What happens when the ECB opens the cash tap? An application to the Portuguese credit market.

Miguel Cravo Ferreira

152417033

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Professor Diana Bonfim

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Miguel Cravo Ferreira
152417033

Abstract:

During the 2008 subprime crisis, central banks took unprecedented measures to restore financial markets. In an effort to boost the Eurozone economy, the ECB introduced the Targeted Longer-Term Refinancing Operations (TLTRO) to stimulate bank lending to the real economy. In this dissertation, using proprietary data from the Bank of Portugal, we show that the TLTRO intervention is positively related with an increase in credit granted to Portuguese firms. Nevertheless, these funds were transmitted to the economy mainly during the last three days of the month and through credit lines, which are riskier, given the lower credit worthiness of borrowers. We empirically confirm this fact, given the higher default rate *ex post*. We also find that companies held less cash after the TLTRO injection. However, the impact of these injections depends, to a great extent, on a company's marginal value of cash, where we find that highly levered firms increased their cash holdings, as opposed to less levered firms. Finally, we show that, after the ECB´s liquidity injection, Portuguese companies decreased their investments and instead used the extra funds as a liquidity buffer. Overall, we provide evidence on two previously undocumented effects of the ECB's Targeted Longer-Term Refinancing Operation: banks provided riskier loans and borrowers did not use the funds for investment purposes.

Keywords: TLTRO, liquidity injection, risk-taking, cash holdings, corporate investment

JEL classification: E52, E58, G32

O que acontece quando o Banco Central Europeu abre a torneira do dinheiro? Um estudo ao mercado português.

Miguel Cravo Ferreira
152417033

Sumário:

Durante a crise de 2008, os bancos centrais tomaram medidas inéditas de modo a estabilizar os mercados financeiros. Num esforço para melhorar a economia da Zona Euro, o BCE introduziu as *Targeted Longer-Term Refinancing Operations* (TLTRO), com o fim de estimular a concessão de crédito à economia. Nesta dissertação, usando dados confidenciais do Banco de Portugal, mostramos que a intervenção das TLTRO está positivamente correlacionada com a concessão de crédito a empresas portuguesas. Contudo, estes fundos foram transmitidos para a economia essencialmente durante os últimos três dias do mês e através de linhas de crédito, sendo mais arriscados, dado a menor qualidade de crédito dos devedores. Empiricamente, confirmamos este facto, tendo em conta a taxa de incumprimento superior *ex post.* Descobrimos ainda que as empresas mantiveram menos dinheiro em caixa, após as injeções das TLTRO. No entanto, o impacto destas injeções depende, em grande medida, do valor marginal do dinheiro para as empresas, onde concluímos que empresas muito alavancadas aumentaram as suas reservas de dinheiro, ao contrário de empresas menos endividadas. Finalmente, mostramos que, após as injeções de liquidez do BCE, as empresas portuguesas diminuíram o seu investimento, tendo antes usado os fundos como almofada de liquidez. No geral, encontramos provas que, na economia portuguesa, as operações de liquidez do BCE não estimularam a economia real por duas razões: os bancos providenciaram empréstimos mais arriscados e os devedores não usaram os fundos para efeitos de investimento.

Palavras-chave: TLTRO, injeção de liquidez, tomada de risco, tesouraria, investimento corporativo

Classificação JEL: E52, E58, G32

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1. Introduction

Since the 2008 global financial crisis, central banks took unprecedented measures to restore and preserve the normal functioning of financial markets. The mechanisms applied constitute the so-called unconventional monetary policies that had the objective of boosting liquidity supply and included large-scale asset purchases, the reduction of official interest rates and refinancing operations at low interest rates (Acharya et al., 2016; Driffill, 2016). Amongst the previously referred policies launched by the European Central Bank (ECB) is the introduction of the Targeted Longer-Term Refinancing Operations (TLTROs), announced in June 2014, and aimed to stimulate bank lending to the real economy.

In this dissertation, we study the transmission mechanism and the impact of the TLTROs in the Portuguese economy. More specifically, we answer to two main research questions. The first one concerns the financial products underlying the introduction of the TLTRO program, *id est*, how was this liquidity injection transmitted to the economy? After that, we study the corporate side of the program, *id est*, how did companies use this money? Both answers should be straightforward: term loans would be the transmission mechanism and companies were supposed to invest the money, as a way to improve the Portuguese economy. In this dissertation we prove the opposite.

The impact of unconventional monetary policies has developed significantly on the aftermath of the 2008 financial crisis and, consequently, the 2010 European sovereign debt crisis. There is no consensus on the impact of these actions. Some authors (Darracq-Paries and Santis, 2013; García-Posada and Marchetti, 2016; Benetton and Fantino, 2018) provide evidence that it positively impacts the economy, whereas some studies find it negligible and, sometimes, negative (Cycon and Koetter, 2015; Daetz et al., 2017). One of the main reasons why there is evidence of a negative impact derived from unconventional monetary policies arises from an increase in risk-taking from banks due to a lower funding rate – a phenomenon known as the risk-taking channel of monetary policy (Jiménez et al., 2009; Altunbas et al., 2009; Bonfim and Soares, 2018).

In our study, we use proprietary data from the Bank of Portugal, comprising all loans granted to non-financial Portuguese corporations, from 2013 to 2016. Our sample is composed by 47 banks, of which 32 participated in the TLTRO program.

We acknowledge that 38% of the total amount of loans is composed of credit lines and, for that reason, we divide our analysis into term loans and credit lines. We present detailed descriptive

statistics that illustrate the differences between the two referred forms of financing and, from a risk perspective, credit lines show a greater risk-taking behavior from banks. The average borrower of a credit line is younger, smaller, less profitable, more levered and less liquid than the average borrower of a term loan. For this reason, we report different results from Sufi (2007), who shows that firms with more reliable cash flows tend to be the ones holding credit lines. Not only the company's' risk profile is worse, but this fact is magnified by the fact the term loans are, on average, more collateralized than credit lines. However, there is evidence on, at least, a partially acknowledgment of the risk profile from loan officers: credit lines hold, on average, a higher interest rate (almost two times higher). As predictable, default rates measured 1-year after the concession are two times larger for credit lines. The weight of credit lines in the credit market has been rising throughout time, passing from 26% in 2014 to 47% in 2016. A curious fact is that the biggest improvement occurred from 2014 to 2015 – a 15 percentage points increase, precisely the time when the TLTROs were introduced. In addition, we analyze whether there is a repetition pattern of credit lines between the same company and bank and find evidence that 68% of the credit lines in our sample have a monthly pattern, which could be justified by the utilization of overdraft lines of credit, a tool used by companies when they need funds to satisfy their liquidity needs. We further expand our analysis by splitting our sample between banks that benefited from the TLTROs and banks that did not. We confirm that only the banks that got liquidity injections from the TLTROs show the same pattern from 2014 to 2015. In fact, banks that did not apply to the program show a decreasing weight of credit lines. For this reason, our findings go in line with Acharya et al. (2014) who show that, in case of a market liquidity dry-up, firms will rely more on cash holdings and less in credit lines. Our event is the opposite, since the TLTROs are, in simple terms, a liquidity boost in the market, but so is our conclusion.

The core objective of the TLTROs was to stimulate the real economy through bank lending. For that reason, we also study the end-of- month effect, *id est*, the percentage of loans granted by the last three days of the month (as in Cao et al., 2018). There is prior research that proves a risk-taking behavior by the month-end: banks provide loans to riskier companies with lower prospects. In order to study the prospects of the Portuguese companies during the TLTRO intervention, we perform Cao et al. (2018) analysis and we start by acknowledging that the end-of-month effect represents, on average, 38% of all loans granted in our time period. After analyzing the daily evolution of credit concession in Portugal, we can see a major spike in the end-of-month effect by December 2014. This effect matches the introduction of the TLTROs

and, as a robustness check, we confirm that only banks that benefited from the TLTROs show the same pattern. For these reasons, we have evidences that the TLTROs were transmitted by the end of each month. The question that remains regards the specificities of the companies that get credit lines during the last three days of the month: compared with credit lines granted during the rest of the month, these companies are smaller, younger, less tangible, profitable and liquid and more levered, hence riskier, going in line with the findings of Tzioumis and Gee, 2013. The TLTROs were transmitted using credit lines, by the end of the month, to companies that present worse prospects. The one-year default rate is 4.5x larger for credit lines granted by the end of the month, compared with the rest of the month. Moreover, using a difference in differences model, we prove that loans conceded in the Portuguese credit market once the TLTROs came in play, became riskier, mainly due to the rise in credit lines.

Moving from the supply-side to the demand-size of the economy, we investigate the impact on Portuguese corporations of this monetary policy tool. The reason we do so is to check whether the original objective of this unconventional monetary policy was fulfilled: "offer long-term funding at attractive conditions to banks in order to further ease private sector credit conditions and stimulate bank lending to the real economy".

First, to prove whether the transmission mechanism fulfilled the ECB's goal and banks transmitted the extra funds to companies, we perform several tests comprising differences in the companies' size, the evolution of the amount in credit lines facilities used and the impact on the companies' leverage due to the introduction of the TLTROs, as a way of studying if there was a liquidity movement from the banks to the companies. Overall, we find evidence that banks transmitted, at least, part of the TLTRO funds to the non-financial institutions and that the TLTROs enhanced credit supply to Portuguese firms.

We proceed with the analysis of the TLTRO's impact on corporate liquidity policies, by studying the evolution of companies' cash-holdings, while controlling for several determinants of it. We conclude that for companies that asked for loans to banks participating in the TLTROs, cash-holdings decreased (comparing *pre* with *post* TLTRO period), and for this reason we find contradictory results with the ones reported by Daetz et al. (2017). However, the impact of the TLTROs depends, to a great extent, on a company's marginal value of cash. For this reason, we extend our analysis and study the differences between the firm's' leverage. We divide companies according to their level of leverage and we confirm that firms with high leverage borrowing from banks that participated in the TLTRO increased their cash-holdings, as opposed

to firms with low leverage, which decreased their cash- holdings. This finding goes in line with the fact that companies with high leverage have a lower cost of carrying cash (Guney et al., 2017).

The final step of our study is to assess how firms used the liquidity injection provided by the TLTROs. Our prior intuition is to expect an increase in the levels of investment and employees' compensation, due to an easier access to the debt market. We regress both variables and conclude the opposite: both the levels of investment and employee compensation decreased for firms that borrowed from banks who participated in the TLTROs. For this reason, our findings go against Harford and Uysal (2014) who, using US data for 1990 to 2011, concluded the opposite regarding investment improvements. We believe that these contradictory results are due to precautionary measures taken by Portuguese companies, who used the loans obtained after the TLTROs as a liquidity buffer in case of a sudden money dry-up.

Our study provides a contribution to several fields of current research. Firstly, we add to the literature that studies the impact of unconventional monetary policies in the credit market. More specifically, our findings provide insights on the failure of the transmission mechanism. We show that, for the Portuguese market, the effect on corporate investment and employees' wages was not as expected: it decreased. For this reason, we find contradictory findings to Angelopoulo et al. (2014) and Harford and Uysal (2014). Moreover, firms used the TLTROs as a liquidity buffer, hence providing virtual equal results to Daetz et al. (2017). Several authors report an increasing trend in corporations investing in cash-holdings, such as Pinkowitz et al. (2015) and Azar et al. (2016), which fits in our results for the Portuguese market.

Secondly, and in a parallel fashion, these results go in line with the literature on bank risk-taking. By showing that banks transmitted the liquidity through risky overdraft lines of credit, we follow Agarwal et al. (2015), Cycon and Koetter (2015) and Daetz et al. (2017) who argue that monetary interventions prove to be ineffective in stimulating the economy. Furthermore, we contribute to the ongoing research trend on increasing risk-taking arising through a relaxation on interest rates (Jiménez et al., 2009; Paligorova and Santos, 2017; Bonfim and Soares, 2018).

Lastly, we develop the literature on the end-of-period effect in a banking context. Past research has studied this effect in non-financial activities (Asch, 1990; Oyer, 1998; Larkin, 2007; Liebman and Mahoney, 2017), but its consequences on banks, consequently in the credit market, is still a recent research trend. Since we provide evidence that 38% of loans are granted

by the last three days of the month (and these loans have worse prospects, hence higher default rates), we report similar findings to Tzioumis and Gee (2013) and Cao et al. (2018), who show an increasing trend of loan officers to increase their output towards the end of the month.

The remainder of our dissertation continues as follows. In Section 2, we display a summary of the current research streams in which our study is inserted. In Section 3, we provide details on the data we used, as well as descriptive statistics on it. Section 4 reports our findings regarding the supply side of the economy, in our case the Portuguese credit market, while Section 5 approaches the real side of the economy, mainly how did the borrowers used the funds. We conclude in Section 6 and present our references, figures & tables and appendices in Section 7, 8 and 9, respectively. For more information regarding ECB liquidity injections, please refer to Appendix B.

2. Literature Review

Academic research on the field of empirical banking has developed profoundly in the last years, especially on the aftermath of the 2008 global recession. On the core of these developments, we can find a strong focus on the consequences of monetary policy, *id est*, the actions that central banks take as a way to control both the size and the rate of growth of money supply. From an asset pricing perspective (Merton, 1974; Mishkin, 2001), moving to the announcement effect on capital markets (Bomfim, 2003), the impact of central banks is unquestionable: the tools they have available influence transversally the economy.

On the other hand, the consequences of the TLTROs are still in a development phase, mainly because of the contemporary aspect of these procedures – having been announced in June 2014, the academic community is still digesting its impact, and upcoming research is expected. Regarding the Longer Term Refinancing Operations (LTRO), there is already significant research on it, given its precedent initiation in December 2011. The Government Council of the ECB described the LTROs as "additional enhanced credit support measures to support bank lending and liquidity in the euro area money market" (ECB, 2011). The Appendix B provides more background information regarding the history of ECB liquidity injections.

Darracq-Paries and Santis (2013) provide evidence that the 3-year LTROs are expansionary over the short to the medium term and are connected with increases in real GDP and loan amounts to non-financial organizations, and a decrease in lending rate spreads. The authors also

study the transmission to the economy, inferring that the LTROs' impact was mainly due to a quantitative easing exercise, rather than a lower cost of financing. They carry on their analysis by showing that the 3-year LTRO were also a key tool in reducing funding risk inherent to the banking sector. Even though the European debt market was highly fragmented due to negative macroeconomic forecasts, political uncertainty (elections in Greece, referendum in Ireland) and solvency problems in Spanish banks, the interbank credit risk declined from 100 to 40 bps, from December 2011 to March 2012. Andrade et al. (2017) estimate that banks borrowing 1 billion from the LTRO program increased their loan supply by approximately 186 million over one year. This transmission mechanism was more significant in the first phase of the program (December 2011), given the higher level of capital constraints banks were facing, at that time. The authors also report that these operations benefited larger borrowers over smaller ones, and, at the same time, did not increase the level of risk taken by banks. García-Posada and Marchetti (2016) study the impact of the LTROs on the Spanish market and their findings suggest a positive-moderately sized effect on credit supply to companies. They report that the effect is higher for illiquid banks and that it was mainly driven by credit to SMEs, having no impact on larger firms.

The Portuguese case presents no exception to this research trend. Concerning very long-term refinancing operations, Jasova, Mendicino and Supera (2018) show that increasing the maturity of bank debt during a crisis reduces the rollover risk and shakes banks' credit concession. Moreover, a reduction in rollover risk had a positive and economically meaningful impact on credit concession to the real economy, investment levels and employment of firms in the Portuguese market. Blattner, Farinha and Nogueira (2016) find that lending rates to the same borrower decreased, on average, 64 bps, at banks exposed to the QE relative to non-exposed banks.

The TLTROs are, to some extent, a second phase of the LTRO program. The main difference arises from the fact that the TLTROs are "targeted", in the sense that banks will receive capital with well-defined restrictions and that same capital must be allocated to loans to firms or to consumption loans. Banks that do not meet the pre-established bank-specific requirements are forced to repay the loans at a penalty rate. Daetz et al. (2017) study the impact of the LTROs on non-financial companies. The authors report that these firms ended up with more cash as the outcome of the liquidity injection, but such increase was not used in an efficient way, due to the fact that companies did not make significant investments - instead, firms stored the cash, which compromises the core objective of the LTROs: "offer long-term funding at attractive

conditions to banks in order to further ease private sector credit conditions and stimulate bank lending to the real economy". This finding goes in line with a research trend that shows that increases in cash holdings are becoming a global phenomenon (Bates et al., 2009; Pinkowitz, Stulz and Williamson 2015; Azar, Kagy and Schmalz 2016). Agarwal et al. (2015) present similar findings regarding the fact that government interventions to decrease funding costs are not effective regarding household consumption. There is also evidence on banks not reducing funding costs, even though they were subject to ECB asset purchases (Cycon and Koetter, 2015).

Benetton and Fantino (2018) study the impact of the TLTROs in the Italian credit market and show that banks that were part of the program decreased loan rates by approximately 20 bps. They extend their research by studying the impact of market concentration and conclude that it plays a major role in the pass-through of TLTROs on the cost of credit: a one standard deviation increase in the level of market concentration reduces the decline in the cost by about 14 bps. The effect is mainly dominated by large banks, which goes against Kishan and Opiela (2000) that report a bigger effect arising from monetary policy on small banks. Carpinelli and Crosignani (2017) study the VLTROs impact on the Italian credit supply market. Specifically, they assess the role of collateral in the transmission of central bank liquidity provision. By showing that more-constrained banks are the ones technically excluded from getting central bank liquidity (due to lack of collateral), the authors demonstrate that a momentary relaxation of collateral requirements may be vital for enhancing bank credit supply. Their results in terms of the VLTRO impact go in line with the remaining authors: they observe that banks that suffered a market dry-up before the program decreased credit supply during periods of capital constraints and expanded it after the ECB intervention. Balfoussia and Gibson (2015) perform a similar analysis to the Greek market. The authors use a financial conditions index developed by Angelopoulo, Balfoussia and Gibson (2014), which comprises several economic variables in order to estimate the potential impact of the TLTROs and conclude that there is a positive impact on the real economic activity both in Greece and on the Eurozone.

Moving to a different angle, Esser and Schwaab (2016) study the impact of the Securities Market Program, an initiative through which the ECB purchase bonds in the market. They report that this program provide stimulus to decrease yield spreads and its volatility in European sovereign bond market. De Pooter et al. (2016) and Faria-e-Castro et al. (2017) find parallel results. On a similar fashion, Garcia-de Andoain et al. (2016) conclude that the ECB liquidity injection was a key tool to stabilize the overnight interbank market.

Since the global financial crisis was originated in the US, many studies use US data. One example is Duchin and Sosyura (2014), who analyze the Troubled Asset Relief Program, a group of programs created by the US treasury to address the financial consequences of the 2008 financial crisis. They conclude that bailed-out banks accepted riskier loans and shifted assets toward riskier securities as a response to the government support. Hence, banks took advantage of cheaper financing and engaged in risk-shifting activities, a practice known in the banking industry as the "risk-taking channel of monetary policy".

The literature on the risk-taking channels has evolved significantly over the last years. Rajan (2006) is one of the first studies that assesses the implications for monetary policy and financial supervision of an increase in the incentive of intermediary managers to take excessive risk. After him, a number of studies have investigated this phenomenon and its consequences (De Nicolò et al., 2010; Borio and Zhu, 2012). Dell'ariccia, Laeven and Suarez (2017) find that *ex-ante* risk taking by banks is negatively correlated with improvements in short-term rates. They also report that this relationship is stronger in areas that are less correlated with the business cycle, and weaker for less capitalized banks or during financial distress' periods.

There are multiple ways in which low interest rates can affect risk-taking. One of these mechanisms is the search for yield: a reduction in policy rates decreases the portfolio income, hence decreases the incentive to monitor it or, analogously, increases search for yield and, consequently, risk-taking (Dell'ariccia et al., 2011). Whereas this movement is asset-driven, there may also be the case that we have a liability-driven effect from the balance sheet, an event known as risk-shifting: a decrease in the policy rate reduces the cost of the bank's liabilities. A lengthy period of low interest rates also plays a role in the field of risk management: it affects assets and collateral valuation, as it is connected with smaller market volatility, hence diminishing the perception of risk (Gambacorta, 2009).

There are several studies that provide empirical evidence on the consequences of low interest rates on risk-taking. Jiménez et al. (2009) find that low interest rates affect the level of risk of the loan portfolio in the Spanish market in two ways. First, and in the short term, low interest rates decrease the default rate of loans indexed at variable rates. In the long-term (and as a consequence of the search for yield), banks will grant riskier loans and reduce their lending principles, towards softer ones. Altunbas et al. (2009) perform a joint study using both European and US data and reports findings that are aligned with the risk-taking channels' theory. Ioannidou, Ongena and Peydró (2009) report similar findings for the Bolivian market, but

present a valuable add-on: in a risk-taking channel, banks not only increase the outstanding amount of risky loans, but also reduce the spread charged to risky borrowers, compared with safer ones. Paligorova and Santos (2017) provide similar evidence for the last finding. Bonfim and Soares (2018) examine the Portuguese market and conclude that riskier borrowers receive more funding at periods of lower interest rates, and that default rates increase as interest rates move from lower to higher ones. Risk-taking is stronger in lower capitalized banks, which presents evidence of risk-shifting. Acharya and Naqvi (2012) also explore the agency problem arising when the bank is oversupplied with liquidity, which leads to the manager taking excessive risk. Besides, it is important to mention that banks' risk-taking behavior is far from homogeneous. There is evidence of stronger risk behavior from poorly capitalized (Dell'ariccia et al., 2017; Ioannidou, 2014), smaller (Buch et al., 2014) and more liquidity-constrained banks (Brissimis and Delis, 2010).

The studies discussed above have mostly studied the impact of market liquidity interventions on financial institutions. Nevertheless, it is important to focus on the actual users of the extra capital, the corporations and their liquidity and investment policies. Garcia-Posada and Marchettin (2016), as well as, Andrade et al. (2015) studied the real impact of LTROs on Spanish and French companies, and both studies found evidence that these unconventional monetary policies positively influenced the supply of bank credit to those countries' firms. Regarding liquidity policies, Acharya, Eisert, Eufinger and Hirsch (2015) found that European firms had larger cash holdings after being exposed to exogenous liquidity shocks. Finally, Daetz et al. (2018) exposed that this increase in liquidity buffer was not employed in an economically efficient manner, as firms did not make significant real investments with the extra funds, meaning that, ultimately, the ECB's goal was not fulfilled.

3. Data

We start this chapter by describing all databases from where our data was retrieved. Following this, we explain the process of preparing the raw data for analysis and conclude with the descriptive statistics of our final sample. It is important to note that we are using perturbed data from the Bank of Portugal, in order to preserve the anonymity of the banks and companies. The main drawback of this method is that it may reduce the magnitude of our coefficients, hence our results can potentially be more expressive if they are replicated in the non-perturbed databases.

3.1 Databases

In order to perform our analysis, we collect confidential data from several databases of the Bank of Portugal, ranging from 2013 to 2016. In this way, we are able to study the outcomes of the ECB intervention after the European sovereign debt crisis, in the Portuguese market. In this section, we start by describing the databases used. Subsequently, we describe how the data was treated and we conclude with an analysis of appropriate summary statistics.

Our main database covers all firm-wide loans granted to non-financial companies in Portugal, between June 2012 and December 2017. The New Operations database, henceforth NewOps, covers 8,825,903 lending relationships linking 313,064 non-financial entities to 53 banks. From this source, we have access to the anonymized tax identification number (TINA), anonymized bank identification number (BINA), date of concession, loan amount, interest rate and collateral of all loans granted in our sample period. Loans present in the sample were granted to both existing and new customers.

Secondly, we used *Informação Empresarial Simplificada*, henceforth IES, a mandatory annual declaration for all companies established in Portugal. From this dataset, we have access to yearly accounting information for the entire period of our sample.

Financial institutions evaluate the borrower's compliance history, with the intention of determining their credit risk. For this purpose, we used *Centro de Responsabilidades de Crédito*, henceforth CRC, an information system managed by Bank of Portugal, which aggregates the history of all past bank-loans granted in Portugal for a given firm. The CRC holds information concerning all credit responsibilities assumed by legal or natural entities, including the type of loan, the debtor, the amount and the loan's status. This status refers whether credit has become overdue, if it was renegotiated, or if it holds an off-balance sheet exposure, such as a bank guarantee or a credit line that has not been used yet. This database enables all financial institutions to consult information on their current and prospective borrowers, allowing CRC to become a crucial tool for sharing information between banks, hence decreasing the level of information asymmetry that is inherent to the loan granting process.

Finally, we had access to other auxiliary databases, namely a dataset that reports which banks had access to the TLTRO mechanism, as well as the net income of each bank in all years of our analysis.

3.2 Data treatment

For our analysis, we will only consider loans conceded between 1st of January 2013 and 31st of December 2016, since, driven by an attempt of the regulator to monitor the quality of loans, banks were only required to report new lending operations from mid-2012 onwards. We merged all available databases to the initial one (NewOps) and we then proceeded with the data treatment. Since we are only interested in active corporations, we follow Bates, Kahle and Stulz (2009) approach, in which the authors require companies to have both a non-negative asset value and non-negative sales in a given year. Loans that did have missing TINA or BINA were removed, as well as, companies that either had zero or negative number of employees or were established outside Portugal. We only consider new operations: all renegotiated loans are excluded from our sample to avoid double counting the same loan. As a way of circumventing outliers, the first and last percentile of interest rate, maturity, loan amount and all the accounting variables, described at Appendix Table A1, were winsorized at a 1% level. For our final sample, we cover 2,956,307 new operations connecting 150,923 non-financial companies to 47 banks in Portugal, between 1st of January 2013 and 31st of December 2016.

3.3 Descriptive Statistics

The following results concerning key loan and borrower characteristics can be seen in Table 1. On average, the loan size was 59,468€, with the largest increase occurring from 2014 to 2015 (euro amount grew 11%). Regarding collateral, on average, 37% of the loans are collateralized and there is evidence that as time passes the proportion of collateralized loans increases: since 2013, when 26% of the loans were protected by collateral, there was an increment of 17 percentage points, leading to 43% of the loans to be collateralized in 2016. Concerning loan maturity, the average loan has a duration of 144 days, but it is important to note that 38% of our total loan sample consists of credit lines with a reported maturity of zero. Finally, on average, the interest rate was 8.7%, but we can see this percentage decreasing as time passes by, which is consistent with an expansionary monetary policy during our time period. In 2013, the average interest rate was 10%, decreasing to 7.42% in 2016.

Regarding the companies financed by banks, they have, on average, 22 years of operations and 11 employees. The average company in our sample can be considered an SME, with an average amount of 2,631,748€ in assets. One condition that highly affects the credit risk of a company is the percentage of tangible assets that could be used as collateral, in case the company defaults (Psillaki et al., 2010). On average, companies in our sample have 24% of tangible assets. Due to the strong recession that affected Portugal early in the decade, the average ROA is -2% and

even though the outlook is positive and the profitability has been improving, in 2016, the average ROA was still -1%. Concerning leverage, Portuguese companies use primarily banks as a way of financing, with only 20% of Portuguese SMEs reporting that bank loans are not a relevant financing source (ECB Survey on the Access to Finance of Enterprises in the euro area 2018), leading to an average leverage ratio of 79%. Finally, we evaluated the companies' liquidity, an important indicator for credit risk (Bonfim, 2008), using the current ratio: companies in our dataset present, on average, a ratio of 1.9, furthermore, it is important to note that this ratio increased almost 15% during the 2013-2016 period. Concerning the TLTROs, of the 47 banks in our sample, 32 participated in the ECB liquidity injections program. Compared with the banks that did not participate in the TLTROs, the banks in the program reported a lower average profitability (0.14% compared with 0.45% of banks that did not participate). Nevertheless, the overall bank profitability improved throughout our sample, becoming positive in 2015, concurrent to the initiation of the program.

As seen previously, approximately 38% of our sample is composed of credit lines. This specific type of credit is usually denoted as revolving credit, inferring that firms obtain an amount of debt capacity while paying a periodical fee. According to the literature, credit lines aid companies to overcome the capital market frictions ensuring that they have the available funds to pursue their projects. Adding to this, studies from Gatev and Strahan (2006) suggest that banks are the most efficient liquidity providers in the economy and protect firms against declines in liquidity at a lower cost than other institutions, therefore it is wise for firms to rely on lines of credit over cash. Nevertheless, it is important to note that this only applies to firms with reliable cash flows: according to Sufi (2007), credit lines are an inadequate liquidity substitute for firms with low expected cash flows, making cash a more reliable source of liquidity for them. All in all, credit lines are liquid assets similar to cash holdings, however they come at a cost. This costs differs from the usual pricing of a term loan (loans approved with a reported maturity higher than zero), in that the borrower pays a commitment fee on the unused amount of the credit line and a predetermined interest on the drawn amount. For this reason, we felt the need to separate our analysis between credit lines and term loans. The summary of the differences in company and loan characteristics between credit lines and term loans is presented on Table 2.

Concerning loan characteristics, credit lines have, on average, worse conditions looking at it from a credit risk standpoint. The average loan amount is bigger on the credit lines, while the percentage of credit being collateralized is 7% lower. The fact that revolving credit is riskier

than a term loan is priced on the interest rate, with the average rate of a credit line being almost twice over the average one of a term loan. Taking all of this into account, it is normal to expect that the default rate in one year is larger for credit lines: 4% for term loans against 8% for lines of credit. Important to note, that the one-year default rate is measured using the firm-bank relationship, meaning that if the firm fails the payment of one loan to a specific bank, we consider that, during that period, all loans linking that specific firm to that bank defaulted.

Looking at the borrower characteristics, one can see a similar pattern regarding credit risk, with riskier companies resorting to credit lines. The common corporate borrower of credit lines is younger, smaller, less profitable, more levered and less liquid than the average borrower of a term loan. Taken as a whole, our results are contrary to the ones of Sufi (2007), since we do not verify the premise that firms with more reliable cash flows rely more on credit lines.

4. TLTROs impact on the Portuguese credit market

In terms of methodology, our approach will be divided into supply side (credit market) and real side of the economy (corporate sector). In the first part, we provide an analysis of the impact of TLTROs in the evolution of loans and credit lines in the Portuguese credit market. Followed by this, we investigate the end-of-month phenomenon and how it changed with the introduction of the ECB refinancing operations. Maintaining our focus on the impact of the TLTROs, we perform an analysis, with the intent of finding the main differences *ex ante* and *ex post* of these operations, by looking at loan and borrower characteristics. In Section 5, we focus our efforts in investigating the impact of these unconventional liquidity injections on corporate liquidity and investment policies: we explore if in fact banks transmitted the ECB's funds to the corporate world and how the non-financial corporations used these extra funds. It must be noted that the decision to participate in the TLTROs was endogenous, meaning that banks choose whether or not to participate in the program and by how much.

4.1 Impact of TLTROs in the evolution of credit type

We explored the evolution of the proportion of credit lines and term loans in the Portuguese market. The following findings can be seen in Table 3. The results are intriguing, as we can see a constant rise (fall) in the proportion of credit lines (term loans). Between 2013 and 2016, the share of credit lines grew approximately 21 percentage points, with a sharp increase in 2015, coincidental with the beginning of the TLTROs.

With the intention of attesting if this growth was a consequence of the TLTROs, we split the examination into banks that participated in the TLTRO operations and the banks that did not meet the requirements to enter in the ECB program. The findings confirm our hypothesis; TLTRO banks demonstrate the increasing (decreasing) share of credit lines (term loans) pattern, while non-TLTRO banks do not. More interesting, while we expected that Non-TLTRO banks had a constant proportion of credit lines and term loans, the reality is that the pattern shown was the opposite of the one exhibited in TLTRO banks. From 2013 to 2016, the share of credit lines decreased 57.4 percentage points, with the proportion of credit lines (term loans) in the final year of our sample being 27.3% (72.7%).

The findings of Acharya et al. (2014) results could explain our discoveries. The authors found that when companies experience an increase in liquidity risk, they react by relying more on cash holdings and moving out of credit lines. In this case, we verify the opposite event: a decrease in liquidity risk. With the introduction of the TLTROs, banks have now access to extra liquidity, hence increasing their incentive to lend at more attractive conditions, which reduces corporate liquidity risk: firms have now easier access to the credit market. This decrease in liquidity risk leads to a reduction in corporate cash holdings and a heavier reliance on credit lines as source of liquidity. In section 6.2, we will confirm our hypothesis, by exploring if the cash holdings of the companies decrease with the introduction of the TLTROs.

In addition, we analyze if there is evidence of a repetition pattern of credit lines, *id est*, how frequent it is for a bank to grant a credit line to the same company in consecutive periods. Our results show a 68%, 6%, 3% and 1% monthly, bi-monthly, trimester and semester repetition pattern, respectively. The monthly pattern findings could be justified by the utilization of overdraft lines of credit, a tool used by companies when they need funds to satisfy their liquidity necessities.

4.2 End-of-Month effect and TLTROs

Based on Cao et al., (2018), we study the end-of-month effect (EOME). The authors exposed that Chinese banks sharply increase their credit quantity near the end of each month, while loan quality declines. Their study, alongside with Tzioumis and Gee (2013), suggest that these patterns could be explained by loan officers' efforts to achieve their monthly quotas. With the purpose of testing this phenomenon, we examined the daily distribution of newly granted loans during the month, the results can be seen in Appendix Figure A1. We discover that 37.6% of the loans are approved during the last three days of the month, with 25.9% concentrated in the

very last day of the month. Following these findings, a more thorough analysis was performed. We explored how this phenomenon unraveled across time, between 2013 and 2016 (the results can be seen on Table 4 and Figure 1). Similar to the proportion of credit lines, we find a growing pattern across time. From the beginning of our time horizon until 2016, the EOME grew almost 16 percentage points, with the largest increment, once again, between 2014 and 2015, coinciding with the beginning of the TLTROs. This hypothesis is confirmed by looking independently to banks that participated in the TLTRO and banks that did not. TLTRO banks reveal the same pattern as the general one, while Non-TLTRO banks demonstrate a diminishing trend, with less loans being granted during the last days of the month as years go by.

Moreover, we examine the general evolution of the number of loans conceded in our sample period. The findings, shown on Figure 2, are overwhelming: on December 31, 2014, the number of newly granted loans exhibit a twofold increase that maintains throughout the rest of the time horizon, providing evidence that the TLTROs had a massive impact on the end-of-month effect. In addition, is also possible to identify several spikes in the number of new operations that correspond to the last day of every month. To confirm the possibility that this phenomenon was related to the TLTROs, the analysis on the evolution of the number of loans granted was performed, but this time, using a new dummy variable that differentiated whether or not a specific bank participated in these unconventional liquidity injections. The results can be seen on the Appendix Figure A2 and A3. The findings confirm our initial assessment: the ECB liquidity injection program positively influenced the EOME, since banks that were not financed with TLTROs do not present any substantial spike during the introduction of the ECB refinancing program, while banks that did, in fact, participated in the program display the same spike on December 31, 2014.

Gathering all this information, we have proof that the TLTROs funds were distributed by banks in the last days of each month, where loans typically have worse prospects, as studied by Cao et al. (2018) and Tzioumis and Gee (2013). This might be related with the design of the assessment framework of the TLTROs, which are assessed using the end-of-month data on loan flows to firms and consumption loans. In addition, as seen in our sample, the one-year default rate is almost five times larger for credit lines granted by the end of the month. The question that remains regards the credit quality of the companies that get credit lines during the last three days of the month. As can be seen on Appendix Table A1, when compared with credit lines granted during the rest of the month (excluding the last three days), borrowers are younger, less tangible, profitable and liquid, while more levered, thus riskier.

One would think that, since the first TLTRO procedure was in September 2014, the effect would have an immediate impact and not only at the end of the year. While this is not necessarily wrong, it is important to note that TLTRO initial operations were conducted on 18th of September and 11th of December 2014. According to the ECB (2014), there are several reasons for why banks would prefer the December operation, instead of the first one: firstly, it could be more attractive due to bank's funding structures and refinancing obligations. Secondly, banks would be better prepared to determine the demand for TLTRO funds for the year ahead in December, rather than in September. Finally, participating only in December would allow banks to take the results of the ECB's comprehensive assessment of the first TLTRO procedure into consideration.

4.3 TLTROs impact on loan and borrower characteristics

In this section, we will investigate how the credit market changed with the intervention of the TLTROs by analyzing the variations in both the loan and borrower characteristics in the Portuguese credit market. We start by studying these dissimilarities using a differences-in-differences approach, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The following results are presented in Table 5.

Beginning our analysis with the loan characteristics, after the TLTRO intervention the average contract in the Portuguese credit market had a higher loan amount (Δ=4,600€) and a significantly lower maturity (Δ=-374 days), which goes in line with the expressive rise in credit lines proportion. The interest rate increases drastically (Δ=5.4%), while the percentage of loans collateralized decreases (Δ=-36%), which is consistent with the positive coefficient for the default rate one year ahead (Δ=0.5%). Looking at it in a credit risk perspective, loans conceded in the Portuguese credit market once the TLTROs came in play, became riskier.

Regarding borrower characteristics, companies who sought for financing after the TLTROs were smaller (Δ=-0.09), older (Δ=0.03), less levered (Δ=-3%) and, although negligible, less tangible (Δ=-0.2%) and more profitable (Δ=1%), while exhibiting a meaningful increase in liquidity (Δ=0.86), a phenomenon that could be explained by the easier access to capital with the introduction of the TLTROs.

To better understand the impact of this liquidity injection, we decomposed the overall effect into credit lines and term loans, our findings are also shown on Table 5. As stated previously, credit lines accounted for a large proportion of our sample and, for that reason, we felt the need to divide our analysis. After the TLTRO intervention, the average credit line amount became

smaller (Δ=-18,000€), less protected by collateral (Δ=-29%) and with a higher interest rate (Δ=3%); nevertheless, these characteristics did not represent accurately the default rate in one year, as this indicator decreased (Δ=-1%). The average credit line borrower also became less risky, as the companies are smaller (Δ=-0.1), less levered (Δ=-3%) and more profitable (Δ=1%). Regarding term loans, with the introduction of the TLTROs, the average amount increased (Δ=20,000), while the maturity shrank (Δ=-66 days). The default rate increased (Δ=2%) and the percentage of loans collateralized decreased (Δ=-6%), but this is already priced with the higher interest rate charged. The standard borrower became smaller (Δ=-0.02), older (Δ=0.04) and more liquid (Δ=0.29).

To summarize, we provide evidence that, after the TLTRO intervention in 2014, the average loan in Portugal became riskier. Nevertheless, the average borrowers improved, from a credit risk perspective. Splitting the analysis in credit lines and term loans and analyzing the default rates for each credit type after the TLTRO intervention, credit lines display a decrease in delinquency rate, while term loans show the opposite pattern. Borrower characteristics present similar results, even though we lack statistical significance on the term loan segment.

5. TLTROs impact on the Portuguese real economy

5.1 Did banks transmit the additional funds to companies?

Before proceeding to the analysis of how companies used the TLTRO funds, we must be certain that the ECB's goal of improving the real economy was fulfilled and that the TLTRO funds received by the banks were, in fact, transmitted to non-financial corporations. Despite the efforts of the ECB, there is no guarantee that these macro-liquidity operations will translate into corporate liquidity. There are two hypotheses: first, unconventional monetary policies, such as the TLTROs, will increase the banks' access to funds, therefore increasing their liquidity, hence making it easier for companies to have access to financing. This would be the preferred outcome for the ECB. However, the opposite may happen: banks can invest the additional funds on high-yield short term securities, instead of lending it to firms (Crosignani, Faria-e-Castro and Fonseca, 2017). It is important to take into account that TLTROs were introduced precisely to offers banks explicit incentives to lend to the economy, thus avoiding some of the pervasive effects of the VLTROs and other untargeted operations.

We expect that with the introduction of this targeted liquidity injection mechanism, firms will receive more financing through bank loans, nonetheless, as explained previously, the opposite cannot be initially ruled out. In order to study the impact of these liquidity injections in the real economy, we will perform several tests comprising differences in the companies' size, the evolution of the amount in credit lines facilities used and the impact on the companies' leverage due to the introduction of the TLTROs. According to Daetz et al. (2017), firms that expect a decrease in the liquidity of their credit lines (post TLTRO), may pursue a more conservative liquidity policy, thus maintaining a higher cash holdings ratio. Therefore, if TLTROs have really been used to boost the real economy, we expect that companies will receive more bank financing and, consequently, will increase their cash reserves for two reasons: first, because they will not need to invest their own cash to finance new projects, but also as a precautionary measure, since they could expect lower liquidity once the TLTRO ends. Thus, if in fact there is a liquidity transmission to the corporate sector, caused by increased borrowing, one would expect that this increase in cash holdings will be more noticeable for larger firms, given their easier access to the debt market.

Generally speaking, large firms are less constrained, allowing them to have better access to capital markets. Hence, we expect that large firms will better exploit the "debt for cash holdings channel" (Daetz et al., 2017), when compared with similar, but smaller firms. To investigate this hypothesis, we divide our sample in *Large Firms* and *Small Firms*. We split our sample into *Large Firm*, if one year before the introduction of TLTROs (2014), the company's assets reported were above the median value; and into *Small Firms* in case the reported value was below the median. The results of this analysis can be seen in Table 6. Starting with *Small Firms,* the coefficient for the *TLTRO Effect*, our variable of interest (which is equal to zero until the first TLTRO procedure in September 2014 and takes the value of one in case the bank participates in the ECB program), is negative and significant, indicating that smaller firms decreased their cash holdings with the TLTRO. Nevertheless, the coefficient for *Large Firms* is positive, but not statistically significant.

Using this method, we cannot provide evidence that an increased liquidity transmission from the banks side to the non-financial entities existed with the TLTRO intervention. However, there are reports from France and Spain that larger borrowers benefited more from the improved loan supply after the intervention of similar liquidity injections (Garcia-Posada and Marchettin, 2016; Andrade et al., 2015).

The TLTROs were introduced with the aim of improving private sector credit conditions and simultaneously encouraging financial institutions' lending to the real economy. These additional funds in the market would lead to lower liquidity risk in the market, therefore it would be expectable that firms' liquidity policies would rely more on credit lines with the introduction of TLTROs (Acharya et al., 2014). In Table 7, we investigate this premise by analyzing how the euro amount of credit lines behaved after the introduction of the TLTROs. Our preliminary results confirm our original hypothesis, the coefficient for *TLTRO Effect* is significantly positive, meaning that the euro amount in credit lines increased considerably with the intervention of the ECB. In order to test the robustness of these claims and to demonstrate that the increase in amount was not due to the general economy performance, we did the same analysis for term loans. The findings indicate that the euro amount for term loans decreased with the TLTROs.

To eliminate any doubt on whether financial institutions truly transmitted liquidity to non-financial firms, instead of investing the additional funds of the ECB in risky instruments, we run a regression on the companies' leverage. The results are exhibited in Table 8. As seen, our results show a negative coefficient for our leverage variable. To further extend our analysis, we split it by credit type in Table 9. For term loans, leverage demonstrated the same decreasing direction as the general analysis. We measured *Leverage* as the ratio of the liabilities to assets and, for this same ratio to decrease either there is a decrease in liabilities or an increase in assets. This result can be explained by an increase in assets: this potential cause will be discussed in the following section, where we find evidence that with the introduction of the TLTROs, firms who relied more on term loans saw an increase in cash holdings as well as in investment, which will lead to higher assets. Since the majority of our sample is still term loans, its effect overlaps the one from credit lines. When looking at the revolving credit, the coefficient is positive, meaning that leverage increased for these firms.

After the results of these three assessments, we are now in position to infer that banks transmitted more liquidity to the non-financial institutions, thus suggesting that TLTROs enhanced credit supply to Portuguese firms.

5.2 TLTROs impact on company's liquidity policies

After demonstrating that the supply-side transferred, at least part, of the TLTRO funds to the demand-side, we will now investigate the impact of ECB's unconventional policy on companies' liquidity and investment policies. It is expected that with the increased liquidity in

the market, companies will have lower necessity of holdings cash reserves as it is easier for them to have access to debt financing. Nevertheless, as seen previously and divergent to ECB's will, banks could have instead invested the extra funds in shorter-term high yield instruments (Crosignani et al., 2017), signaling to non-financial entities that banks are pursuing a risk-taking strategy, thus making companies take on a more conservative approach, leading to an increase in corporate cash holdings. With our analysis, we will try to infer which outcome dominates over the other.

To investigate the companies' response to the introduction of TLTROs, we use *Cash Holdings* as our main dependent variable and regress this variable on a set of determinants of cash holdings, while also controlling for firm and time fixed effects. Our variable of interest is *TLTRO Effect,* which is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. For determinants of cash holdings, we follow the approach of Opler, Pinkowitz, Stulz and Williamson (1999) and Bates, Kahle and Stulz (2009). We classify the *Size* variable as the natural logarithm of total assets. *Cash Flow/Assets* is equal to the ratio of Earnings before interest, tax, depreciation and amortization (EBITDA) to total assets. As a way of measuring the amount of debt used, *Leverage* is measured as the book value of debt divided by total assets. We use return on assets as the proxy for *Profitability* and *Tangibility* is calculated as the ratio of tangible assets to total assets. *Net Working Capital* is the ratio of net working capital to total assets and, finally, *Capital Expenditures* is the capital expenditures scaled by assets. Our results using the postulated cash holding determinants can be seen Table 10. We observe a negative and significant coefficient for *TLTRO Effect*, implying that firms decrease their cash reserves. Hence, we find in our preliminary results that Portuguese companies reduced their cash holdings with the introduction of the TLTROs. The coefficients for the other control variables are consistent with prior literature findings. Large firms commonly have better access to capital markets and substitutes for cash, making them hold relatively lower cash proportion to total assets. *Cash flows* positively impact corporate cash holdings, while *Capital Expenditures* have a negative impact, since cash reserves can be used in the acquisition, and, in addition, this would also create assets that could be used as collateral, decreasing the need for liquid assets as reserve. To better understand the impact of this event, an isolated analysis for credit lines and term loans was performed, as shown in Table 11. The results reveal that the different types of credit had contrasting impacts on the cash holdings. Firms who relied more on credit lines saw their cash holdings increase, while with term loans the proportion of cash reserves decreased. This can be

explained by the fact that lines of credit are liquid assets similar to corporate cash holdings and can be used to satisfy liquidity necessities, meaning that by relying on them, companies would allocate less of their cash to these needs, thus increasing their cash holdings.

The previous, although preliminary, results suggest that Portuguese companies reduced their cash reserves after the TLTRO liquidity injection. Nevertheless, the impact of these operations on corporate liquidity policies may be dependent on the companies' specific marginal value of cash: in cases where the cash is highly valued, companies have higher precautionary demand for cash, which leads to an increase in cash reserves. Hence, we further develop our analysis by looking at the differences in the firms' levels of leverage and their response to the TLTRO intervention. More levered firms have increased default risk in conjunction with a higher precautionary demand for cash reserves. All other factors constant, the costs of carrying cash will be lower for riskier firms, meaning that, in theory, highly levered firms should have larger cash holdings. In order to test this hypothesis, we regress, once again, cash holdings for firms with low leverage and high leverage. With the purpose of dividing firms according to their leverage, we classified as *High Leverage*, all companies that one year before the TLTROs (2014) had a leverage ratio above the median value of our sample for that year (the same process was applied to *Low Leverage*). In the results presented in Table 12, we can confirm our initial hypothesis: for firms classified as *High Leverage*, we find a positive and significant coefficient for *TLTRO Effect*, while for *Low Leverage* firms the coefficient is negative. These results imply that the firm's risk influences the impact of the TLTRO liquidity injection and firm's precautionary demand for cash, as all else equal, the marginal value of cash is higher for riskier firms, thus leading to higher cash holdings.

5.3 TLTROs impact on company's investment policies

In this section, we analyze the impact of the unconventional liquidity operations on corporate investment policies. According to Harford and Uysal (2014), access to debt markets significantly impacts corporations' investment policies, therefore it is expected that the TLTRO intervention positively affects corporate investment and improved employment compensation, due to the increased availability of debt financing in the market. To investigate our original hypothesis, we use the ratio of capital expenditure to total assets as a proxy for *Corporate Investment* and the logarithm of wages as proxy for *Employee Compensation*. We regress these variables against our variable of interest controlling for *Cash Flows, Size*, *Leverage*, *Sales* and *Working Capital,* following Daetz et al. (2018) approach, while simultaneously using firm and time fixed effects. As can be seen in Table 13, our results contradict our original premise, as

we find statistically significant negative coefficients for both *Corporate Investment* and *Employee Compensation*, indicating that Portuguese companies reduced both investments and wages with the TLTRO intervention. Our results can be explained by precautionary motives. Companies may have borrowed as much as possible solely because of their concern of a decrease in market funding from their banks, as soon as the TLTRO intervention ends, impacting their future access to financing in debt markets (Bolton et al, 2013). To better study this phenomenon, we perform an additional research, by dividing the analysis into credit lines and term loans. The results, which can be seen in Table 14, become even clearer. For term loans, both *Corporate Investment* and *Employee Compensation* increase but, in spite of this, the effect of credit lines overlaps the one from term loans. By proving that companies that use term loans increased their real investment, hence assets, we are now in the position of confirming our intuition in section 4.3, where we justified a decrease in the leverage ratio of companies that asked for term loans with a possible increase in their assets. When looking at these investment variables for credit lines, the results are exactly the opposite, with both capital expenditures and wages decreasing, which can be explained by the fact that the funds pilled with the TLTROs were not used for investment purposes, but perhaps for filling liquidity necessities.

6. Conclusions

In this paper, we investigate the impact of the TLTRO procedure on both the supply and demand side in the Portuguese credit market. We document that TLTRO funds were transmitted to the Portuguese economy mainly during the last three days of the month and through credit lines. From a risk perspective, these credit lines by the end of the month demonstrate a greater risk-taking behavior from banks, with the average borrower being younger, smaller, less profitable, more levered and less liquid than the average borrower of a term loan. Therefore, with the beginning of the TLTRO intervention, the average loan in Portugal became riskier.

Connecting the supply side to the demand side, our findings show that banks, in fact, transmitted liquidity to the non-financial institutions and that TLTROs seems to have enhanced credit supply to Portuguese firms. By examining the impact of TLTRO in the Portuguese credit market, between 2013 and 2016, we find that the average company held less cash after the TLTRO injection. Nevertheless, the impact of these injections depends, to a great extent, on a company's marginal value of cash, where we find that highly levered firms increased their cash

holdings, as opposed to less levered firms, which can be explained by the lower cost of carrying cash. Regarding to how the Portuguese companies used these additional funds, after the ECB's liquidity injections, non-financial entities decreased their investments, which might be due to precautionary motives taken by the firms, who used the extra funds as a liquidity buffer, in case of a sudden market dry-up.

Nonetheless, it is important to note that despite the TLTROs impacting all countries in the Eurozone, we only investigate the impact in the Portuguese credit market. Nevertheless, Acharya et al. (2018) found that companies that exhibited the largest drop in corporate investment, during the European sovereign debt crisis, were located in the GIIPS (Greece, Ireland, Italy, Portugal and Spain). Therefore, our results in the Portuguese market are significantly more expressive that the general impact in the Eurozone. Despite the fact that this study provided important insights regarding the influence of the TLTROs in the Portuguese credit market, some aspects need to be taken into account. Although, this study is important for the Portuguese economy, an investigation incorporating the remaining countries in the Eurozone could provide more significant and insightful results. In addition, this study lacked information regarding the financial health of the banks, which could have also influenced the impact of these unconventional procedures. Finally, in our analysis, we did not take into account several other factors that could be key on the TLTRO efficiency, such as the actual TLTRO uptake of each bank and the corporate taxes, of which the companies in our sample were subject to. In general, our investigation casts doubt on the effectiveness of the ECB's targeted longer-term refinancing operation, mainly in the Portuguese economy. Nevertheless, we need to take into consideration that the decision to participate in the TLTROs was endogenous, meaning that banks choose whether or not to participate in the program and by how much, which raises identification challenges for their analysis.

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8. Figures and Tables

Figure 1: Evolution of the End-of-Month Effect

This figure outlines the evolution of the End-of-Month Effect, during the 2013-2016 period. It is possible to see a constant growth of the effect and the biggest increment corresponds to December 2014, coincident with the TLTRO intervention.

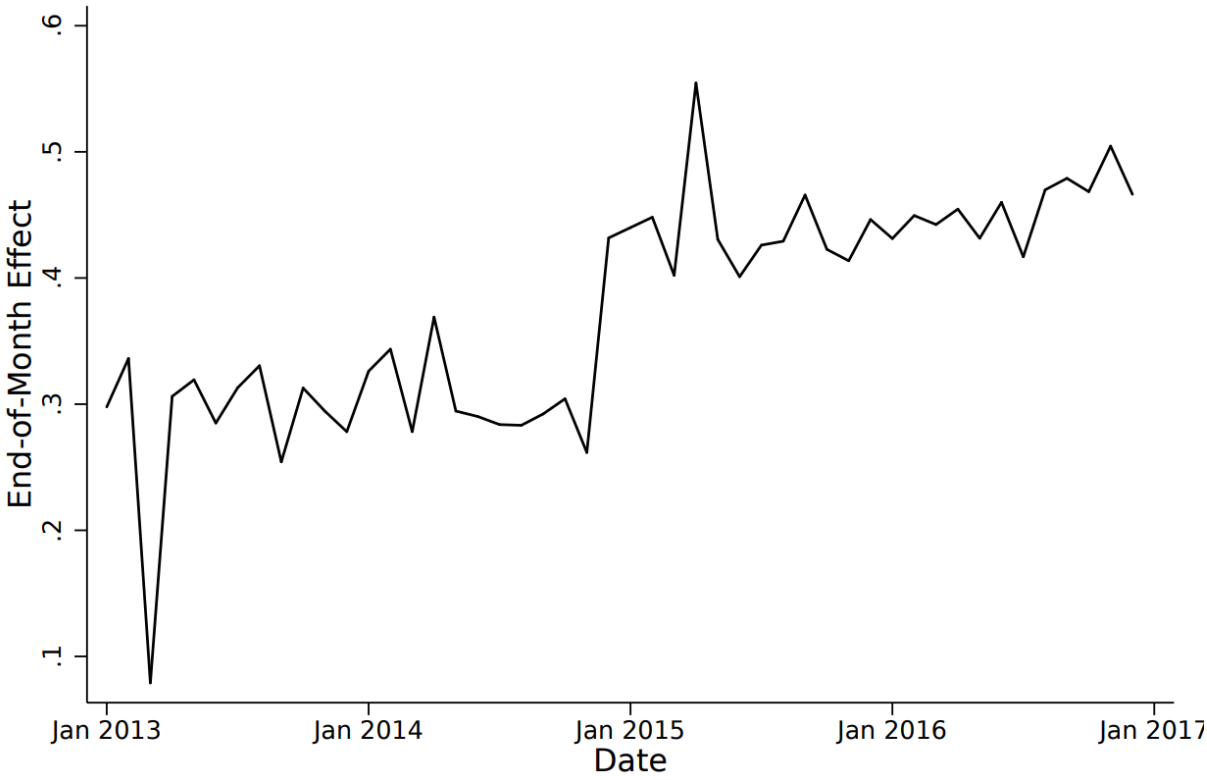

Figure 2: Evolution of the amount of loan operations

This figure outlines the evolution of the amount of loan operations, during the 2013-2016 period. Each dot represents the last day of the month. It is possible to see that each spike corresponds to the last day of the corresponding month. The first big increment corresponds to December 31, 2014.

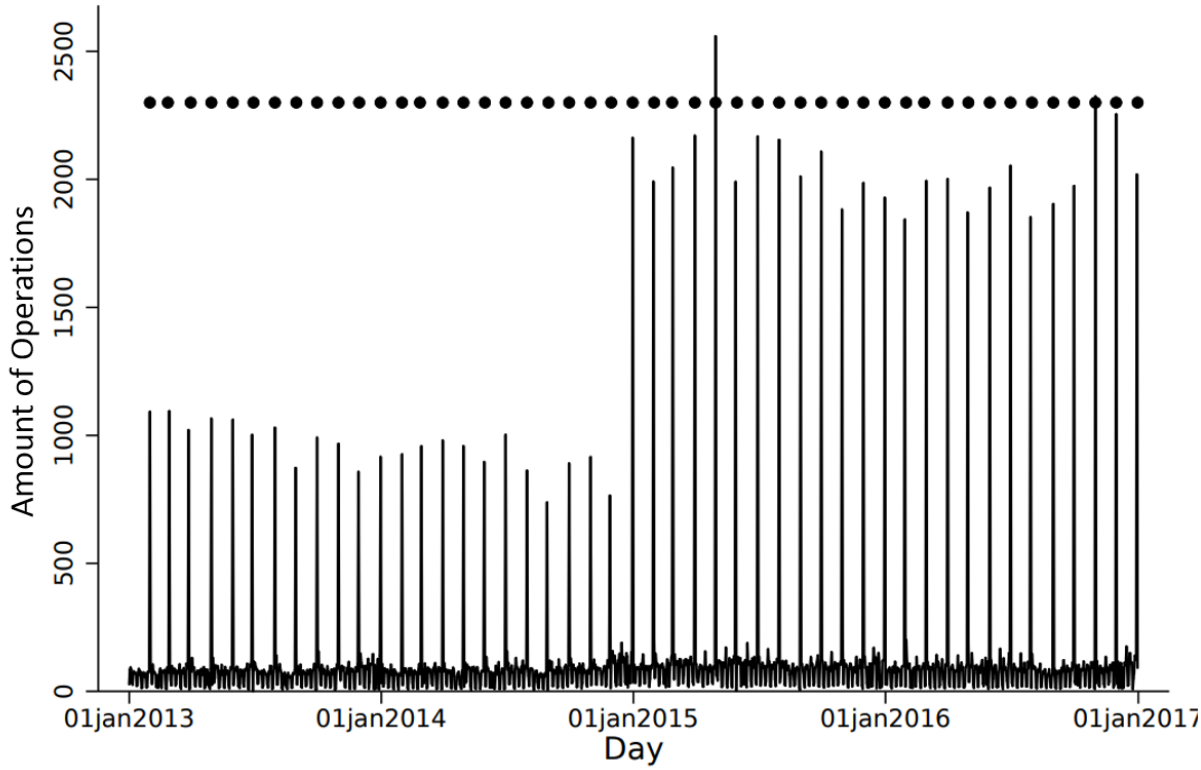

Table 1: Summary Statistics for key loan and borrower characteristics

This table outlines the summary statistics for key loan and borrower characteristics. Panel A aggregates all variables concerning loan characteristics, such as amount, collateral, maturity, interest rate and one-year default rate. Panel B reports the descriptive statistics regarding borrower characteristics, such as size, age, tangibility, profitability, leverage and liquidity. The statistical measures reported contain the number of observations, mean, standard deviation, minimum, percentile 25, percentile 50, percentile 75 and maximum for each variable.

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max
Panel A: Loan Characteristics								
Amount	2,956,307	0.06	0.14	0.00	0.00	0.01	0.04	0.96
Collateral	2,956,307	0.37	0.48	0.00	0.00	0.00	1.00	1.00
Maturity	2,956,307	143.5	372	0.00	0.00	43.00	97.0	2,190
Interest rate	2,956,307	8.66	7.23	1.05	3.96	6.04	10.2	32.03
Default	2,616,805	0.57	0.23	0.00	0.00	0.00	0.00	1.00
Panel B: Borrower Characteristics								
Size	2,954,167	14.08	2.01	9.25	12.66	14.02	15.52	18.68
Age	2,887,234	21.29	14.43	1.00	10.00	19.00	29.00	72.00
Tangibility	2,954,374	0.24	0.22	0.00	0.06	0.18	0.37	0.90
Profitability	2,954,374	-0.02	0.20	-1.37	0.00	0.01	0.04	0.30
Leverage	2,954,374	0.79	0.56	0.10	0.57	0.72	0.85	4.61
Liquidity	2,736,004	9.07	67.34	0.09	0.11	0.99	1.95	15.43

Table 2: Comparison between term loans and credit lines in the Portuguese credit market

Table 2 describes the main differences regarding the average term loan and credit line in the Portuguese market, between 2013 and 2016. Panel A aggregates all variables concerning loan characteristics, while Panel B reports the descriptive statistics regarding borrower characteristics. For the different types of credit, the mean of each variable studied is presented, as well as, the p-value for the difference in the means of each credit type (t-test).

Variable	Term Loans	Credit Lines	p-value
Panel A: Loan Characteristics			
Amount	0.05	0.08	0.00
Collateral	0.40	0.33	0.00
Maturity	232.12	-	0.00
Interest rate	6.38	12.36	0.00
Default	0.04	0.08	0.00
Panel B: Borrower Characteristics			
Size	14.64	13.17	0.00
Age	22.93	18.28	0.00
Tangibility	0.24	0.24	0.00
Profitability	0.00	-0.05	0.00
Leverage	0.72	0.90	0.00
Liquidity	10.91	5.87	0.00

Table 3: Evolution of the proportion of term loans and credit lines

Table 3 reports the evolution, in percentage, of the two different credit types studied in the Portuguese credit market, between 2013 and 2016. Panel A describes the general evolution, while Panel B detaches the analysis in banks that participated in TLTROs, while Panel C reports banks that did not took part in the TLTROs. The table reports the percentage of each credit type to the total amount of loans for every year in our sample, as well as, the compound annual growth rate (CAGR) for term loans and credit lines.

Credit type	2013	2014	2015	2016	CAGR
Panel A: General Analysis					
Term Loans	74.0%	70.1%	55.4%	52.7%	-11%
Credit Lines	26.0%	29.9%	44.6%	47.3%	22%
Panel B: TLTRO Banks					
Term Loans	75.0%	70.8%	54.6%	51.8%	-12%
Credit Lines	25.0%	29.2%	45.4%	48.2%	25%
Panel C: Non-TLTRO Banks					
Term Loans	15.2%	37.6%	73.6%	72.7%	68%
Credit Lines	84.8%	62.4%	26.5%	27.3%	-31%

Table 4: Evolution of the end-of-month effect in the Portuguese credit market

Table 4 reports the evolution of the quantity of loans granted during the last three days of the month, compared with the remaining days of the month. Panel A describes the general evolution, while Panel B detaches the analysis in banks that participated in TLTROs, while Panel C reports banks that did not took part in the TLTROs. The table reports the percentage of the amount of according to the time of the month when it was approved, as well as, the compound annual growth rate (CAGR) for each period.

Time of Month	2013	2014	2015	2016	CAGR
Panel A: General Analysis					
End of month	28.3%	31.6%	42.8%	44.2%	16%
Rest of month	71.7%	68.4%	57.2%	55.8%	-8%
Panel B: TLTRO Banks					
End of month	28.4%	31.8%	44.0%	45.7%	17%
Rest of month	71.6%	68.3%	56.0%	54.4%	-9%
Panel C: Non-TLTRO Banks					
End of month	25.4%	25.4%	17.3%	13.9%	-18%
Rest of month	74.6%	74.6%	82.7%	86.1%	5%

Table 5: TLTRO impact on loan and borrower characteristics

Table 5 reports the difference between loan and borrower characteristics *ex ante* and *ex post* the TLTRO, using the differences-in-differences approach, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. Panel A aggregates all variables concerning loan characteristics, while Panel B reports the descriptive statistics regarding borrower characteristics. Additionally, the division between credit lines and term loans is also presented. For each variable, the coefficient, the standard error and the p-value of the regression are presented. For each variable, the coefficient of term loans and credit lines is presented. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

Variable	Full Sample	Credit Lines	Term Loans
Panel A: Loan Characteristics			
Amount	0.0046***	-0.0181***	0.0252***
	(0.0015)	(0.0021)	(0.0033)
Maturity	-374.23***	-	-65.688***
	(5.0251)	-	(10.4397)
Interest rate	5.4248***	3.1026***	0.1301***
	(0.9004)	(0.1492)	(0.0503)
Collateral	-0.3635***	-0.2902***	-0.0597***
	(0.0047)	(0.0066)	(0.0066)
Default	0.0048**	-0.0126***	0.0211***
	(0.0023)	(0.0039)	(0.0031)
Panel B: Borrower Characteristics			
Size	-0.0894***	-0.1049***	-0.0288***
	(0.0026)	(0.0042)	(0.0029)
Age	0.0295***	0.0241***	0.0386***
	(0.0019)	(0.0026)	(0.0046)
Tangibility	-0.0021***	0.0017	-0.0004
	(0.0007)	(0.0011)	(0.0009)
Profitability	0.0088***	0.0228***	0.0101
	(0.0008)	(0.0015)	(0.0008)
Leverage	-0.0259***	-0.0316***	-0.0013
	(0.0023)	(0.0032)	(0.0015)
Liquidity	0.8759	0.3375	0.2864***
	-0.7764	(1.4601)	(0.1074)
Time fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes

Table 6: Corporate Size and TLTRO effect on cash holdings

Table 6 presents the estimates of the effect of the TLTRO intervention on corporate cash holdings, for Portuguese companies, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. The sample is divided into *Large Firm*, if one year before the introduction of TLTROs (2014), the company's assets reported were above the median value; and into *Small Firms* in case the reported value was below the median. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

	Cash Holdings	
Variable	Large Firms	Small Firms
TLTRO Effect	0.0001	-0.0023***
	(0.0001)	(0.0001)
Leverage	-0.0468***	-0.0066***
	(0.0063)	(0.0008)
Profitability	0.1082***	0.0255***
	(0.0287)	(0.0013)
Cash Flows	-0.0837***	0.0000
	(0.0273)	(0.0000)
Size	-0.0000	-0.0157***
	(0.0008)	(0.0008)
Tangibility	-0.1316***	-0.2091***
	(0.0072)	(0.0023)
Capital Expenditure	0.0289***	0.0002
	(0.0074)	(0.0001)
Working Capital	-0.0501***	-0.0001***
	(0.0132)	(0.0000)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.881	0.849
N	1,417,146	1,367,862

Table 7: TLTRO intervention impact on credit type amount

Table 7 presents the estimates of the effect of the TLTRO intervention on corporate use of credit line facilities and term loans in the Portuguese credit market, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

	Euro Amount	
Variable	Credit Lines	Term Loans
TLTRO Effect	0.0384***	-0.0371***
	(0.0003)	(0.0003)
Leverage	0.0006*	0.0007*
	(0.0004)	(0.0003)
Profitability	-0.0104***	-0.0101***
	(0.0006)	(0.0006)
Cash Flows	0.0000**	0.0000***
	(0.0000)	(0.0000)
Size	0.0179***	0.0173***
	(0.0004)	(0.0004)
Tangibility	0.0060***	0.0051***
	(0.0012)	(0.0012)
Capital Expenditure	0.0000	0.0000
	(0.0000)	(0.0000)
Working Capital	-0.0000	-0.0001
	(0.0000)	(0.0000)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.4507	0.4507
N	2,785,757	2,785,757

Table 8: TLTRO intervention impact on corporate leverage

Table 8 presents the estimates of the effect of the TLTRO intervention on corporate leverage policies, in the Portuguese credit market, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. Leverage is measured as the value of total debt divided by assets. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

Variable	Leverage
TLTRO Effect	-0.0024***
	(0.0005)
Cash Flows	-0.0029***
	(0.0004)
Size	-0.2845***
	(0.0022)
Working Capital	-0.0000
	(0.0001)
Cash Holdings	-0.0785***
	(0.0057)
Liquidity	-0.0000***
	(0.0057)
Tangibilitity	0.1251***
	(0.0000)
Capital Expenditure	-0.0062***
	(0.0013)
Time fixed effect	Yes
Firm fixed effect	Yes
R-square	0.929
N	2,783,549

Table 9: TLTRO intervention and credit type impact on corporate leverage

Table 9 presents the estimates of the effect of the TLTRO intervention on corporate leverage policies, according to each credit type (term loans and credit lines), in the Portuguese credit market, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. Leverage is measured as the value of total debt divided by assets. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

	Leverage	
Variable	Credit Lines	Term Loans
TLTRO Effect	0.0086***	-0.0086***
	(0.0003)	(0.0003)
Cash Flows	-0.0029***	-0.0029*
	(0.0004)	(0.0004)
Size	-0.2837***	-0.2838***
	(0.0022)	(0.0021)
Working Capital	0.0000	-0.0000***
	(0.0057)	(0.0001)
Cash Holdings	0.0781***	-0.0781***
	(0.0004)	(0.0057)
Liquidity	0.0000***	-0.0000***
	(0.0000)	(0.0000)
Tangibilitity	0.1258***	0.1256
	(0.0053)	(0.0053)
Capital Expenditure	-0.0062***	-0.0062
	(0.0013)	(0.0013)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.929	0.929
N	2,783,549	2,783,549

Table 10: TLTRO intervention impact on corporate cash holdings

Table 10 presents the estimates of the effect of the TLTRO intervention on corporate cash holdings, for Portuguese companies, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

Variable	Cash Holdings
TLTRO Effect	-0.0013***
	(0.0003)
Leverage	-0.0041***
	(0.0008)
Profitability	0.0254***
	(0.011)
Cash Flows	0.0000
	(0.0000)
Size	-0.0117***
	(0.0008)
Tangibility	-0.1655***
	(0.0023)
Capital Expenditure	0.0002
	(0.0001)
Working Capital	-0.0001***
	(0.0000)
Time fixed effect	Yes
Firm fixed effect	Yes
R-square	0.845
N	2,785,757

Table 11: TLTRO intervention and credit type impact on corporate cash holdings

Table 11 presents the estimates of the effect of the TLTRO intervention on corporate cash holdings, according to each credit type (term loans and credit lines), for Portuguese companies, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

	Cash Holdings	
Variable	Credit Lines	Term Loans
TLTRO Effect	-0.0016***	0.0013***
	(0.0001)	(0.0001)
Leverage	-0.0040***	-0.0040**
	(0.0008)	(0.0008)
Profitability	0.0255***	0.0254***
	(0.0011)	(0.0011)
Cash Flows	0.0000	0.0000
	(0.0000)	(0.0000)
Size	-0.0118***	-0.0117***
	(0.0008)	(0.0008)
Tangibility	-0.1655***	-0.1655***
	(0.0023)	(0.0023)
Capital Expenditure	0.0002	0.0002
	(0.0001)	(0.0001)
Working Capital	-0.0001***	-0.0001***
	(0.0000)	(0.0000)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.845	0.845
N	2,785,757	2,785,757

Table 12: TLTRO intervention and corporate leverage impact on corporate cash holdings

Table 12 presents the estimates of the effect of the TLTRO intervention on corporate cash holdings, for Portuguese companies, between 2013 and 2016, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The sample is divided into *High Leverage,* if one year before the introduction of the TLTRO (2014), the company's leverage was above the median value; and into *Low Leverage* in case the reported value was below the median. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

	Cash Holdings	
Variable	High Leverage	Low Leverage
TLTRO Effect	0.0011***	-0.0010***
	(0.0003)	(0.0003)
Leverage	-0.2825***	0.0019**
	(0.0059)	(0.0008)
Profitability	-0.0057*	0.0200***
	(0.0034)	(0.0013)
Cash Flows	0.0195***	0.0000
	(0.0025)	(0.0000)
Size	0.0102***	-0.0077***
	(0.0008)	(0.0005)
Tangibility	-0.3941***	-0.1486***
	(0.0042)	(0.0019)
Capital Expenditure	-0.0000	0.0008**
	(0.0000)	(0.0003)
Working Capital	-0.3672***	-0.0001***
	(0.0085)	(0.0000)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.934	0.832
N	1,415,059	1,367,112

Table 13: TLTRO intervention impact on corporate investment policies

Table 13 presents the estimates of the effect of the TLTRO intervention on corporate investment and employment compensations, controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

Variable	Capital Expenditure	Wages
TLTRO Effect	-0.0010***	-0.0031**
	(0.0004)	(0.0016)
Cash Flows	-0.0198	-0.0007
	(0.1312)	(0.0025)
Size	0.0149	0.4505***
	(0.0166)	(0.032)
Leverage	0.0535	0.0291***
	(0.0501)	(0.0051)
Sales	0.0029	0.0213***
	(0.0065)	(0.0006)
Working Capital	0.0183	-0.0014
	(0.0566)	(0.0023)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.224	0.976
N	2,252,941	2,337,157

Table 14: TLTRO intervention and credit type impact on corporate investment policies

Table 14 presents the estimates of the effect of the TLTRO intervention on corporate investment and employment compensations, according to each credit type (term loans and credit lines), controlling for borrower's characteristics, while simultaneously using firm and time fixed effects. The TLTRO Effect variable is equal to zero until the first TLTRO operation (September 2014) and takes the value of one in case the bank participates in the TLTRO intervention. *** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.

	Capital Expenditure		Wages	
Variable	Credit Lines	Term Loans	Credit Lines	Term Loans
TLTRO Effect	-0.0025***	0.0022***	-0.0103***	0.0092***
	(0.0007)	(0.0008)	(0.0007)	(0.0007)
Cash Flows	-0.0198	-0.0198	-0.0007	-0.0007
	(0.1312)	(0.1312)	(0.0025)	(0.0026)
Size	0.014	0.0148	0.4501***	0.4502***
	(0.0166)	(0.0166)	(0.0033)	(0.0033)
Leverage	0.0535	0.0535	0.0290***	0.0291***
	(0.0502)	(0.0502)	(0.0051)	(0.0051)
Sales	0.0029	0.0029	0.0214***	0.0214***
	(0.0065)	(0.0065)	(0.0006)	(0.0006)
Working Capital	0.0183	0.0183	-0.0015	-0.0015
	(0.0566)	(0.0567)	(0.0009)	(0.0011)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.224	0.224	0.979	0.979
N	2,252,941	2,252,941	2,337,157	2,337,157

9. Appendix

Appendix A: Additional Figures and Tables

Figure A1: Loan distribution by day

Figure A1 outlines the evolution of the loan distribution by day. The x-axis represents the days left until the last day of month, meaning that the 0 represents the very last day of the month.

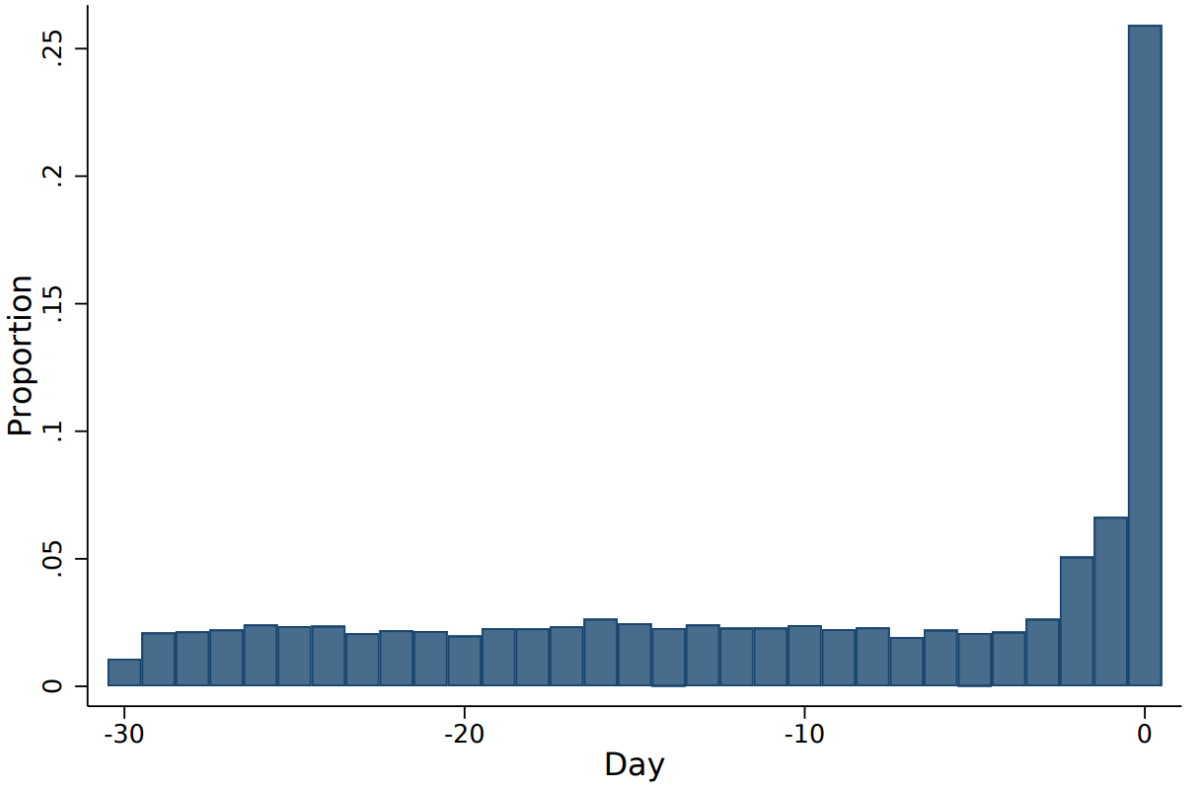

Figure A2: Evolution of the amount of loan operations for TLTRO banks

Figure A2 outlines the evolution of the amount of loan operations for banks that participated in the TLTRO intervention. Each dot represents the last day of the month. It is possible to see that each spike corresponds to the last day of the corresponding month. The first big increment corresponds to December 31, 2014.

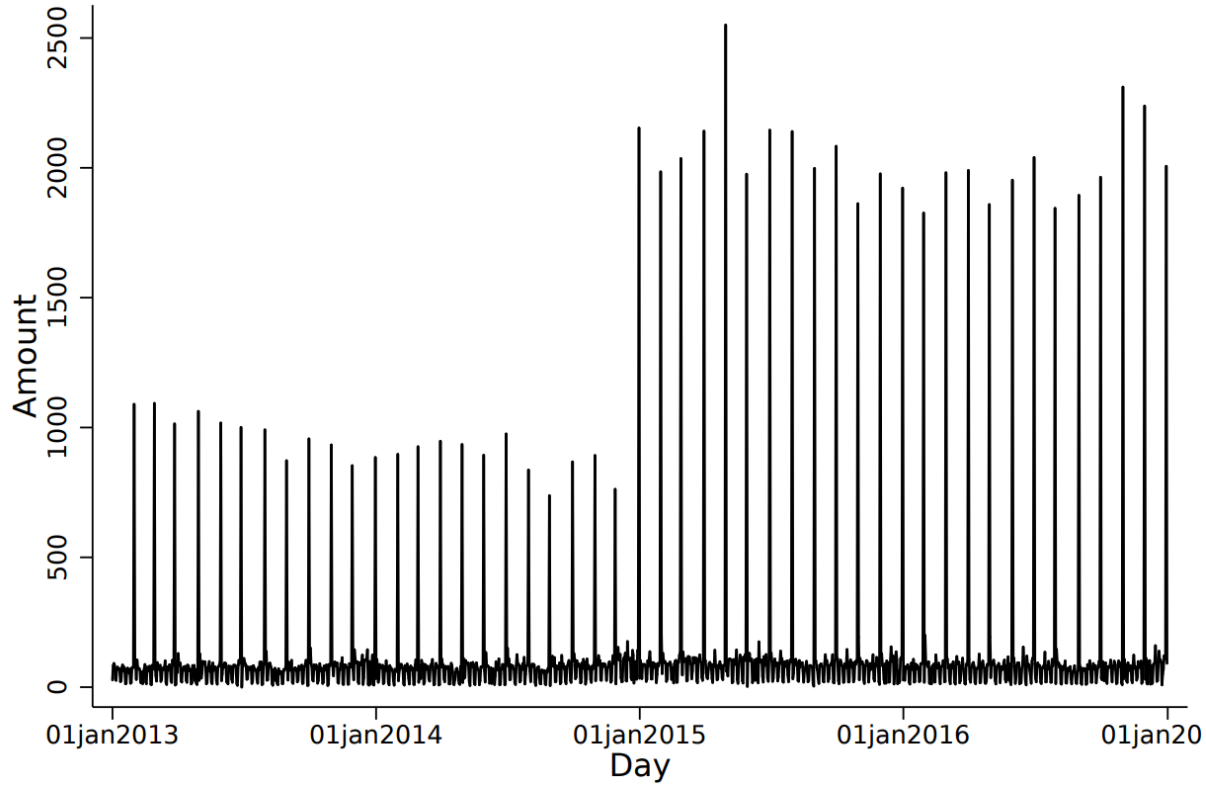

Figure A3: Evolution of the amount of loan operations for Non-TLTRO banks

Figure A2 outlines the evolution of the amount of loan operations for banks that did not participate in the TLTRO intervention. Each dot represents the last day of the month. It is possible to see that each spike corresponds to the last day of the corresponding month. The first big increment corresponds to December 31, 2014.

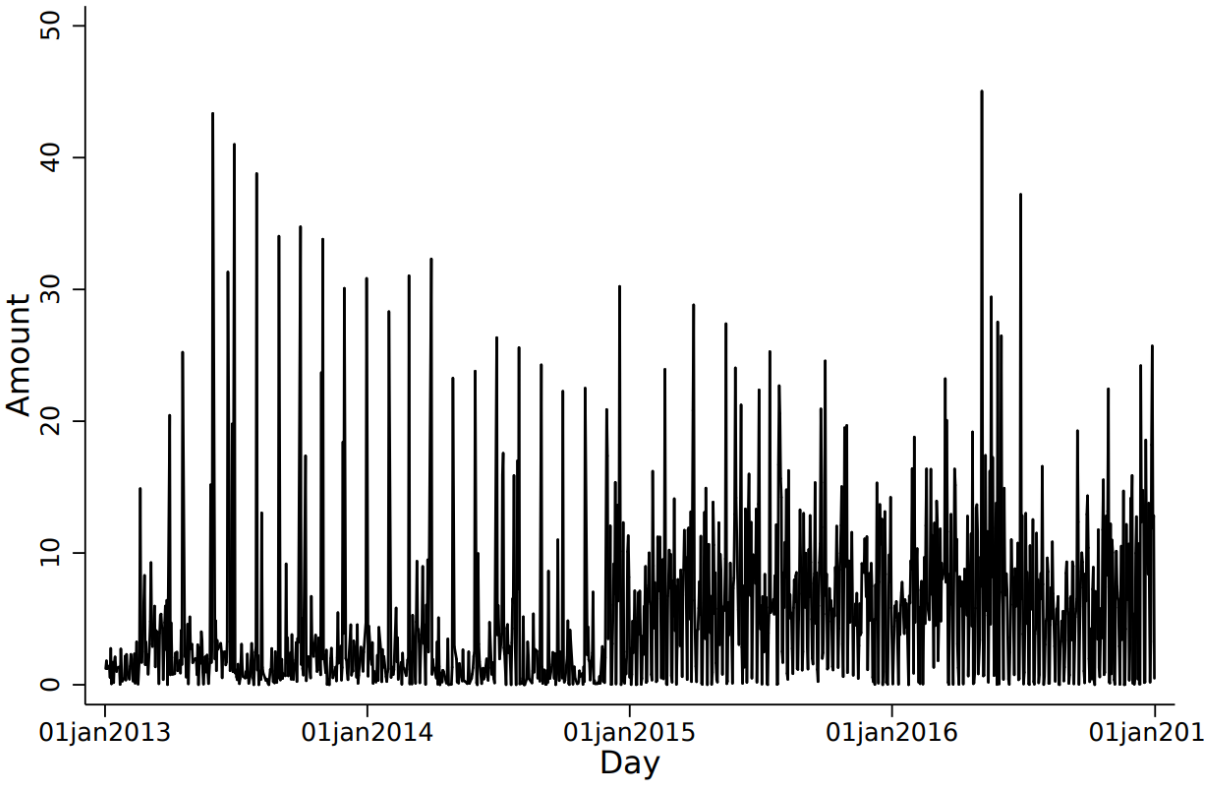

Table A1: Description of main variables

Table A1 reports the description of the main variables used throughout the study. All variables were retrieved from IES.

Variable	Formula
Firm Size	*Log(Total Assets)*
Tangibility	*Tangible Assets/ Total Assets*
Profitability	*Net Income/ Total Assets*
Leverage	*Total Debt/ Total Assets*
Liquidity	*(Current Assets/ Current Liabilities)*
Cash Flows	*EBITDA/ Total Assets*
Capital Expenditures	*CAPEX / Total Assets*
Working Capital	*(Net Working Capital - Cash) / Total Assets*
Wages	*Log(Wages)*
Cash Holdings	*Cash/ Total Assets*

Table A2: Loan and borrower characteristics comparison of credit lines between the end of the month and the rest of the month

Table A2 reports the comparison regarding the loan and borrower characteristics of credit lines, divided into end of month (last 3 days) and rest of the month. The p-value derives from the difference in the means test using the t-test.

	Credit Lines		
Variable	End of month	Rest of month	p-value
Panel A: Loan Characteristics			
Amount	0.07	0.09	0.00
Collateral	0.25	0.74	0.00
Maturity	-	-	-
Interest rate	13.13	8.30	0.00
Default	0.09	0.02	0.00
Panel B: Borrower Characteristics			
Size	14.64	13.17	0.00
Age	22.93	18.28	0.00
Tangibility	0.24	0.24	0.00
Profitability	0.00	-0.05	0.00
Leverage	0.72	0.90	0.00
Liquidity	10.91	5.87	0.00

Table A3: Summary Statistics for key loan and borrower characteristics – Year level (2013)

This table outlines the summary statistics for key loan and borrower characteristics. Panel A aggregates all variables concerning loan characteristics, such as amount, collateral, maturity, interest rate and one-year default rate. Panel B reports the descriptive statistics regarding borrower characteristics, such as size, age, tangibility, profitability, leverage and liquidity. The statistical measures reported contain the number of observations, mean, standard deviation, minimum, percentile 25, percentile 50, percentile 75 and maximum for each variable.

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max
Panel A: Loan Characteristics								
Amount	633,843	0.06	0.14	0.00	0.00	0.01	0.04	0.96
Collateral	633,843	0.26	0.44	0.00	0.00	0.00	1.00	1.00
Maturity	633,843	135.9	330.1	0.00	0.00	59.0	103.0	1,826
Interest rate	633,843	10.00	7.09	2.29	5.27	7.16	11.89	32.03
Default	569,492	0.08	0.26	0.00	0.00	0.00	0.00	1.00
Panel B: Borrower Characteristics								
Size	633,843	14.26	1.95	9.58	12.89	14.23	15.69	18.68
Age	633,843	21.13	14.33	1.00	11.00	19.00	28.00	72.00
Tangibility	633,843	0.23	0.21	0.00	0.06	0.17	0.35	0.89
Profitability	633,843	-0.03	0.19	-1.15	-0.01	0.01	0.03	0.23
Leverage	633,843	0.79	0.21	0.11	0.06	0.17	0.86	3.70
Liquidity	633,843	6.07	63.70	0.10	-0.22	0.53	1.85	12.29

Table A4: Summary Statistics for key loan and borrower characteristics – Year level (2014)

This table outlines the summary statistics for key loan and borrower characteristics. Panel A aggregates all variables concerning loan characteristics, such as amount, collateral, maturity, interest rate and one-year default rate. Panel B reports the descriptive statistics regarding borrower characteristics, such as size, age, tangibility, profitability, leverage and liquidity. The statistical measures reported contain the number of observations, mean, standard deviation, minimum, percentile 25, percentile 50, percentile 75 and maximum for each variable.

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max
Panel A: Loan Characteristics								
Amount	636,436	0.06	0.14	0.00	0.00	0.01	0.04	0.96
Collateral	636,436	0.34	0.47	0.00	0.00	0.00	1.00	1.00
Maturity	636,436	149.7	371.4	0.00	0.00	58.00	100.0	2,190
Interest rate	636,436	9.28	7.12	1.97	4.69	6.54	2.73	32.03
Default	568,221	0.06	0.24	0.00	0.00	0.00	0.00	1.00
Panel B: Borrower Characteristics								
Size	636,436	14.15	1.99	9.40	12.75	14.09	15.57	18.68
Age	636,436	21.00	14.51	1.00	10.00	19.00	28.00	72.00
Tangibility	636,436	0.24	0.22	0.00	0.06	0.18	0.37	0.90
Profitability	636,436	-0.02	0.20	-1.15	0.00	0.01	0.03	0.28
Leverage	636,436	0.79	0.53	0.10	0.58	0.73	0.86	4.00
Liquidity	636,436	6.81	62.98	0.10	0.05	0.80	1.92	14.26

Table A5: Summary Statistics for key loan and borrower characteristics – Year level (2015)

This table outlines the summary statistics for key loan and borrower characteristics. Panel A aggregates all variables concerning loan characteristics, such as amount, collateral, maturity, interest rate and one-year default rate. Panel B reports the descriptive statistics regarding borrower characteristics, such as size, age, tangibility, profitability, leverage and liquidity. The statistical measures reported contain the number of observations, mean, standard deviation, minimum, percentile 25, percentile 50, percentile 75 and maximum for each variable.

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max
Panel A: Loan Characteristics								
Amount	867,782	0.06	0.14	0.00	0.00	0.02	0.05	0.95
Collateral	867,782	0.43	0.50	0.00	0.00	0.00	1.00	1.00
Maturity	867,782	141.3	379.0	0.00	0.00	30.00	94.00	2,190
Interest rate	867,782	8.40	7.38	1.05	3.46	5.70	9.53	32.03
Default	763,828	0.05	0.22	0.00	0.00	0.00	0.00	1.00
Panel B: Borrower Characteristics								
Size	867,782	14.02	2.04	9.25	12.58	13.94	15.47	18.67
Age	867,782	21.29	14.44	2.00	10.00	19.00	29.00	71.00
Tangibility	867,782	0.24	0.23	0.00	0.06	0.18	0.38	0.90
Profitability	867,782	-0.02	0.20	-1.37	0.00	0.01	0.04	0.30
Leverage	867,782	0.80	0.59	0.09	0.56	0.72	0.85	4.61
Liquidity	867,782	9.96	67.96	0.08	0.16	1.17	2.02	16.81

Table A6: Summary Statistics for key loan and borrower characteristics – Year level (2016)

This table outlines the summary statistics for key loan and borrower characteristics. Panel A aggregates all variables concerning loan characteristics, such as amount, collateral, maturity, interest rate and one-year default rate. Panel B reports the descriptive statistics regarding borrower characteristics, such as size, age, tangibility, profitability, leverage and liquidity. The statistical measures reported contain the number of observations, mean, standard deviation, minimum, percentile 25, percentile 50, percentile 75 and maximum for each variable.

Variable	N	Mean	Std. Dev.	Min.	Q1	Median	Q3	Max
Panel A: Loan Characteristics								
Amount	818,246	0.06	0.14	0.00	0.00	0.02	0.05	0.89
Collateral	818,246	0.43	0.49	0.00	0.00	0.00	1.00	1.00
Maturity	818,246	146.97	396.13	0.00	0.00	27.00	93.00	2,190.00
Interest rate	818,246	7.42	7.04	1.05	2.78	4.90	8.20	30.86
Default	705,264	0.05	0.21	0.00	0.00	0.00	0.00	1.00
Panel B: Borrower Characteristics								
Size	818,246	13.96	2.04	9.25	12.53	13.87	15.41	18.66
Age	818,246	21.67	14.43	2.00	11.00	19.00	29.00	72.00
Tangibility	818,246	0.25	0.23	0.00	0.06	0.18	0.38	0.90
Profitability	818,246	-0.01	0.20	-1.37	0.00	0.02	0.05	0.30
Leverage	818,246	0.79	0.59	0.09	0.56	0.72	0.85	4.61
Liquidity	818,246	12.24	72.41	0.08	0.24	1.56	2.06	16.76

Appendix B: Background on ECB Liquidity Injections

This section provides some background regarding the history of ECB liquidity injections. The reversal of the housing boom in the US and the crash of the subprime mortgage market enabled a worldwide crisis in 2008. In the Eurozone, the financial burst step up to a sovereign crisis in 2010. By that time, doubts regarding countries with bulky fiscal deficits' solvency arose – and a loop between banking and sovereign credit began. In response to a crisis escalation, the major central banks adopted unconventional monetary policies. For further analysis on unconventional monetary policies, Fawley and Neely (2013) provide a thorough summary of the decisions taken by the FED, the Bank of England, the ECB and the Bank of Japan.

Monetary policy measures prior to the 2008 shock

Before the 2008 financial crisis, the ECB was a regular provider of liquidity throughout Open Market Operations (OMO), which had a tenor up to three months at a floating rate. There are two standard operations: the Main Refinancing Operation (MRO), a weekly-run program with a matching maturity and the Longer-Term Refinancing Operation (LTRO), a monthly-run program with a 3-months maturity. The target of the previously referred programs differ. The first one intends to drive short-term interest rates and support the liquidity management of banks, whereas the last one provides longer-term liquidity to financial institutions and acts as a tool to lower sovereign debt yields, since countries can use their own sovereign debt as collateral (hence increasing its demand and decrease the associated yield).

The ECB reaction: a liquidity boost in the Eurozone

The financial crisis and its repercussions posed a considerable number of challenges for central banks. While conventional monetary policy has proven to achieve stable levels of inflation, its role in promoting financial stability remains subject to debate. Even before the collapse of Lehman Brothers in September 2008, there were already strong signals of market instability: banks were reluctant in participating in the money market due to counterparty' credit risk. Hence, liquidity was getting scarce and, in 2007, the ECB conducted non-regular operations, namely an additional stream of Longer-Term Refinancing Operations (LTRO) with 3-months maturity.

By purchasing assets (either government bonds or private debt), central banks will expand its balance sheets. These purchases are explicitly about quantities, as opposed to decisions about a target interest rate. Hence, central banks increase its balance sheet and shift the portfolio mix

of assets held by the private sector who will hold more claims on the central bank ("money" – the liability side on a central bank's balance sheet).

In the beginning of 2008, the Eurosystem conducted a new round of non-regular operations (6-months maturity) as well as a new tranche of 3-months' LTROs. With Lehman filling for Chapter 11, new extraordinary measures were required. The ECB implemented the fixed-rate full allotment in the open-market operations (under a fixed interest rate, defined by the ECB, and considering that both parties have sufficient collateral, their bids are satisfied). A new 1-year LTRO, as well as the first covered bond purchase program (CBPP). The Securities Market Program (SMP) was announced in May 2010 and it was the first purchase program of public and private debt instruments. Between 2011 and 2012 the sovereign crisis intensified, and the ECB launched new programs: the second purchase program of covered bonds (CBPP2), two new 3-year LTROs, a reduction in the minimum reserve requirement coefficient from 2% to 1%, a decrease in the deposit facility interest rate to 0% and the announcement of the Outright Monetary Transactions (OMT) program.

In 2014, the risk of deflation led the Eurosystem to introduce new measures to attain its price stability target: the Quantitative Easing (QE) program. This concept was originally applied to Japan when it came across a real estate bubble and deflationary pressures in the 90s and was introduced to signal a shift in focus towards targeting quantity variables (Joyce, Miles, Scott and Vayanos 2012). In the ECB context, the QE program included the implementation of negative interest rate on the deposit facility, as well as the Expanded Asset Purchase Program (APP). In the APP setting, it includes all purchase programs under which both private and public securities are bought to address the risks of a too lengthy period of low inflation. Specifically, it includes four programs: corporate sector (CSPP), public sector (PSPP), asset-backed securities (ABSPP) and the third-edition of the covered bond program (CBPP3).

The outcome of this set of unconventional monetary actions has been widely studied in the literature. Fratzscher, Duca and Straub (2014) show that ECB policies impacted asset prices in the euro area and reduced market fragmentation in bond markets. Besides that, the spillover effect positively influenced global equity markets and investors' confidence levels. Afonso and Kazemi (2018) report that ECB's monetary measures were crucial to stabilize sovereign yield spreads after the 2010 sovereign crisis. Other studies assess the impact of QE outside the Eurozone market (Krishnamurthy and Vissing-Jorgensen, 2011; Fawley and Neely, 2013).

The Targeted Longer-Term Refinancing Operations (TLTROs)

In this thesis, we focus on one special measure adopted by the ECB during the crisis. In June 2014, the ECB's Governing Council created a tool designed to provide financing to credit institutions for periods up to four years – the Targeted Longer-Term Refinancing Operations (TLTROs). This mechanism offers long-term funding with the aim of enhancing private sector credit conditions and encourage financial institutions' lending to the real economy. The TLTROs are targeted operations as the amount banks are eligible to borrow is directly connected to their loans to non-financial organizations and households.

Under the TLTRO scheme, banks would initially be able to borrow 7% of the total amount of their loans to the euro area non-financial private sector (not including loans for house purchase) outstanding on 30 April 2014. In two successive TLTROs conducted in September and December 2014, banks were able to borrow an amount that cumulative does not exceed the initial threshold of 7%. Banks could participate in this mechanism either individually or jointly with a group of banks (either domestic or foreigner). In case of a foreign banking group, the lead institution participates in the program based on the net lending of all banks in the group and is then responsible to allocate the credit granted to each bank.

The TLTRO program had two rounds: the first one (TLTRO I) between September 2014 and June 2016 and the second one (TLTRO II) between June 2016 and March 2017. For the TLTRO I, which consisted of eight quarterly operations (with a maturity of four years), the funding rate was indexed to the main refinancing operations at the time of take-up. Concerning the TLTRO II, composed of four quarterly operations (with a maturity of four years), the funding rate was a function of the evolution of net lending from February 2015 to January 2018, floored at the minimum equivalent to the depository facility rate at the time (-0.45%) and capped at the main refinancing operation rate (0%).

The TLTRO program injected €1,172 billion in the financial institutions of the Eurozone, through 849 banks that represent 46% of the Eurozone's banking system (measured by total assets). The TLTRO-I injected €432 billion in the Eurozone, of which €12 billion were borrowed to Portuguese banks. The second edition of the mechanism (TLTRO-II) injected €21 billion in Portugal, compared with a total amount of €740 billion. It is important to note that the net amount injected in the economy was not €1,172 billion: a substitution effect between the two operations arose, due to a better interest rate on the TLTRO II. The overall impact on the Eurozone was €768 billion and €20.5 billion in the Portuguese market.