0.01** (0.00)	0.00 (0.01)
N	428,594	428,594	428,594	428,594	81,502	81,620
R ²	0.54	0.54	0.54	0.54	0.51	0.51
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes

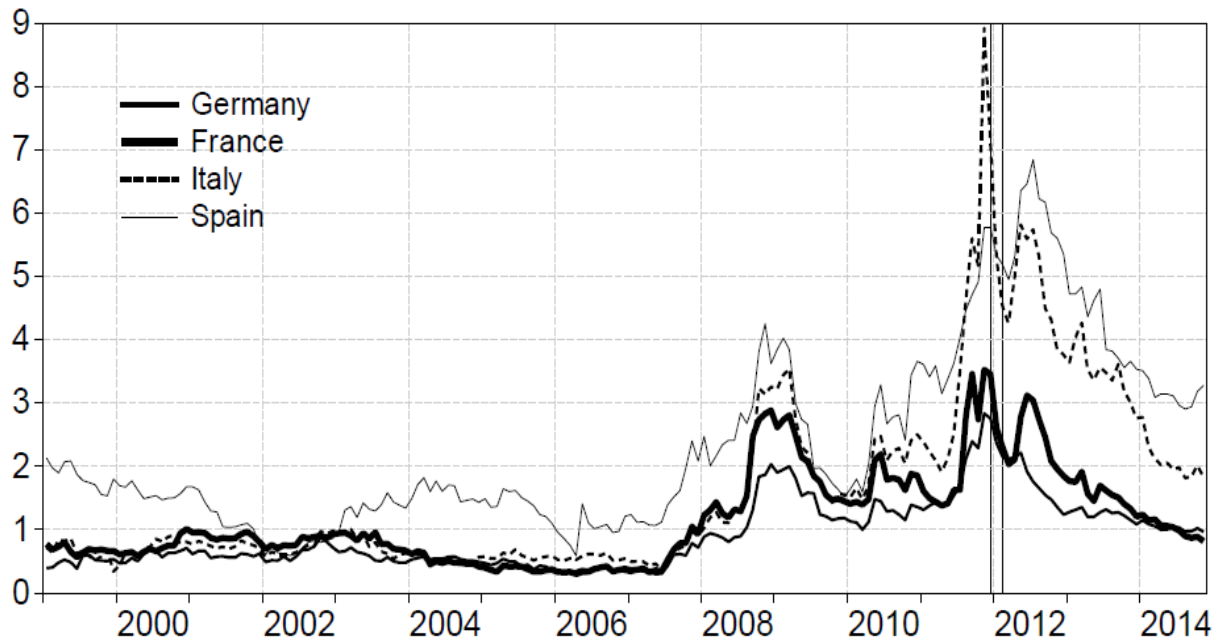
Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of committed credit volume (drawn and undrawn) for each selected firm-bank pair over the period from September 2011 to September 2012 (as a percentage). The sample is restricted in all regressions to firms that have at least two banking relationships. *ECB Eligibility Status* is a dummy variable that takes the value of one if the firm's rating makes loans to this firm eligible as collateral for refinancing operations with the Eurosystem. *Firm ACC Status* is a dummy variable that takes the value of one if the firm's rating makes loans to this firm eligible as collateral as part of the Additional Credit Claim category. *Firm Relationship Age* is a dummy that takes the value of one if the average length of a firm's credit relationship with its lenders is above three years. *Profitability* is the ratio of net operating profits to net turnover (as a percentage). *Financial Soundness* is the ratio of earnings before tax to earnings before net interest payments and tax (as a percentage). *Bank LTRO Round 1* measures the ratio of total amounts borrowed in the first round of 3-year LTROs by the lending bank to this bank's total assets (as a percentage). Bank controls are consolidated balance sheet variables and ratios (as of June 2011) and dummy variables for participation in standard refinancing operations, state-owned institutions and foreign subsidiaries. See the note in Table 1 for more details. A constant is included but not shown. Standard errors in brackets are clustered at the bank*firm sector (NAF 1 digit) level. The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

TABLE 14. Credit substitution at the firm level

	(1)	(2)	(3)	(4)	(5)	(6)
	Total of two LTRO rounds			LTRO 1	LTRO 2	
Bank LTRO	0.32 (0.20)	0.39** (0.19)	0.40* (0.21)	0.30 (0.28)	0.75** (0.32)	-0.02 (0.20)
Small borrower	1.07** (0.44)	1.78*** (0.61)	1.70** (0.66)	1.60** (0.63)	1.84*** (0.59)	1.23 (0.80)
Interm. borrow.	3.35*** (0.89)	4.43*** (0.49)	4.22*** (0.55)	4.06*** (0.55)	4.37*** (0.56)	3.55*** (0.78)
Large borrow.	7.29*** (1.38)	8.92*** (0.89)	8.58*** (0.95)	8.19*** (0.77)	8.45*** (0.85)	7.62*** (1.01)
Av. Relationship Age			-1.34 (0.99)	-1.36 (1.01)	-1.34 (1.02)	-1.37 (1.00)
Eligibility			1.39*** (0.27)	1.32*** (0.31)	1.33*** (0.31)	1.30*** (0.30)
ACC			2.11*** (0.34)	2.08*** (0.36)	2.09*** (0.36)	2.06*** (0.35)
Sector fixed effects	No	Yes	Yes	Yes	Yes	Yes
Bank controls	No	No	No	Yes	Yes	Yes
N	182,248	182,248	182,248	182,248	182,248	182,248
R ²	0.01	0.06	0.06	0.06	0.06	0.06

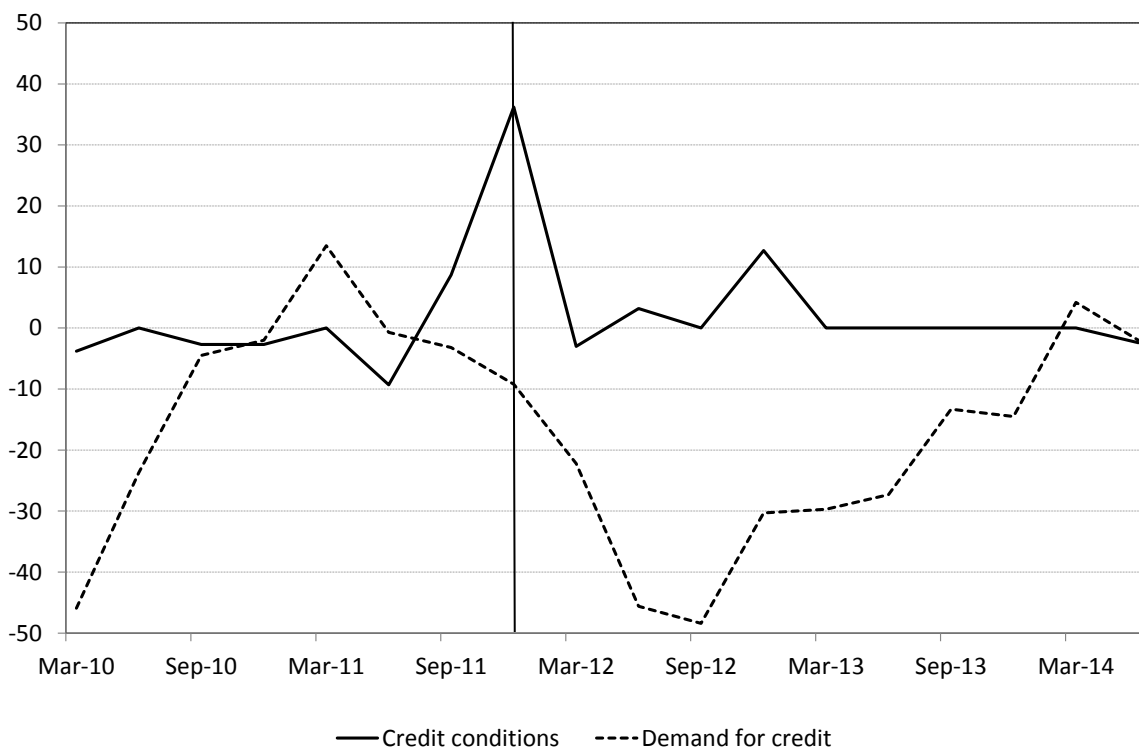
Note. This table presents the results of OLS regressions, where the dependent variable is the change in the (log) level of granted bank credit (drawn and committed, but yet undrawn) for each selected firm over the period from September 2011 to September 2012 (as a percentage). *Bank LTRO* measures the weighted average ratio of total amounts borrowed in the LTROs by a bank lending to a given firm to this bank's total assets (as a percentage) and weighted by the share of this bank in total bank borrowing by this firm. The sample is restricted in all regressions to firms that have at least two banking relationships with selected banking groups, so as to compare with the results of previous regressions run at the bank-firm level. Columns (1-4) refer to the total uptake in both LTROs, while columns (5-6) refer to Rounds 1 and 2 of the LTROs respectively. Firms are sorted into size buckets according to the distribution of total bank credit across firms in September 2011. *Very Small* firms are below the median, *Small* in the 6th to 9th deciles, *Intermediate* in the 90th to 99th percentiles, and *Large* in the top percentile of the credit size distribution. *ECB Eligibility Status* is a dummy variable that takes the value of one if the firm's rating makes loans to this firm eligible as collateral for refinancing operations with the Eurosystem. *ACC Status* is a dummy variable that takes the value of one if the firm's rating makes loans to this firm eligible as collateral as part of the Additional Credit Claim category. *Av. Relationship Age* is a dummy that takes the value of one if the average length of a firm's credit relationship with its lenders is above three years. *Bank controls* are weighted averages across all banks' lending to a given firm of bank controls used in Table 5 regressions and defined in Table 1. The weights are the share of each bank in total bank borrowing by this firm. A constant is included but not shown. Sector fixed effects relate to the detailed industry level (NAF 5 digits, representing about 730 sectors present in our sample). Standard errors in brackets are clustered at the broad industry level (NAF 2 digits, representing 89 clusters present in our sample). The symbols *, ** and *** denote significant coefficients at the 10, 5 and 1 percent levels respectively.

FIGURE 1. Bond spreads for euro area banks



Note. This figure shows for each country the average spread of bank bonds with the German Bund. Aggregate spreads are computed from individual bond data following the methodology in Gilchrist and Mojon (2014). Vertical lines stand for the two rounds of LTROs.

FIGURE 2. Tightness of credit conditions (credit supply) to, and demand for credit from non-financial corporations in France



Note. This figure shows the index of credit conditions for bank lending to non-financial firms (solid line) and the index for credit demand from non-financial firms (dashed line), as taken from the Eurosystem's Bank Lending Survey for France. Positive numbers denote tighter supply and stronger demand respectively. End-of-quarter figures refer to perceived changes over the previous three months.

A. List of banking groups

TABLE A.1. List of banking groups in sample

Code	Name of BHC	Nb. of banks	Public	Foreign
1163	BPCE	91	0	0
27	CREDIT AGRICOLE	59	0	0
29	CREDIT MUTUEL	34	0	0
768	BNP-PARIBAS	34	0	0
30	SOCIETE GENERALE	33	0	0
1133	CREDIT IMMOBILIER DE FRANCE	13	0	0
263	GENERAL ELECTRIC	11	0	1
160	HSBC HOLDINGS	7	0	1
129	ING	4	0	1
223	RABOBANK	4	0	1
52	RENAULT	3	0	0
291	COMMERZBANK	3	0	1
63	PSA PEUGEOT CITROEN	2	0	0
159	BARCLAYS	2	0	1
248	AGENCE FRANCAISE DE DEVELOPPEMENT	2	1	0
1024	OSEO	2	1	0
1186	ABN AMRO BANK	2	0	1
158	ESPIRITO SANTO	1	0	1
349	BBVA	1	0	1
839	MIZUHO FINANCIAL GROUP	1	0	1
923	JP MORGAN CHASE	1	0	1
970	HYPO REAL ESTATE	1	0	1
1033	MITSUBISHI UFJ FINANCIAL	1	0	1
40031	CDC	1	1	0

Note. Column (2) displays the number of individual banks considered in our sample for each selected banking group. This number may differ from the total number of affiliates of each group. French subsidiaries of foreign banks are treated as independent groups and are not consolidated with their holding companies overseas.

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