LISBON
SCHOOL OF
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UNIVERSIDADE DE LISBOA

MASTER

MONETARY AND FINANCIAL ECONOMICS

MASTER´S FINAL WORK

DISSERTATION

THE TRANSMISSION OF UNCONVENTIONAL MONETARY POLICY TO BANK CREDIT SUPPLY: EVIDENCE FROM THE TLTROS

JOANA DOS REIS OLIVEIRA DE SOUSA LEITE

OCTOBER 2018

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SUPERVISION:

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The Transmission of Unconventional Monetary Policy to Bank Credit Supply: Evidence from the TLTROs

Joana Sousa Leite

October 2018

Abstract:

This dissertation assesses the transmission of the Targeted Longer-Term Refinancing Operations (TLTROs) to the bank credit supply for the Euro area and for Portugal in particular, using a panel data approach. For the Euro area countries, we found a positive correlation between the TLTROs and the amount of credit granted to the real economy. In the Euro area, the effects of the TLTROs on the stock of credit increased during the period under analysis and are stronger for the less vulnerable countries. For Portugal, using a difference-in-differences model, we found that treated banks decreased loan rates by, approximately, 1.7 percentage points relative to control banks. In Portugal, the effects of the TLTROs on loan rates also increased during the period under analysis and are stronger for the small banks. Therefore, our results indicate that, in Portugal, the TLTROs contributed to the well-functioning of the Monetary Policy transmission mechanism.

Keywords: Unconventional Monetary Policy, Targeted Longer-Term Refinancing Operations, bank credit supply, lending rates, bank lending channel.

JEL: C33, C87, E50, E51, E52, E58.

The Transmission of Unconventional Monetary Policy to Bank Credit Supply: Evidence from the TLTROs

Joana Sousa Leite

Outubro 2018

Resumo:

Esta dissertação estuda a transmissão das Operações de Refinanciamento de Prazo Alargado Direcionadas (TLTRO) para a oferta de crédito pelo setor bancário na área do Euro e, em particular, em Portugal, através de uma abordagem de dados em painel. Para os países da área do Euro, verificámos uma correlação positiva entre as TLTRO e o montante de crédito concedido pelos bancos à economia real. Na área do Euro, os efeitos das TLTRO no montante de crédito concedido aumentam ao longo do período em análise e são mais fortes nos países menos vulneráveis. Para Portugal, recorrendo o modelo *diference-in-differences*, demonstrámos que os bancos que participaram nas TLTRO diminuíram as taxas de juro aplicadas no crédito concedido à economia real em aproximadamente 1.7 pontos percentuais em relação aos bancos que não participaram. Em Portugal, os efeitos das TLTRO nas taxas de juro do crédito também aumentam ao longo do período em análise e são mais fortes nos bancos pequenos. Deste modo, os resultados mostram que, em Portugal, as TLTRO contribuíram para o correto funcionamento do mecanismo de transmissão da Política Monetária.

Palavras-chave: Política Monetária não convencional, Operações de Refinanciamento de Prazo Alargado Direcionadas, oferta de crédito bancário, taxas de juro, canal de crédito bancário.

JEL: C33, C87, E50, E51, E52, E58.

Contents

Figures

Tables

1. INTRODUCTION

The 2008-2009 Global Financial Crisis (GFC) forced the major Central Banks[1] to implement a set of unconventional Monetary Policy measures, assumed to have a temporary character (Mishkin, 2011; Roman & Purcel, 2014; Trichet, 2013). These unprecedented measures were aimed at restoring the stability of the financial markets and the correct functioning of the Monetary Policy transmission mechanism and consisted of liquidity injections via credit refinancing operations at low interest rates, asset purchases from the market in order to lower interest rates, the reduction of Monetary Policy official interest rates and forward guidance on policy announcements (Acharya et al, 2012; Driffill, 2016; Gertler & Karadi, 2010; Kashyap & Stein, 2000).

Amongst the unconventional Monetary Policy measures undertaken by the European Central Bank (ECB) is the so-called quantitative easing (QE), which includes the introduction of the Targeted Longer-Term Refinancing Operations (TLTRO), announced on the 5th of June 2014, by the ECB Governing Council, *"designed to enhance the functioning of the Monetary Policy transmission mechanism by supporting bank lending to the real economy"* (Draghi, 2014a).

This dissertation aims at studying the transmission of the TLTROs to the bank credit supply, in order to assess if the liquidity obtained from these operations has met the essence of its main goal, namely if banks have used this liquidity to increase the credit granted to the real economy. To measure the impact of the TLTROs, we estimated the correlation between these operations and the credit granted by the banking sector to the real economy. Our study is divided into two separate analyses: an empirical analysis for the Euro area, studying the impact on the amount of bank credit supply and a more detailed empirical analysis for Portugal, considering not only the amounts but also the cost of credit. Both analyses measure the impact of the TLTROs on the bank credit supply as a correlation effect and not as a causal effect.

For the Euro area analysis, we aim at estimating the transmission of the TLTROs to the amount of credit granted to the real economy. To do so, we studied the evolution of the stock of credit between the 30th of April 2014 and the 31st of January 2018, using an OLS empirical regression with bank fixed effects. First, we found a positive correlation between the TLTROs and the amount of credit granted to the real economy, showing that the TLTROs had a positive and significant impact on the stock of credit, which means that banks used part of the money borrowed in the TLTROs to grant credit to the real economy. Moreover, we found that TLTROs

[1] European Central Bank (ECB), Federal Reserve System (FED), Bank of Japan (BoJ) and Bank of England (BoE).

had a higher impact in less vulnerable countries, showing that the transmission worked better in these countries. Second, we assessed how the competition affects the transmission between the TLTROs and the stock of credit, using the Herfindahl Index of market concentration per country. The results do not prove any significant correlation between market concentration and the transmission of the TLTROs to the bank credit supply.

For the specific case of Portugal, we estimated not only the transmission of the TLTROs to the amount of credit granted to the real economy, but also the pass-through of its favourable interest rates to loan rates. We used a difference-in-differences OLS regression with bank and time fixed effects, introducing a control group composed by the Monetary Policy counterparties that did not participate in the TLTROs, as well as the period before the implementation of these operations. First, we did not find a significant correlation between the TLTROs and the amount of credit granted to the real economy. Second, we found a negative significant correlation between the TLTROs and the cost of credit. In 2017, treated banks decreased its loan rates on average by, approximately, 1.71 percentage points relative to control banks and the effects of the TLTROs on the cost of credit have increased during the period under analysis. The results also show that, for the group of large banks, treated banks decreased its loan rates on average by, approximately, 1.63 percentage points relative to control banks, while for the group of small banks, treated banks decrease its loan rates on average by, approximately, 2.95 percentage points relative to control banks. Hence, the difference between treated and control banks is higher for the group of small banks, indicating that the transmission of the TLTROs to the cost of credit was stronger for these banks.

The results on the transmission of the TLTRO to loan rates characterise the correct functioning of Monetary Policy transmission mechanism. Therefore, the results demonstrate that the TLTROs had a positive and significant impact on the Monetary Policy transmission mechanism.

The remainder of the dissertation is organised as follows. Section 2 describes the background of the TLTROs. Section 3 reviews the most relevant literature on this topic and describes the contribution of this dissertation to the literature. Section 4 summarises the data. Section 5 explains the methodology used to perform this analysis. Sections 6 and 7 present and comment the empirical results for the Euro area and for Portugal, respectively. Section 8 concludes.

2. BACKGROUND

2.1. Unconventional Monetary Policy measures

Until the 2008-2009 GFC, the ECB provided liquidity on a regular basis through the open market operations (OMO), which are auctions with tenors up to three months, at a variable rate (American auction), in the form of a repurchase agreement against eligible collateral. The ECB has two regular refinancing operations: the Main Refinancing Operation (MRO), on a weekly basis and with a tenor of one week and the Longer-Term Refinancing Operation (LTRO), on a monthly basis and with a tenor of three months. The MRO aims at steering the short-term interest rates, in order to support the liquidity management of the banks and to give signals to the Market about the Monetary Policy stance, while the LTRO aims at providing additional liquidity with a longer maturity to the financial sector (Banco de Portugal, 2017).

With the GFC, followed by the bankruptcy of the investment bank Lehman Brothers in September 2008, which intensified the market instability initiated with the GFC, the ECB implemented the first unconventional Monetary Policy measures, including the fixed-rate full allotment (FRFA) in the OMO (under an interest rate fixed by the ECB, considering that counterparties have enough eligible collateral available, their bids are fully satisfied), a new LTRO with one-year maturity (1-year LTRO) and the first purchase programme of covered bonds (CBPP1). Following these measures and the sovereign debt crisis started in 2010, the ECB introduced the Securities Market Programme (SMP), the first purchase programme of public and private debt securities. Between 2011 and 2012, with the intensification of the sovereign debt crisis, the ECB implemented the second purchase programme of covered bonds (CBPP2), two new LTROs with three-year maturity (3-year LTRO), reduced the minimum reserve requirement coefficient from 2% to 1%, lowered the interest rate on the deposit facility to 0% and announced the Outright Monetary Transactions (OMT) programme. Moreover, regarding the eligible collateral in the OMO, the compliance with the minimum rating level was suspended in the case of securities issued or guaranteed by the Government and bank loans (additional bank loans on individual and aggregated bases) started to be accepted (Banco de Portugal, 2017).

In 2014, the Euro deflation crisis led the ECB to implement a new set of unconventional Monetary Policy measures, the so-called QE, which included the establishment of a negative interest rate on the deposit facility, the Expanded Asset Purchase Programme (APP) and the TLTROs. Along with this set of measures, forward QE guidance was disclosed to the market, not only on the ECB official interest rates, expected to remain at low levels for a considerable period of time, but also on the ECB willingness to increase the extent and/or the duration of

APP, in case a less favourable outlook would occur or an unwarranted tightening of the financial conditions would arise. These unconventional measures, besides injecting liquidity in the economy, were also implemented to achieve the main ECB goal of an inflation rate below, but close to, 2% over the medium term (Banco de Portugal, 2017; Draghi, 2014b).

In the APP context, the ECB buys private and public debt, under four purchase programmes: Asset-Backed Securities (ABSPP), Covered Bonds (CBPP3), Public Sector Debt (PSPP) and Corporate Sector Debt (CSPP) (ECB/2015/10). In the context of low interest rates, asset purchase programmes aimed at mitigating the risks associated with a prolonged period of low inflation rate, providing a monetary stimulus to the real economy and, consequently, contributing to the achievement of the main goal of the ECB (Andrade et al, 2016).

The unconventional Monetary Policy measures were responsible for containing sovereign yield spreads, in relation to German yields, for the Euro area, after the 2008-2009 GFC and the 2010 sovereign debt crisis (Afonso & Kazemi, 2018). Besides, these measures resulted in the expansion of the ECB balance sheet, reducing the responsiveness of the sovereign yield spreads to their fundamental determinants (Afonso et al, 2018). In fact, QE is the major responsible for the excess liquidity scenario verified since March 2015. The liquidity injected through APP and TLTROs has had a huge impact on the size of National Central Banks (NCB) balance sheets (Baldo et al, 2017).

2.2. Targeted Longer-Term Refinancing Operations (TLTRO)

The TLTROs are longer-term refinancing operations, with the specific target of supporting the bank lending to the real economy, contributing to the well-functioning of the Monetary Policy transmission mechanism (Draghi, 2014a). The amounts that credit institutions can borrow on these operations are linked to their eligible credit granted to both non-financial corporations and households[2], excluding lending for house purchase, in all currencies, for the Euro area residents. Banks were able to participate in these operations either individually or associated in a banking group, domestic or cross-border. In the case of a cross-border banking group, the lead institution participates in the TLTROs based on the eligible net lending of all the banks included in the group, allocating all the credit granted by the banks incorporated in the group to the jurisdiction of the lead institution (ECB, 2014).

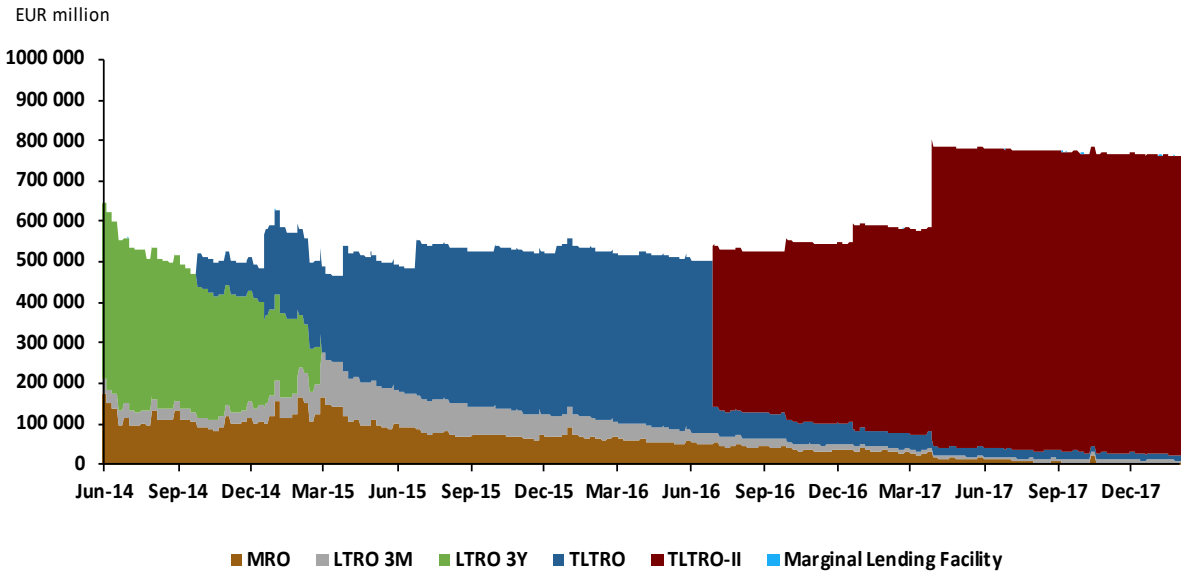
The TLTROs had two series: the first one between the 24th of September 2014 and the 29th of June 2016, consisting of 8 quarterly operations, where the interest rate was indexed to the MRO at the settlement date and the second series between the 29th of June 2016 and the 29th

[2] Households include non-profit institutions serving households.

of March 2017 (TLTRO-II), with 4 quarterly operations, as illustrated in Figure 1. For the second series, the interest rate applied was dependent on the evolution of the net lending from the 1st of February 2015 to the 31st of January 2018, ranging from a minimum equivalent to the deposit facility rate at the bidding date (-0.4%) to a maximum of the MRO rate (0%) (ECB/2014/34; ECB/2016/10).

The two series of the TLTROs injected a total amount of EUR 1 172 billion in the Euro area banks, through 849 banks representing 46% of the Euro area banking system, assessed by its total assets. Although the second series has provided EUR 740 billion, the total net injection was only EUR 336 billion, due to the substitution effect between the two, profiting from a better interest rate of the second series. As illustrated in Chart 1, in the end of 2017, the outstanding amount of the TLTROs represents around 99% of the total outstanding amount of the OMO.

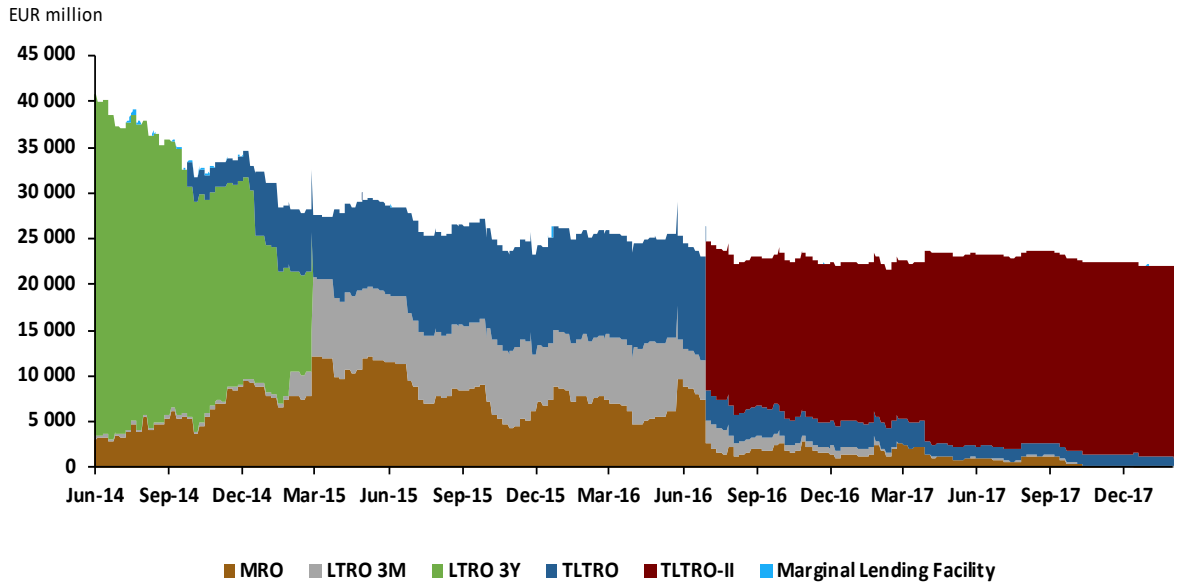
Chart 1: Evolution of Monetary Policy Refinancing Operations for the Euro area



Source: ECB. Calculations by the author.

In Portugal, the TLTROs have injected a total amount of EUR 333 billion, through 17 banks. The second series has also had a higher demand, providing EUR 210 billion, albeit the net injection was only EUR 85 billion, considering the substitution effect between TLTRO and TLTRO-II. Similarly, as Chart 2 illustrates, in the end of 2017, the outstanding amount of the TLTROs represents the total outstanding amount borrowed by Portuguese counterparties in the OMO.

Chart 2: Evolution of Monetary Policy Refinancing Operations for Portugal



Source: Banco de Portugal. Calculations by the author.

3. LITERATURE

The effects of the TLTROs have not yet been largely studied in the existing literature, mostly due to the recent character of these operations. However, the 3-year LTROs, implemented between the 21st of December 2011 and the 29th of February 2012, have already been the object of several academic researches. These operations have provided EUR 1 019 billion to 800 Euro area banks and were described as *"credit support measures to support bank lending and liquidity in the Euro area money market"* (ECB/2012/18).

When analysing the effects of the 3-year LTROs, using a panel-VAR (vector autoregression) for the Euro area countries with information from the BLS, Darracq-Paries & Santis (2013) concluded that 3-year LTROs gave a significant contribution to the improvement of the real GDP projections and to the credit granted to non-financial corporations, supporting the provision of bank lending and avoiding a sudden dry-up of credit supply. Nevertheless, the authors also analysed the transmission to the real economy, concluding that 3-year LTROs seem to have resulted more in a quantitative credit easing than in a lower cost of financing. Carpinelli & Crosignani (2017) showed that banks exposed to the foreign wholesale market reduced their credit supply during the period of funding stress and restored their credit supply once the Central Bank injected liquidity into the system through the 3-year LTROs, albeit a significant fraction of the Central Bank liquidity was used to increase holdings of high-yield securities, mainly for the banks less affected by the wholesale funding dry-up, using the funds to reach-for-yield. Andrade et al (2015) studied the impact of the 3-year LTROs in France and concluded

that banks seized the opportunity to replace their short-term financing with a longer-term Central Bank borrowing, showing that 3-year LTROs worked via the bank lending channel when banks were financially constrained, allowing an increase on their lending to firms with intensive margin by the use of their 3-year LTROs uptakes. Jasova et al (2018) analysed the impact of the 3-year LTROs in Portugal and showed that its extended maturity had a positive and economically sizable impact on the credit granted to the real economy. Additionally, the authors also showed that 3-year LTROs had a policy side-effect, as banks used this liquidity to purchase more securities and therefore partially replaced the lending to the real economy.

In June 2014, the ECB announced the TLTROs, with the specific target of supporting the credit granted by the banking system. These operations were specifically designed to give banks the incentive to increase loans to non-financial corporations and households (except lending for house purchase), since the borrowing limits of these collateralised cash loans were a function of their net lending. In the TLTRO-II, not only the borrowing limits but also its interest rate depended on their net lending, what contributes to a better functioning of the Monetary Policy transmission mechanism (ECB/2016/10).

In fact, the conditions of the TLTROs are a key aspect for its success. For instance, banks seem to prefer a longer-term refinancing rather than a roll-over of short-term Monetary Policy refinancing operations, not only due to the uncertainty on the maintenance of the FRFA in the OMO over the subsequent years, but also for regulatory reasons, for instance longer-term operations contributes to the fulfilment of the net stable funding ratio (NSFR) (Renne, 2014).

When analysing the bank lending survey (BLS), addressed to a representative sample of Euro area banks in order to improve the knowledge of the Euro area bank lending behaviour, we concluded that responses are quite similar for both series of TLTROs (TLTRO and TLTRO-II). Among the reasons presented by the Euro area banks to participate in these longer-term operations, the most commonly referred was its attractive conditions (profitability motive), along with the reduction of the current difficulties and/or the prevention of future ones (precautionary motive) and, in a small extent, the enhancement of the regulatory liquidity requirements fulfilment (namely the NSFR). On the other hand, Euro area banks indicated the absence of fund constraints as the main reason for not participating in TLTROs, but also the concerns about insufficient loan demand (the fulfilment of the required TLTRO net lending benchmark), capital and collateral constraints, as well as concerns about market stigma. The Euro area banks that participated in the TLTROs used the funds to grant loans to non-financial corporations and households, to substitute maturing debt and interbank lending, as well as to replace other Eurosystem refinancing operations, namely the 3-years LTROs. Banks indicated

that the TLTROs contributed to the improvement of not only the credit supply, but also its terms and conditions, especially for non-financial corporations (ECB, 2017a; ECB, 2017b).

Balfoussia & Gibson (2015) concluded that there is a significant impact of the TLTROs on the real economy activity, both for the Euro area as a whole and for the specific case of Greece, via an easing of the financial conditions, affecting several real economy indicators, verified as positive and significant, and possibly resulting in an overall economic growth increase. The authors used a financial conditions index (FCI) developed by Angelopoulou et al (2013), which includes a wide range of prices, quantities, spreads and survey data, in line with the economic theory followed by the authors, combined with a VAR framework, in order to estimate the potential impact of TLTROs on several economic activity aspects.

Benetton & Fantino (2017) estimated the effect of the TLTROs on the price of credit for Italy, concluding that bidder banks lowered their loan rates by, approximately, 20 basis points relative to the banks that did not participate in these operations. The authors also studied how the competition affects the transmission of the TLTROs to the cost of credit, showing that market concentration reduces the pass-through of the TLTROs to firms through the cost of credit.

In 2017, two ECB Economic Bulletins presented, for the Euro area, the evolution of both the amounts and lending rates of the credit granted to non-financial corporations, showing that the two series of TLTROs have resulted in more attractive credit conditions. Bidder banks located in vulnerable countries have lowered their interest rates more than banks that did not participate in these operations (non-bidders). Therefore, vulnerable countries had a stronger response to the TLTROs than less vulnerable ones, which contributed to a lower dispersion of banking lending rates, resulting in a reduction of the fragmentation of the Eurosystem financing conditions. Additionally, banks with high levels of excess liquidity verified significant increases in credit volumes (ECB, 2017c). For less vulnerable countries, the stock of credit has increased for bidder banks and was kept relatively stable for non-bidders. In the case of vulnerable countries, non-bidder banks verified a significant decrease in intermediation amounts, while, for bidders, the decline was smoother (ECB, 2017d). However, the two abovementioned Economic Bulletins analysed the credit granted only to non-financial corporations, by a limited sample of banks and did not cover the entire TLTRO period.

Contribution to the Literature

Our work contributes to three strands of literature. First, we studied the transmission of Monetary Policy to credit supply (Agarwal et al, 2015; Jiménez et al, 2012; Jiménez et al, 2014), in particular the effects of the unconventional Monetary Policy on the amount of credit supply (Chakraborty et al, 2016; Chodorow-Reich, 2014; Di Maggio et al, 2014; Khwaja and Mian, 2008). In this dissertation, we aim at assessing how a positive funding shock, namely a Central Bank liquidity injection, impacts the credit supply of banks (Andrade et al, 2015; Carpinelli & Crosignani, 2017; Schnabl, 2012). Most of the existing literature on the impact of either 3-year LTROs or TLTROs on credit supply analyses the amounts of new credit operations, which may lead to a biased conclusion[3]. To overcome this, we considered the amount of the stock of credit, calculated with the eligible initial stock of credit and the quarterly eligible net lending used by the ECB to calculate the borrowing allowances and the interest rate for TLTRO-II, including not only the amount of new credit granted to non-financial corporations and households (except the lending for house purchase), but also the repayments and other adjustments pre-defined by the ECB.

Second, for the Portuguese case we studied the pass-through of the Central Bank borrowing rate to the real economy lending rates (Benetton & Fantino, 2017; Cottarelli et al, 1995; van Leuvensteijn et al, 2008). In line with the main contributions of the literature on the Monetary Policy transmission mechanism, we included bank and time fixed effects to control for time-invariant bank level unobserved heterogeneity. However, while most of the existing literature on the impact of either 3-year LTROs and TLTROs study the bank-firm relationship and thus only analyse the credit granted to non-financial corporations (Andrade et al, 2015; Benetton & Fantino, 2017; Carpinelli & Crosignani, 2017; Khwaja and Mian, 2008), our study analyses the credit granted to both non-financial corporations and households (except lending for house purchase), in line with Angelopoulou et al (2013) and Balfoussia & Gibson (2015).

Finally, for the Euro area we analysed the relation between competition and Monetary Policy (Berger & Hannan, 1989; de Graeve et al, 2007; Neumark & Sharpe, 1992), in particular the relation between market concentration and the transmission of Monetary Policy. In line with Benetton & Fantino (2017) analysis, we used the Herfindahl Index to measure the market

[3] E.g., bank A grants EUR 100 million of new credit, but has an amount of EUR 150 million of repayments of old credit, resulting in an eligible net lending of EUR -50 million. Bank B grants EUR 50 million of new credit and has an amount of EUR 25 million of repayments of old credit, resulting in an eligible net lending of EUR 25 million. Considering only the new operations, bank A (EUR 100 million) seems to have a better performance than bank B (EUR 50 million), while for the purpose of TLTROs, bank B (EUR 25 millions) has a higher amount of eligible net lending than bank A (EUR -50 million), resulting in a higher borrowing allowance, as well as a more favourable interest rate in the case of TLTRO-II.

concentration of banking business by country. However, while the abovementioned research studied the impact of the competition on the pass-through of the TLTROs to the cost of credit, we analysed the impact of the competition on the transmission of the TLTROs to the amount of credit granted to the real economy.

4. DATA

4.1. Euro area

To perform our analysis at the Euro area level, we used confidential data on credit, by bank or banking group, to non-financial corporations and households, excluding lending for house purchase, for all the Euro area countries. These data include the initial outstanding amount of credit and quarterly net lending amounts, which allowed us to calculate eligible stock of credit by quarter. Moreover, we also included confidential data about the participation in the TLTROs and early repayments by bank or banking group.

These data consist on individual loan-level bank information between the 30th of April 2014 and the 31st of January 2018, for the 19 countries of the Euro area: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Lithuania (LT), Luxembourg (LU), Latvia (LV), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI) and Slovakia (SK). For the first series of TLTROs, the data were reported on a quarterly basis (from the 30th of April 2014 to the 30th of April 2016), albeit for the second series banks had only two reporting periods (from the 1st of February 2015 to the 31st January 2016 and from the 1st of February 2016 to the 31st January 2018). Therefore, for the latter period, as we only had the initial stock and the net lending during the period, we divided the eligible net lending into quarters to construct the quarterly panel, assuming the growth of the stock of credit was linear during the period.

For the control variables, we used the Moody's Analytics BankFocus database that provides year-end data, by bank, for the chosen variables: total assets value, loans over assets ratio, bad loans over loans ratio and capital ratio (Common Equity Tier 1 ratio, included in Capital Requirements Directive 2013/36/EU and Common Requirements Regulation 575/2013, transposed to the European Union from the Basel III global standards on bank capital).

In total, 849 banks and banking groups participated in the TLTROs. However, there are some considerations regarding the composition of the final sample. For instance, bidder banks that have been merged or acquired by another bidder bank during the period under analysis were integrated in the respective merging or acquiring bank, since the outstanding amounts of the TLTROs were transferred to the new owner in these cases. Additionally, banks that did not

have available information for the control variables, for example branches that participated through the NCB of its location, but its financial statement is integrated in the financial statement of its headquarters, were withdrawn from the sample. Moreover, banks that went bankrupt during this period were kept in the sample, albeit with data only up to the date of the bankruptcy. Lastly, the final sample has 749 banks.

Table 1 shows the descriptive statistics of the variables included in the dataset. The dependent variable is the natural logarithm of the stock of credit, granted by bank b at time t. The stock of credit was on average around EUR 4 919 million, although the dataset includes amounts of credit between EUR 19 and 104 056 million. The first and the last percentile of the distribution of the stock of credit were winsorised, to account for the presence of outliers in the sample.

The average outstanding amount in the TLTROs was EUR 656 million. During the 12 operations in total of both TLTRO and TLTRO-II, several banks have repaid in advance some of the borrowed amounts, for various motives, such as the more attractive interest rates applied to the last operations when compared to the first ones. For this reason, we used the outstanding amounts instead of the total take-up.

The Herfindahl index refers to the market concentration and was obtained by summing the squares of the market shares of all the credit institutions in the banking sector of the country. The exact formula according to which banks must report the data to the ECB is described in the ECB Guideline on monetary and financial statistics, (ECB/2014/15)[4]. The credit market in the Euro area is quite competitive, as the average value of the index is 0.049, with values ranging between 0.025 and 0.363, as illustrated in Figure 2.

Finally, we used the main structural characteristics of the banks as control variables. Banks had on average EUR 31 719 million of total assets, about 59.7% of the total assets being loans, from which 5.7% are bad loans (impaired or non-performing loans), representing quite a low risk of the credit portfolio. The capital adequacy is measured by the capital ratio, according to the Basel III rules, which is on average 14.5%.

[4] The Herfindahl Index is obtained by summing the squares of the market shares of all the Credit Institutions (CI) in the banking sector and must be reported to the ECB in accordance with the following formula:
$HI = \sum_{i=1}^{n} (\frac{X_i}{X})^2$,
where n is the number of CI in the country, X_i represents the total assets of CI_i and $X = \sum_{i=1}^{n} Xi$ represents the total assets of all CIs of the country.

Table 1: Descriptive statistics for all the Euro area countries

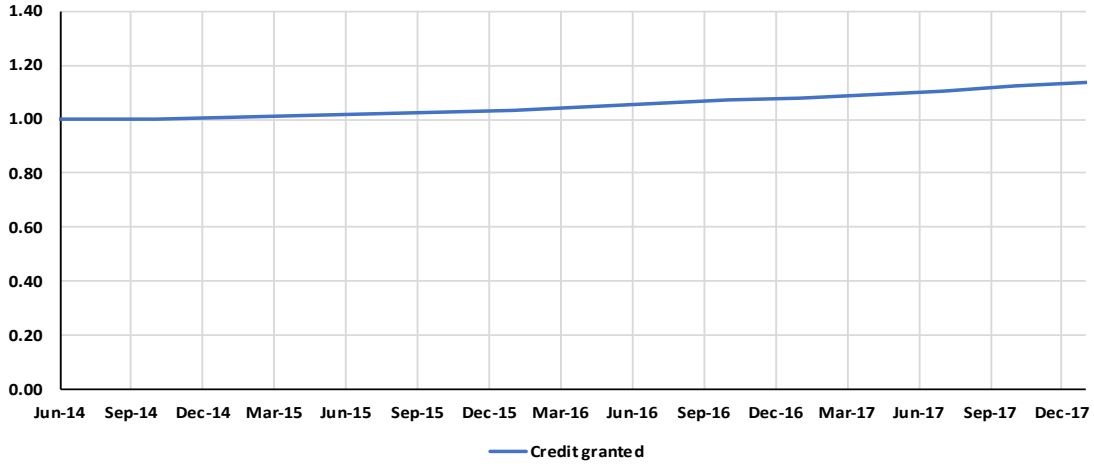
	EURO AREA				
VARIABLES	Obs	Mean	Std.Dev.	Min	Max
Stock of credit (EUR million)	9 337	4 919	14 902	19	104 056
TLTRO (EUR million)	9 337	656	2 924	0	60 920
Herfindahl Index	9 337	0.049	0.044	0.025	0.363
TLTRO*HerfindahI Index	9 337	45	209	0	3 786
Total assets (EUR million)	9 337	31 719	147 420	37	2 077 758
Loans over assets ratio (%)	9 337	59.74	15.39	3.21	95.33
Bad loans over loans ratio (%)	9 337	5.74	9.45	0.00	81.76
Capital ratio (%)	8 650	14.53	4.85	0.54	145.60

Source: ECB and Moody's Analytics. Calculations by the author.

As the data are confidential at country level, we aggregated it, classifying the countries into two groups, according to ECB Economic Bulletins approach (ECB, 2017c; ECB, 2017d): vulnerable (CY, ES, GR, IE, IT, PT and SI) and less vulnerable (AT, BE, DE, EE, FI, FR, LT, LU, LV, MT, NL and SK) countries. The descriptive statistics of the variables included in the dataset for the two groups of countries are presented in Table 2.

Chart 3 shows the evolution of bank lending to non-financial corporations and households (except lending for house purchase), using an index equal to 1 in June 2014, prior to the announcement of the TLTROs. Overall, Euro area banks increased the amount of credit granted by 14% since June 2014.

Chart 3: Evolution of the stock of credit for all the Euro area countries



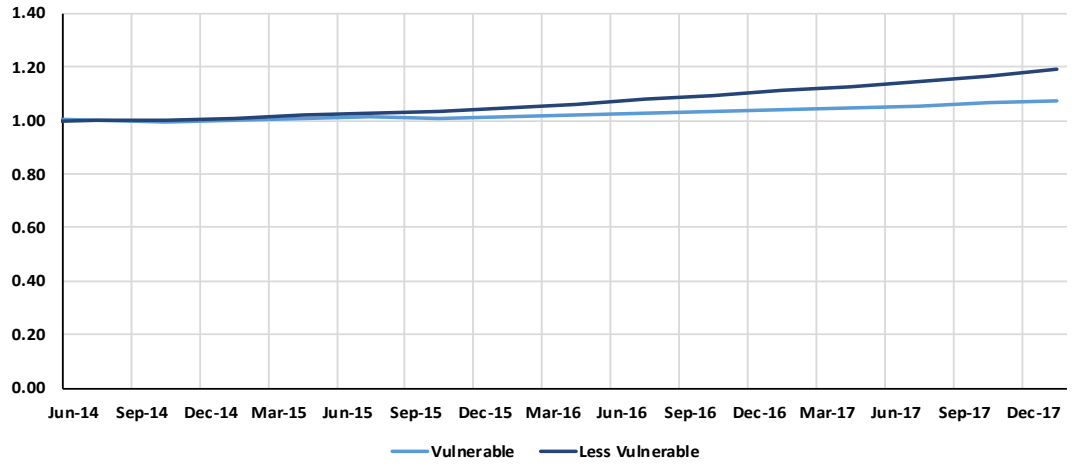
Index=1 in June 2014

Notes: Notional stock of loans to non-financial corporations and households. Depicted by the aggregate evolution for the group of banks that borrowed from TLTRO-I and/or TLTRO-II (bidders) and the group of banks which did not access any of the two (non-bidders).

Source: ECB. Calculations by the author.

However, chart 4 indicates that, while in less vulnerable countries bank lending has increased by 19% since June 2014, in vulnerable countries the growth was only by 7% in the same period.

Chart 4: Evolution of the stock of credit for the Euro area vulnerable and less vulnerable countries



Index=1 in June 2014

Notes: Notional stock of loans to non-financial corporations and households. Depicted by the aggregate evolution for the group of banks that borrowed from TLTRO-I and/or TLTRO-II (bidders) and the group of banks which did not access any of the two (non-bidders).

Source: ECB. Calculations by the author.

4.2. Portugal

We also performed a more detailed analysis for Portugal, using Balance Sheet Information (BSI) and Monetary Interest Rate (MIR) databases reported by the Portuguese banks to the Statistics Department of Banco de Portugal, within the same abovementioned dates, for all the Monetary Policy counterparties established in Portugal. The sample was restricted to the Monetary Policy counterparties, instead of all banks, because only these banks have had access to the TLTROs. These data include monthly outstanding amounts of credit, adjustments to loan sales and purchases, as well as other loan transfers, plus other adjustments (currency revaluations, write-offs/write-downs and credit reclassifications), which allowed us to calculate eligible stocks of credit and net lending amounts for the TLTROs. Additionally, we inferred if the financing conditions have improved during the period of the TLTROs, using the loan rates applied to new credit operations (annualised agreed rate).

For the Portuguese analysis, we introduced a control group composed by the Monetary Policy counterparties that did not participate in the TLTROs and a period before the implementation of these operations. Thus, we compared the evolution of both the amounts of credit granted and the cost of credit applied by bidder banks (treated group) and non-bidder banks (control group), for the periods before (from February 2011 to May 2014) and after the

announcement of the TLTROs (from June 2014 to January 2018). The descriptive statistics of the variables included in the dataset for all the Monetary Policy counterparties are presented in Table 3.

Table 4 shows the descriptive statistics of the variables included in the dataset, comparing the banks that have participated in at least one TLTRO operation (treated) with the other banks (control), in the periods before and after the announcement of the TLTROs in June 2014. The dependent variable is the natural logarithm of the stock of credit, granted by bank b at time t. The first and the last percentile of the stock of credit and interest rates variables were winsorised, to account for the presence of outliers in the sample.

The stock of credit decreased, on average, between the periods before and after the TLTROs, for both groups, although the reduction in relative terms was higher in the control group (30% comparing with 8% for the treated group). The interest rate was, on average, higher in the treated group, mainly due to the characteristics of the participant banks, but decreased in both groups between the two periods. The 17 Portuguese banks that participated in the TLTROs had, on average, EUR 752 million of outstanding amount in the TLTROs.

The treated group is, on average, composed by larger banks (EUR 22 770 million of total assets) than control group (EUR 1 359 million of total assets), although the other bank specific characteristics are quite similar.

Table 4: Descriptive statistics for the Portuguese treated and control banks

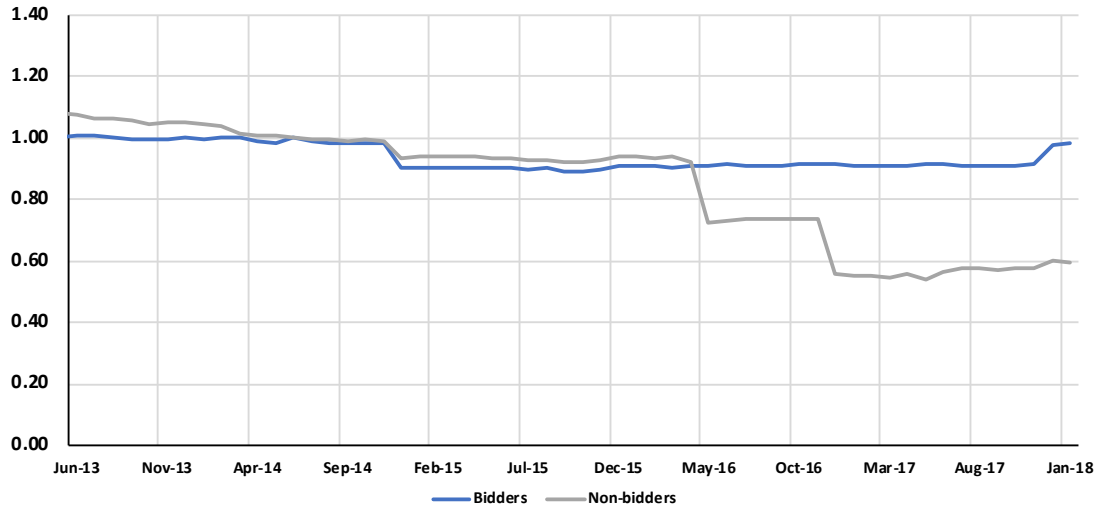
	PORTUGAL					
	Treated			Control		
VARIABLES	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
Before						
Stock of credit (EUR million)	680	6 914	8 951	640	463	518
Interest Rate (%)	680	6.1	3.9	640	3.8	3.4
TLTRO (EUR million)	680	0	0	640	0	0
Total assets (EUR million)	680	26 628	36 722	640	1 674	2 034
Loans over assets ratio (%)	680	58.9	16.2	640	67.9	26.2
Bad loans over loans ratio (%)	680	4.4	3.5	640	5.1	7.8
Government bonds over assets ratio (%)	680	15.1	18.9	640	10.6	21.2
After						
Stock of credit (EUR million)	748	6 332	7 582	694	325	374
Interest Rate (%)	748	3.5	2.8	694	2.0	2.2
TLTRO (EUR million)	748	752	1 282	694	0	0
Total assets (EUR million)	748	22 770	29 264	694	1 359	1 501
Loans over assets ratio (%)	748	57.2	16.5	694	60.7	30.4
Bad loans over loans ratio (%)	748	4.9	4.5	694	4.6	7.8
Government bonds over assets ratio (%)	748	17.1	15.8	694	21.8	34.4

Source: Banco de Portugal. Calculations by the author.

Besides the improved financial conditions offered to the Euro area banks, TLTROs have been designed to pass its favourable borrowing conditions to the credit granted to non-financial corporations and households. Charts 5 and 6 depict the aggregate evolution for the group of banks that have borrowed from TLTRO and/or TLTRO-II (bidders) and the group of banks that have accessed neither of the two (non-bidders).

Chart 5 provides evidence on the evolution of the credit granted to non-financial corporations and households (except lending for house purchase), using an index equal to 1 in June 2014, the announcement of the TLTROs. For the Portuguese banks, TLTROs seem to have prevented the slowdown in credit volumes visible in non-bidder banks. Therefore, bidder banks broadly maintained the stock of credit between June 2014 and January 2018, while non-bidder banks decreased the stock of credit by, approximately, 41%.

Chart 5: Evolution of the stock of credit for the Portuguese treated and control banks



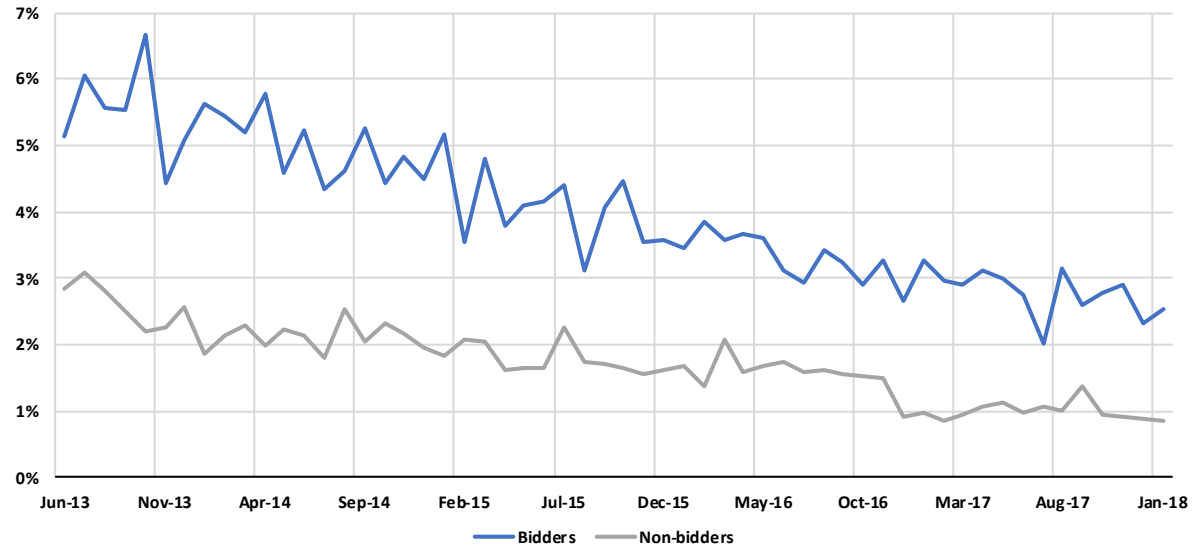
Index=1 in June 2014

Notes: Notional stock of loans to non-financial corporations and households. Depicted by the aggregate evolution for the group of banks that borrowed from TLTRO-I and/or TLTRO-II (bidders) and the group of banks which did not access any of the two (non-bidders).

Source: Banco de Portugal. Calculations by the author.

Due to the benefits associated with these operations, banks had the incentive to increase the amount of credit granted to the real economy, which has also led to more favourable interest rates. The evidence suggests that bidder banks lowered their loan rates by more than non-bidder banks, as Chart 6 shows. Although non-bidders presented, on average, lower interest rates in the beginning of the TLTROs compared to bidder banks, the decrease in loan rates during the period under analysis was only by 1.3 percentage points, while bidder banks decreased their loan rates by 2.7 percentage points since June 2014.

Chart 6: Evolution of loan rates for the Portuguese treated and control banks



Source: Banco de Portugal. Calculations by the author.

5. METHODOLOGY

5.1. Euro area

To analyse the data, we used a panel data approach. We constructed a quarterly balanced panel for 749 banks and 15 periods, between the 30th of April 2014 and the 31st of January 2018. Panel data has several advantages relevant to our empirical analysis, as it allows for more information, more variability, less collinearity, more degrees of freedom and more efficiency (Balgati, 2005).

We included time varying coefficients to capture the dynamics of the transmission of the TLTROs to the credit granted and clustered the standard errors by bank. Therefore, the OLS empirical regression is:

$$(1) \qquad L_{b,c,t} = \alpha + \lambda_b + \sum_T \beta_T \Phi_{T=t} TLTRO_{b,T} + \theta X_{b,t} + \varepsilon_{b,c,t}$$

where $L_{b,c,t}$ is the natural logarithm of the stock of credit, granted by bank b, in country c, in period t, $TLTRO_{b,t}$ is the natural logarithm of the TLTRO outstanding amount of bank b on time t, λ_b are bank fixed effects, $\Phi_{T=t}$ is dummy equal to 1 when t corresponds to year i (i=2014, 2015, 2016, 2017) and $\varepsilon_{b,c,t}$ is an error term. These variables were also complemented with control variables, deemed relevant to explain net lending, as each bank has its own individual characteristics affecting the dependent variable (Benetton & Fantino, 2017). Hence, $X_{b,t}$ are bank controls, specifically the value of total assets, the loans over assets ratio, the bad loans over loans ratio and the capital ratio.

To identify how the competition affects the transmission between the TLTROs and the stock of credit, we added an interaction term to equation (1):

$$(2) \qquad L_{b,c,t} = \alpha + \lambda_b + \sum_T \beta_T \Phi_{T=t} TLTRO_{b,T} + \sum_T \gamma_T \Phi_{T=t} TLTRO_{b,T}\, HI_c + \theta X_{b,t} + \varepsilon_{b,c,t}$$

where the HI_c is the Herfindahl Index for credit institutions in country c. The interaction between $TLTRO_{b,t}$ and HI_c measures the effects of the competition on the transmission of the unconventional Monetary Policy to the real economy. We included bank fixed effects, in order to control for time-invariant unobserved heterogeneity at bank level.

5.2. Portugal

To analyse the data for Portugal, we constructed a monthly balanced panel for 35 banks and 84 periods, between the 1st of February 2011 and the 1st of January 2018. We performed two distinct analyses: the transmission of the TLTROs to the stock of credit and to the cost of credit. However, for Portugal we did not apply the Herfindahl index for the regional market of the loans, as the credit conditions are similar among the country. The analyses were performed using a difference-in-differences OLS regression for the balanced panel. Nonetheless, as the participation on the TLTROs was a choice of banks, the selection of the treatment group might present some endogeneity.

First, we estimated the transmission of the TLTROs to the amount of credit granted by the banking sector to the real economy. We included time varying coefficients to capture the dynamics of the transmission of the TLTROs to the stock of credit and clustered the standard errors by bank and time. Therefore, the OLS empirical regression is:

$$(3) \qquad L_{b,t} = \alpha + \varphi_t + \lambda_b + \sum_T \beta_T \Phi_{T=t} TLTRO_{b,T} + \delta Y_{b,t} + \theta X_{b,t} + \varepsilon_{b,t}$$

where $L_{b,t}$ is the natural logarithm of the stock of credit of bank b, in period t, $Y_{b,t}$ is the weighted average interest rate applied by bank b on time t, φ_t are time fixed effects, γ_b are bank fixed effects, $\Phi_{T=t}$ is dummy equal to 1 when t corresponds to year i (i=2014, 2015, 2016, 2017) and $\varepsilon_{b,t}$ is an error term. These variables were complemented with time-varying control variables, deemed relevant to explain the stock of credit, representing bank individual characteristics that affect the dependent variable (Benetton & Fantino, 2017). Hence, $X_{b,t}$ are bank controls, namely the value of total assets, the loans over assets ratio, the bad loans over loans ratio and the government bonds over assets ratio.

$TLTRO_{b,t}$ is the treatment variable. Firstly, we estimated one specification where the TLTRO variable is a dummy equal to one after the announcement of the policy if the bank has

participated in the TLTROs, correspondent to the binary treatment. Secondly, we estimated another specification, the continuous treatment, where the TLTRO variable, instead of a dummy, is the natural logarithm of the TLTRO outstanding amount, which measures the intensity of the TLTROs.

Second, we analysed the pass-through of the favourable interest rates of the TLTROs to the loan rates applied by banks to the real economy. We also included time varying coefficients to capture the dynamics of the transmission mechanism and clustered the standard errors by bank and time. The OLS empirical regression is:

$$(4) \qquad Y_{b,t} = \alpha + \varphi_t + \lambda_b + \sum_T \beta_T \Phi_{T=t} TLTRO_{b,T} + \theta X_{b,t} + \varepsilon_{b,t}$$

where $Y_{b,t}$ is the weighted average interest rate applied by bank b, in period t, $TLTRO_{b,t}$ is the treatment variable, φ_t are time fixed effects, γ_b are bank fixed effects, $\Phi_{T=t}$ is dummy equal to 1 when t corresponds to year i (i=2014, 2015, 2016, 2017) and $\varepsilon_{b,t}$ is an error term. These variables were also complemented with the same time-varying control variables, $X_{b,t}$, such as the value of total assets, the loans over assets ratio, the bad loans over loans ratio and the government bonds over assets ratio.

6. RESULTS FOR THE EURO AREA

6.1. The effects on the amount of credit

The first set of empirical results identifies a correlation between the TLTROs and the stock of credit granted to the real economy. Table 5 shows the results for the OLS regression, controlling for bank fixed effects and clustered the standard errors by bank. Column (1) presents the results for all the Euro area banks, controlling for bank-specific characteristics. The results suggest a positive correlation between the TLTROs and the stock of credit, but the effects are not statistically significant.

In columns (2) and (3), we divided the Euro area countries into less vulnerable and vulnerable countries. For the less vulnerable countries, the coefficients of the TLTRO outstanding are positive, but also not statistically significant. Nevertheless, for the vulnerable countries, the coefficients of the TLTROs are positive and statistically significant in 2016 and 2017. Thus, the results indicate that banks in vulnerable countries used part of the money borrowed in the TLTROs to increase the credit to the real economy. Moreover, the coefficient increases from 2016 to 2017, which means that the effects of the TLTROs may have increased since its implementation.

Table 5: Transmission of TLTRO liquidity to the stock of credit for the Euro area

	Log of Stocks		
	All countries	Less vulnerable countries	Vulnerable countries
VARIABLES	(1)	(2)	(3)
Log of TLTRO x			
2014	-0.000133	-0.000530	0.000004
	(0.000276)	(0.000758)	(0.000003)
2015	0.000097	-0.000454	0.000006
	(0.000251)	(0.000929)	(0.000004)
2016	0.001095	0.001659	0.000014***
	(0.000837)	(0.001280)	(0.000005)
2017	0.001013	0.001571	0.000021***
	(0.000791)	(0.001252)	(0.000006)
Bank F.E.	YES	YES	YES
Bank-time controls	YES	YES	YES
Observations	8 641	6 103	2 538
R-squared	0.01	0.02	0.13
Number of Bank	749	540	209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Additionally, we subdivided the banks in the two groups of countries into large and small banks, assessed by its total assets. Thus, banks were considered as large banks if its amount of total assets was, on average, higher than or equal to EUR 1 000 million and as small banks, otherwise.

Table 6 shows the results for the OLS regression, controlling for bank fixed effects and clustered the standard errors by bank. Columns (3) and (4) show a positive correlation between the TLTROs and the stock of credit, for both large and small banks in less vulnerable countries, although only marginally statistically significant for the small banks in 2014, 2015 and 2016. Columns (6) and (7) also show that the coefficients of the TLTROs are positive and statistically significant in 2016 and 2017 for both large and small banks located in vulnerable countries. Moreover, the coefficient is increasing since its implementation, which indicates that the increasing path we identified in our previous results was observed for both large and small banks. Furthermore, the effects seem to be higher in less vulnerable countries, which indicates that the transmission worked better in these countries. The results also seem to suggest that the effects of the TLTROs was higher in small banks.

Nevertheless, the introduction of the APP in 2014 might be contributing to the reduced effects of the TLTROs on the stock of credit, as the APP was the major responsible for the significant excess liquidity growth verified for the Euro area banks and therefore to increase the credit granted to the real economy (Andrade et al, 2016; Baldo et al, 2017).

Table 6: Transmission of TLTRO liquidity to the stock of credit, for large and small banks, for the Euro area

	Log of Stocks						
	All countries	Less vulnerable countries			Vulnerable countries		
	All banks	All banks	Large banks	Small banks	All banks	Large banks	Small banks
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log of TLTRO x							
2014	-0.000133	-0.000530	-0.000712	0.001413*	0.000004	0.000002	-0.000002
	(0.000276)	(0.000758)	(0.000675)	(0.000794)	(0.000003)	(0.000003)	(0.000004)
2015	0.000097	-0.000454	-0.000661	0.001622*	0.000006	0.000002	0.000008
	(0.000251)	(0.000929)	(0.000931)	(0.000902)	(0.000004)	(0.000004)	(0.000005)
2016	0.001095	0.001659	0.001789	0.001043*	0.000014***	0.000010**	0.000017***
	(0.000837)	(0.001280)	(0.001570)	(0.000580)	(0.000005)	(0.000005)	(0.000005)
2017	0.001013	0.001571	0.001726	0.000691	0.000021***	0.000018***	0.000022***
	(0.000791)	(0.001252)	(0.001513)	(0.000420)	(0.000007)	(0.000007)	(0.000005)
Bank F.E.	YES	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES	YES
Observations	8 641	6 103	3 467	2 636	2 538	1 843	695
R-squared	0.01	0.02	0.02	0.01	0.13	0.13	0.41
Number of Bank	749	540	290	250	209	143	66

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results for the Euro area confirm that the increase in the stock of credit illustrated in Chart 3 was in part explained by the liquidity injected through the TLTROs. Moreover, when dividing into vulnerable and less vulnerable countries, the results also verify that the behaviour of the stock of credit illustrated in Chart 4, as well as in ECB (2017d), can also be in part explained by the TLTROs. The results also show a stronger correlation between the TLTROs and the stock of credit for less vulnerable countries, which is also in line with Chart 4 and ECB (2017d). Moreover, the results are also in line with the BLS, in which banks have mentioned that only used part of the liquidity borrowed from the TLTROs to grant credit (ECB, 2017a; ECB, 2017b).

6.2. The effects of competition

The second set of empirical results identifies how the competition affects this transmission between the TLTROs and the stock of credit. The coefficient captures the interaction between the TLTROs and bank competition assessed by the Herfindahl Index of the country. Table 7 presents the results for the OLS regression, controlling for bank fixed effects and clustered the standard errors by bank. Despite the negative effects for the majority of the years under analysis, the effects are not statistically significant. Hence, the results do not prove a significant correlation between market concentration and the transmission of the TLTRO to the stock of credit. Therefore, we cannot take a conclusion on how the competition affects this transmission between the TLTROs and the amount of credit granted to the real economy.

Table 7: TLTROs and competition for the Euro area

	Log of Stocks		
	All countries	Less vulnerable countries	Vulnerable countries
VARIABLES	(1)	(2)	(3)
Log of TLTRO x			
2014	-0.000280	-0.000862	0.000010
	(0.000536)	(0.001187)	(0.000007)
2015	-0.000185	-0.000832	0.000006
	(0.000691)	(0.001452)	(0.000005)
2016	0.001661	0.002151	0.000019**
	(0.001280)	(0.001671)	(0.000007)
2017	0.001586	0.002053	0.000029***
	(0.001273)	(0.001669)	(0.000011)
Log of TLTRO x HI x			
2014	0.000908	0.004284	-0.000083
	(0.003020)	(0.006419)	(0.000061)
2015	0.002554	0.005482	-0.000012
	(0.005646)	(0.008445)	(0.000039)
2016	-0.010631	-0.010524	-0.000074
	(0.008503)	(0.008622)	(0.000051)
2017	-0.010746	-0.010703	-0.000106
	(0.009126)	(0.009440)	(0.000076)
Bank F.E.	YES	YES	YES
Bank-time controls	YES	YES	YES
Observations	8 641	6 103	2 538
R-squared	0.01	0.02	0.14
Number of Bank	749	540	209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3. Robustness

To check the robustness of our previous results, we used an alternative dependent variable. Instead of the natural logarithm of the stock of credit, we used the amount of the quarterly net lending in EUR million. Moreover, we used the actual amounts of TLTRO outstanding amounts and total assets in EUR million instead of its natural logarithm. Table 8 shows the results for the Euro area and also for vulnerable and less vulnerable countries. Column (1) shows a positive and statistically significant correlation between the TLTROs and the quarterly net lending in 2015, 2016 and 2017, indicating that banks used part of the money borrowed in the TLTROs to increase the credit to the economy, which is in line with the expected behaviour of net lending. Additionally, this coefficient is increasing since 2015, which means that the effects of the TLTROs may have increased since its implementation. According to these results, in 2017, per EUR 1 million borrowed from the TLTROs, banks increased the quarterly net lending, on average, by EUR 27 thousand.

In column (2) the effects of the TLTRO outstanding amounts are positive and statistically significant in 2015, 2016 and 2017, also indicating that banks used part of the money borrowed in the TLTROs to increase the credit to the real economy. Column (3) shows a positive and statistically significant correlation between the TLTROs and the quarterly net

lending in 2016 and 2017, confirming our previous results. These coefficients are also increasing since 2015, which means that the effects of the TLTROs may have increased since its implementation in 2014, except in 2017 for less vulnerable countries, where the coefficient slightly decreases in relation to the previous year. However, while banks in less vulnerable countries increased the quarterly net lending, on average, by EUR 44 thousand per EUR 1 million borrowed from the TLTROs, banks in vulnerable countries have only increased the quarterly net lending, on average, by EUR 23 thousand per EUR 1 million borrowed from the TLTROs, which confirms that the TLTROs had a higher impact on less vulnerable countries.

Table 8: Transmission of TLTRO liquidity to the stock of credit for the Euro area - Robustness

	Quarterly net lending		
	All countries	Less vulnerable countries	Vulnerable countries
VARIABLES	(1)	(2)	(3)
TLTRO x			
2014	0.0051	0.0034	0.0258
	(0.0245)	(0.0319)	(0.0403)
2015	0.0203**	0.0496***	0.0149
	(0.0088)	(0.0116)	(0.0123)
2016	0.0257***	0.0485**	0.0221***
	(0.0059)	(0.0189)	(0.0077)
2017	0.0273***	0.0440***	0.0233***
	(0.0056)	(0.0153)	(0.0070)
Bank F.E.	YES	YES	YES
Bank-time controls	YES	YES	YES
Observations	8 641	6 103	2 538
R-squared	0.13	0.14	0.17
Number of Bank	750	541	209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7. RESULTS FOR PORTUGAL

7.1. The effects on the amount of credit

The first set of empirical results identifies the correlation between the TLTROs and the stock of credit granted to the real economy, namely non-financial corporations and households (except lending for house purchase).

Table 9 presents the results on the effects of the TLTROs on the stock of credit granted, controlling for bank and time fixed effects and clustering the standard errors by bank and time. Column (1) shows the results for all Portuguese banks, but the effects are not statistically significant.

Additionally, we divided the Portuguese Monetary Policy counterparties sample in large and small banks, assessed by its total assets. Thus, banks were considered as large banks if its amount of total assets was, on average, higher than or equal to EUR 1 000 million and as small

banks, otherwise. Hence, both the treated group and the control group were adjusted accordingly to divide the sample into large and small banks. Among the 35 banks in the sample, 20 were classified as large banks, 12 of which have participated in the TLTROs. The remaining 15 banks were considered small banks, 5 of which have participated in the TLTROs. Column (2) and (3) present the results for the sample of large banks and small banks, respectively, but the effects are not statistically significant.

In the continuous treatment, we substituted the TLTRO dummy by the natural logarithm of the actual outstanding amount borrowed from the TLTROs. The results are also not statistically significant.

Table 9: Transmission of TLTRO liquidity to the stock of credit for Portugal

	Log of Stocks					
	Binary treatment			Continuous treatment		
	All banks	Large banks	Small banks	All banks	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log of TLTRO x						
2014	0.0771	0.0774	0.2552	-0.0213	0.0043	0.0814
	(0.0740)	(0.0714)	(0.1892)	(0.0158)	(0.0111)	(0.1349)
2015	0.0555	0.0482	0.3208	-0.0154	0.0041	0.0607
	(0.1132)	(0.0860)	(0.3109)	(0.0152)	(0.0086)	(0.1078)
2016	0.0587	0.0871	0.2841	-0.0114	0.0108	0.0323
	(0.1170)	(0.0875)	(0.3371)	(0.0153)	(0.0083)	(0.0984)
2017	0.0381	0.0916	0.2069	-0.0146	0.0125	-0.0349
	(0.1155)	(0.1008)	(0.3225)	(0.0152)	(0.0092)	(0.0597)
Bank F.E.	YES	YES	YES	YES	YES	YES
Time F.E.	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES
Observations	2 762	1 597	1 165	2 762	1 597	1 165
R-squared	0.25	0.16	0.39	0.24	0.16	0.36
Number of Bank	35	20	15	35	20	15

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Hence, the results do not prove a significant correlation between the TLTROs and the amount of credit granted to the real economy. The lack of significant results might be explained by the implementation of the APP in 2014, which had a huge impact on excess liquidity amounts held by the Euro area banks and, consequently, on the stock of credit (Andrade et al, 2016; Baldo et al, 2017). According to Chart 3, in the last quarter of 2015 and again in the last quarter of 2017, non-bidder banks decreased the stock of credit, while bidder banks maintained the stock of credit relatively constant. This behaviour might be explained by a stronger effect of the APP in bidder banks, due its specific characteristics, for instance being, on average, larger banks, and not necessarily due to the liquidity injected through the TLTROs. Therefore, we cannot take a conclusion about the transmission of the TLTROs to the amount of bank credit supply.

7.2. The effects on the cost of credit

The second set of empirical results identifies the correlation between the TLTROs and the cost of credit. We also estimated both specifications, the binary treatment, where the TLTRO variable is a dummy equal to one after the announcement of the policy if the bank has participated in the TLTROs, and the continuous treatment, measuring the intensity of the TLTROs, where the TLTRO variable is the natural logarithm of the TLTRO outstanding amount.

Table 10 presents the results on the effects of the TLTROs on the cost of credit, controlling for bank and time fixed effects and clustering the standard errors by bank and time. In column (1), we estimated the model on the full sample of banks and the effects are statistically significant. Treated banks decreased its loan rates relative to control banks and the effects are statistically significant in 2016 and 2017. In 2017, banks that have borrowed from the TLTROs decreased its loan rates on average by, approximately, 1.71 percentage points relative to control banks.

We also divided the Portuguese Monetary Policy counterparties sample into large and small banks, assessed by the amount of its total assets. The effects of the TLTROs in the cost of credit was higher for small banks, showing that the transmission mechanism worked better in these banks. In column (2), we estimated the OLS regression on the sample of large banks. The results are statistically significant for all the periods under analysis, verifying our previous conclusion of an increase in the effect of TLTROs along the years. In 2017, treated banks decreased its loan rates on average by, approximately, 1.63 percentage points relative to control banks. Finally, in column (3) we performed the same analysis for the small banks, showing that the effects of the TLTROs were higher when comparing treated and control banks. The results are still statistically significant in 2016 and 2017 and show that, in 2017, treated banks reduced on average its loans rates by, approximately, 2.95 percentage points relative to control banks.

In the continuous treatment, we substituted the TLTRO dummy by the natural logarithm of the TLTRO outstanding amounts. The results are statistically significant and show that TLTROs had a positive impact on the cost of credit. Similarly to the binary treatment, the impact was stronger on small banks and the effects increased during the years under analysis.

Table 10: Transmission of TLTRO liquidity to the cost of credit for Portugal

	Interest Rate					
	Binary treatment			Continuous treatment		
	All banks	Large banks	Small banks	All banks	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log of TLTRO x						
2014	-0.3047	-0.6136**	-0.4080	0.0231	-0.0285	0.4637
	(0.2222)	(0.2807)	(0.5176)	(0.0581)	(0.0656)	(0.4643)
2015	-0.6711	-0.9549*	-0.6736	-0.0704	-0.1061	-0.0591
	(0.4060)	(0.5105)	(0.9266)	(0.0512)	(0.0650)	(0.3111)
2016	-1.2344***	-1.3370**	-2.1078**	-0.1447***	-0.1638**	-0.3131
	(0.3727)	(0.5037)	(0.7719)	(0.0483)	(0.0620)	(0.1902)
2017	-1.7084***	-1.6292***	-2.9541***	-0.2136***	-0.2103***	-0.6608**
	(0.3887)	(0.5371)	(0.9541)	(0.0528)	(0.0664)	(0.2853)
Bank F.E.	YES	YES	YES	YES	YES	YES
Time F.E.	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES
Observations	2 762	1 597	1 165	2 762	1 597	1 165
R-squared	0.29	0.39	0.22	0.28	0.39	0.21
Number of Bank	35	20	15	35	20	15

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, the results suggest a positive and significant transmission of the TLTROs to the cost of credit. Furthermore, the difference in the loan rates between treated and control banks increased since the beginning of the TLTROs, which could be explained by the introduction of the TLTRO-II in March 2016, which had the interest rate incentive and so the amount of net lending was used not only to determine the borrowing allowance, but also the interest rate applied to these operations, ranging from the MRO rate to the deposit facility rate (from 0% to -0.4%, respectively), which might led to a decrease in loan rates in order to increase the amount of credit granted to the real economy. These results verify that the decrease in loan rates by treated banks illustrated in Chart 4 is explained by the introduction of the TLTROs. Therefore, since its implementation in 2014, treated banks decreased its loan rates in relation to control banks, thereby reducing the difference between both groups of banks observed in the beginning of the TLTROs. The results on the effects of the TLTROs on the cost of credit characterise the correct functioning of Monetary Policy transmission mechanism, by the pass-through of the favourable interest rates applied in the TLTROs to the loan rates applied to the real economy.

The results on the functioning of the Monetary Policy transmission mechanism are in line with the existence literature, particularly the Balfoussia & Gibson (2015) analysis, which verified an easing of the financial conditions resulted from the TLTROs, for both the Euro area and Greece and the Benetton & Fantino (2017) study, which found a decrease in loan rates by treated banks in relation to control banks, for the Italian case.

7.3. Robustness

In order to check the robustness of our previous results, we used the actual amounts of TLTRO outstanding amounts and total assets in EUR million instead of its natural logarithm. Table 11 shows that the results are statistically significant and similar to the previous ones, verifying that that the TLTROs contributed to a decline in loan rates. However, the results show a smaller difference between treated and control banks, when comparing to the previous ones. Moreover, columns (2) and (3) corroborate that the effects of the TLTROs on the cost of credit increased during the years under analysis and were higher in small banks.

Table 11: Transmission of TLTRO liquidity to the cost of credit for Portugal - Robustness

	Interest rate					
	Binary treatment			Continuous treatment		
	All	Large banks	Small banks	All	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
TLTRO x						
2014	-0.1753	-0.5294*	-0.2775	0.0005**	0.0003	0.0380
	(0.2588)	(0.2900)	(0.5052)	(0.0002)	(0.0003)	(0.0382)
2015	-0.4610	-0.8162	-0.4998	-0.0000	-0.0001	0.0038
	(0.4476)	(0.5658)	(0.8575)	(0.0002)	(0.0002)	(0.0159)
2016	-1.0226**	-1.1991**	-1.9576**	-0.0002*	-0.0002**	-0.0082
	(0.4182)	(0.5499)	(0.7307)	(0.0001)	(0.0001)	(0.0047)
2017	-1.4773***	-1.4735**	-2.8158***	-0.0002*	-0.0003**	-0.0285***
	(0.4363)	(0.5758)	(0.9370)	(0.0001)	(0.0001)	(0.0088)
Bank F.E.	YES	YES	YES	YES	YES	YES
Time F.E.	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES
Observations	2 762	1 597	1 165	2 762	1 597	1 165
R-squared	0.28	0.40	0.22	0.26	0.38	0.20
Number of Bank	35	20	15	35	20	15

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8. CONCLUSIONS

In this dissertation, we assessed the transmission of the unconventional Monetary Policy measures to bank credit supply, by studying the correlation between the TLTROs and the credit granted by the banking system to non-financial corporations and households (except lending for house purchase).

First, we performed a more general analysis for the Euro area, using an OLS empirical regression on a quarterly balanced panel. We found a positive correlation between the TLTROs and the stock of credit, which means that banks used part of the money borrowed in the TLTROs to grant credit to the real economy. We also found that TLTROs had a higher impact in less vulnerable countries, showing that the transmission worked better in these countries. Additionally, we assessed how the competition affects the transmission between TLTROs and

the stock of credit, using the Herfindahl Index per country, which measures the market concentration of banking business. The results do not prove a significant correlation between the market concentration and the transmission of the TLTRO to the stock of credit, which did not allow us to conclude on how the competition affects this transmission between the TLTROs and the amount of credit granted to the real economy.

Second, we performed a more detailed analysis for Portugal, using a difference-in-differences OLS regression on a monthly balanced panel. The results do not prove a significant correlation between the TLTROs and the amount of credit granted to the real economy, which did not allow us to conclude on the transmission of the TLTROs to the amount of bank credit supply. Regarding the effects of the TLTROs on credit conditions, we found a significant correlation between the TLTROs and the cost of credit, indicating that treated banks decreased its loan rates on average by, approximately, 1.71 percentage points relative to control banks, in 2017. We also found that the difference between treated and control banks is higher for the group of small banks in terms of the cost of credit. Moreover, the effects of the TLTROs on loan rates increased during the period under analysis, both in large and small banks.

The pass-through of TLTRO interest rates to loan rates characterises the well-functioning of Monetary Policy transmission mechanism, which is the aim of the Monetary Policy measures. Therefore, the results show that the TLTROs had a positive and significant impact on the Monetary Policy transmission mechanism.

As a follow-up, an interesting avenue for future research on the transmission of unconventional Monetary Policy to bank credit supply is the extension of the Euro area analysis, performing a similar analysis as the one for Portugal. This study requires additional data, to which we did not have had access to, namely for the period before the TLTROs and for the Monetary Policy counterparties that did not participate in the TLTROs (control group). Additionally, data on the interest rates would also be necessary, to infer the pass-through of the favourable interest rates applied to the TLTROs to loan rates. Using a difference-in-difference approach, we would be able to infer the evolution of both the amounts of credit granted and the loan rates of the banks that have participated in the TLTROs relative to the group of control banks.

REFERENCES

Acharya, V., Eisert, T., Eufinger, C. & Hirsch, C. (2012). Whatever it takes: The real effects of unconventional monetary policy. *SAFE Working Paper Series* 152.

Afonso, A., G. Arghyrou, M., Dolores Gadea, M. & Kontonikas, A. (2018). ‘‘Whatever it takes” to resolve the European sovereign debt crisis? Bond pricing regime switches and Monetary Policy effects. *Journal of International Money and Finance* 86, 1-30.

Afonso, A. & Kazemi, M. (2018). Euro Area Sovereign Yields and the Power of Unconventional Monetary Policy. *Finance a úvěr-Czech Journal of Economics and Finance* 68 (2).

Agarwal, S., Chomsisengphet, S., Mahoney, N. & Stroebel, J. (2015). Do Banks Pass Through Credit Expansions? The Marginal Profitability of Consumer Lending During the Great Recession. *NBER Working Paper* 21567.

Andrade, P., Cahn, C., Fraisse, H. & Mésonnier, J. S. (2015). Can the provision of long-term liquidity help to avoid a credit crunch? Evidence from the Eurosystem’s TLTROs. *Banque de France Working Paper.*

Angelopoulou, E., Balfoussia, H. & Gibson, H. (2013). Building a financial conditions index for the euro area and selected euro area countries: what does it tell us about the crisis? *ECB Working Paper* 1541.

Baldo, L., Hallinger B., Helmus, C., Herrala, N., Martins, D., Mohing, F., Petroulakis, F., Resinek, M., Vergote, O., Usciati, B. & Wang, Y. (2017). The distribution of excess liquidity in the Euro area. *ECB Working Paper* 200.

Balfoussia, H. & Gibson, H. D. (2015). Financial conditions and economic activity: the potential impact of the TLTROs. *Bank of Greece Working Paper 194.*

Balgati, B. H. (2005). *Econometric Analysis of Panel Data,* 3rd Ed. England: John Wiley and Sons Ltd.

Banco de Portugal (2017). Decisões de política monetária desde o início da crise financeira. *Relatório da Implementação da Política Monetária,* December 2017, 14-15.

Benetton, M. & Fantino, D. (2017). Competition and the Pass-through of Unconventional Monetary Policy: Evidence from TLTROs. *Working Paper.*

Berger, A. N. & Hannan, T. H. (1989). The Price-Concentration Relationship in Banking. *The Review of Economics and Statistics* 71 (2), 291-299.

Carpinelli, L. & Crosignani, M. (2017). The Effect of Central Bank Liquidity Injections on Bank Credit Supply. *Finance and Economics Discussion Series,* 2017-038.

Chodorow-Reich, G. (2014). Effects of Unconventional Monetary Policy on Financial Institutions. *Brookings Papers on Economic Activity,* 155-204.

Cottarelli, C., Ferri, G. & Generale, A. (1995). Bank Lending Rates and Financial Structure in Italy: A Case Study. *IMF Staff Papers* 42 (3), 670-700.

Darracq-Paries, M. & De Santis, R. (2013). A Non-standard Monetary Policy Shock: The ECB's 3-year LTROs and the Shift in Credit Supply. *ECB Working Paper.*

De Graeve, F., De Jonghe, O. & Vennet, R. Vander (2007). Competition, Transmission and Bank Pricing Policies: Evidence from Belgian Loan and Deposit Markets. *Journal of Banking & Finance* 31(1), 259-278.

Decision (EU) of the European Central Bank of 2 August 2012 on additional temporary measures relating to Eurosystem refinancing operations and eligibility of collateral and amending Guideline ECB/2007/9 (ECB/2012/18).

Decision (EU) of the European Central Bank of 4 April 2014 on monetary and financial statistics (ECB/2014/15).

Decision (EU) of the European Central Bank of 29 July 2014 on measures relating to targeted longer-term refinancing operations (ECB/2014/34).

Decision (EU) 2015/774 of the European Central Bank of 4 March 2015 on a secondary markets public sector asset purchase programme (ECB/2015/10).

Decision (EU) 2016/810 of the European Central Bank of 28 April 2016 on a second series of targeted longer-term refinancing operations (ECB/2016/10).

Di Maggio, M., Kermani, A. & Ramcharan, R. (2014). Monetary Policy Pass-Through: Household Consumption and Voluntary Deleveraging. *Working Paper.*

Draghi, M. (2014a). Introductory statement to the press conference (with Q&A). Frankfurt am Main, Germany. July 4.

Draghi, M. (2014b). Safeguarding price and financial stability in the euro area. Helsinki, Finland. November 27.

Driffill, E. (2016). Unconventional Monetary Policy in the Euro Zone. *Open Economies Review* 27 (2), 387-404.

European Central Bank [ECB] (2014). Targeted Longer-Term Refinancing Operations: Guidelines for Completing the Reporting Template. *Technical report.*

European Central Bank [ECB] (2017a). Analysing the ECB's targeted long-term refinancing operations. *The euro area bank lending survey*, January 2017, 26-29.

European Central Bank [ECB] (2017b). Analysing the ECB's targeted long-term refinancing operations. *The euro area bank lending survey*, July 2017, 26-29.

European Central Bank [ECB] (2017c). Impact of the ECB's non-standard measures on financing conditions: taking stock of recent evidence. *Economic Bulletin* 2 (3), 46-51.

European Central Bank [ECB] (2017d). The targeted longer-term refinancing operations: an overview of the take-up and their impact on bank intermediation. *Economic Bulletin* 3 (5), 42-46.

Gertler, M. & Karadi, P. (2010). A model of unconventional monetary policy. *Journal of Monetary Economics* 58 (1), 17-34.

Chakraborty, I., Goldstein, I. & MacKinlay, A. (2016). Monetary Stimulus and Bank Lending. *Working Paper.*

Jasova, M., Mendicino, C. & Supera, D. (2018). Rollover Risk and Bank Lending Behavior: Evidence from Unconventional Central Bank Liquidity. *Working Paper.*

Jiménez, G., Ongena, S. Peydró, J. L. & Saurina, J. (2012). Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications. *The American Economic Review* 102 (5), 2301-2326.

Jiménez, G., Ongena, S. Peydró, J. L. & Saurina, J. (2014). Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking? *Econometrica* 82 (2), 463-505.

Kashyap, A. K. & Stein, J.C. (2000). What do a million observations on banks say about the transmission of monetary policy? *American Economic Review 90*, 407-428.

Khwaja, A. I. & Mian, A. (2008). Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market. *American Economic Review* 98 (4), 1413-1442.

Mishkin, F. S. (2011). Monetary Policy Strategy: Lessons from the Crisis. *NBER Working Paper 16755.*

Neumark, D. & Sharpe, S. A. (1992). Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits. *The Quarterly Journal of Economics* 107 (2), 657-680.

Renne, J. P. (2014). Options Embedded in ECB Targeted Refinancing Operations. *Banque de France Working Paper.*

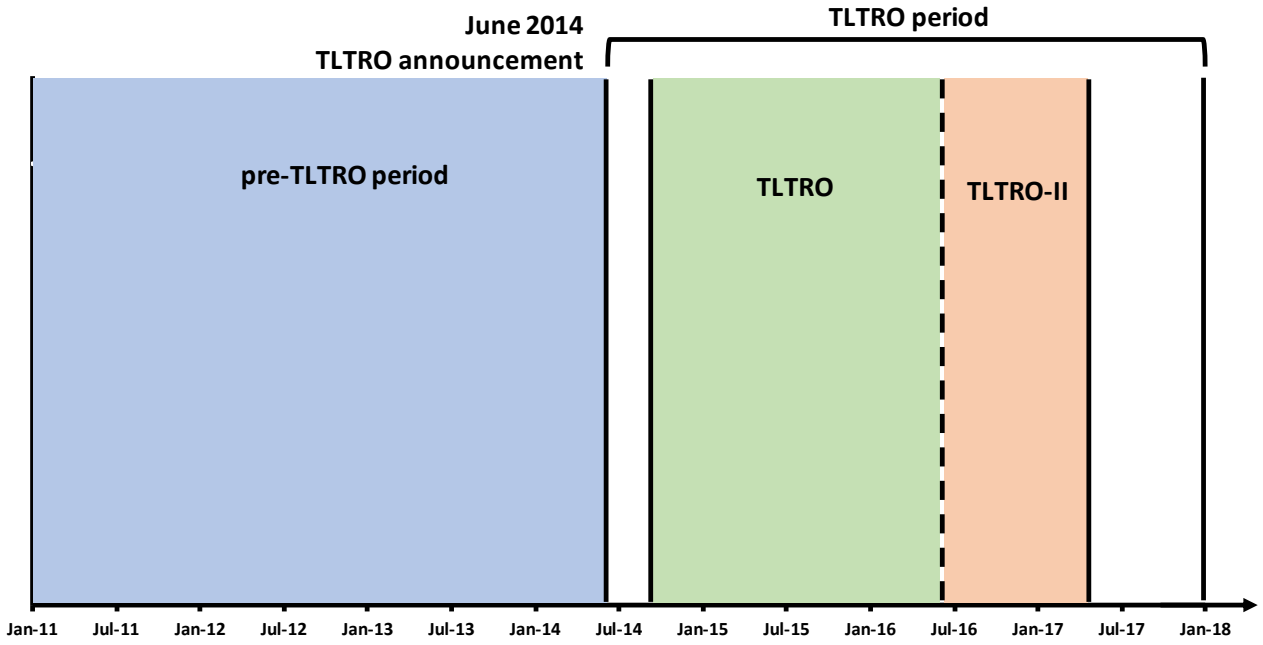
Roman, A. & Purcel, D. (2014). The monetary policy under the impact of the recent global financial crisis. *Review of Economic and Business Studies* 7 (2), 179-188.

Schnabl, P. (2012). The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market. *The Journal of Finance 67* (3), 897-932.

Trichet, J. C. (2011). Unconventional Monetary Policy Measures: Principles - Conditions - Raison d'être. *International Journal of Central Banking, International Journal of Central Banking* 9 (1), 229-250.

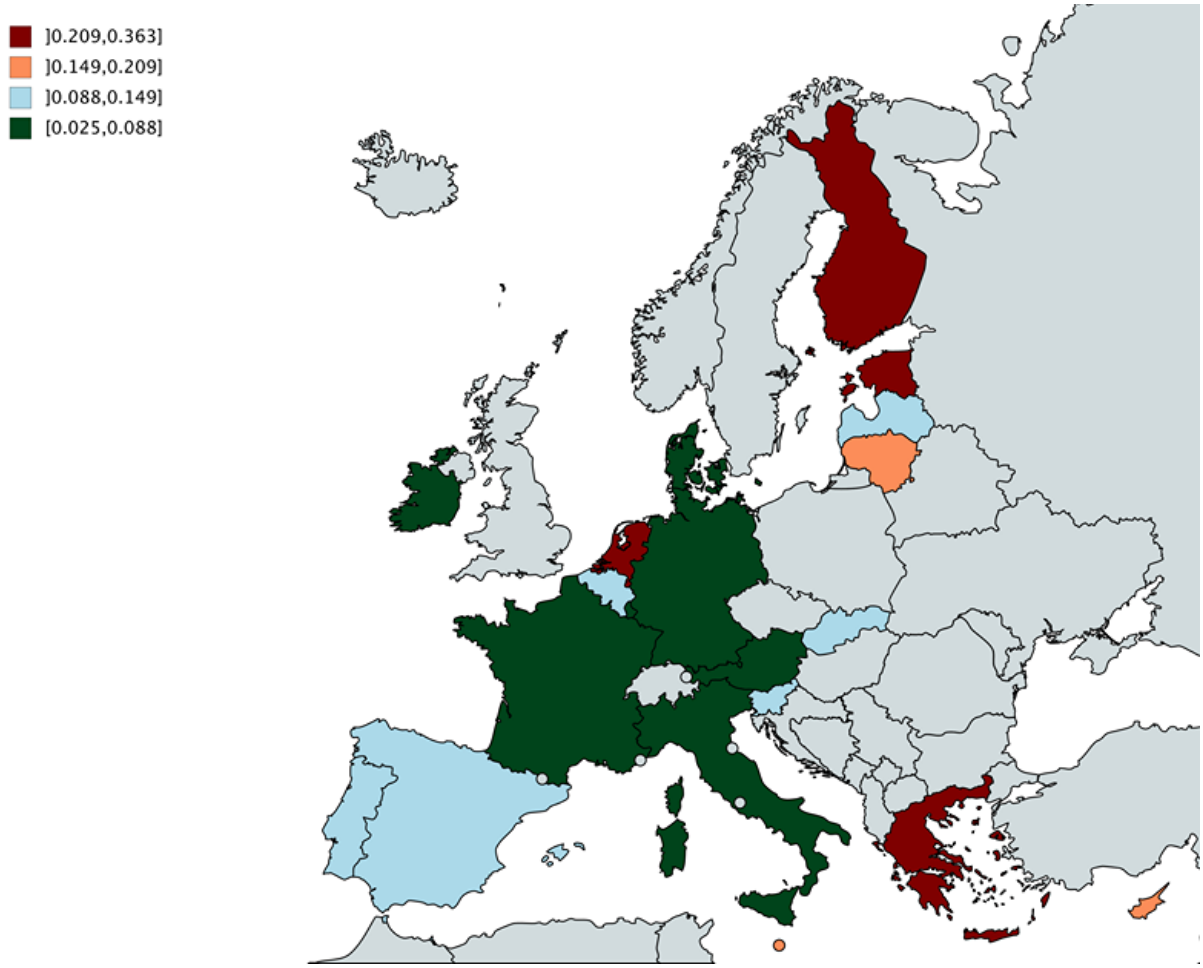
Van Leuvensteijn, M., Sorensen, C. K., Bikker, J. A. & van Rixtel, A. (2008). Impact of Bank Competition on the Interest Rate Pass-through in the Euro Area. *ECB Working Paper* 885.

Figure 1: Timeline of the analysis (pre-TLTRO and TLTRO periods)



Source: ECB. Calculations by the author.

Figure 2: Geographical distribution of the Herfindahl Index



Source: ECB. Calculations by the author.

Table 1: Descriptive statistics for all the Euro area countries

	EURO AREA				
VARIABLES	Obs	Mean	Std.Dev.	Min	Max
Stock of credit (EUR million)	9 337	4 919	14 902	19	104 056
TLTRO (EUR million)	9 337	656	2 924	0	60 920
Herfindahl Index	9 337	0.049	0.044	0.025	0.363
TLTRO*HerfindahI Index	9 337	45	209	0	3 786
Total assets (EUR million)	9 337	31 719	147 420	37	2 077 758
Loans over assets ratio (%)	9 337	59.74	15.39	3.21	95.33
Bad loans over loans ratio (%)	9 337	5.74	9.45	0.00	81.76
Capital ratio (%)	8 650	14.53	4.85	0.54	145.60

Source: ECB and Moody's Analytics. Calculations by the author.

Table 2: Descriptive statistics for the Euro area vulnerable and less vulnerable countries

	EURO AREA					
	LESS VULNERABLE COUNTRIES			VULNERABLE COUNTRIES		
VARIABLES	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
Stock of credit (EUR million)	6 527	3 200	11 398	2 810	8 028	18 479
TLTRO (EUR million)	6 527	348	1 802	2 810	1 290	4 340
Herfindahl Index	6 527	0.041	0.045	2 810	0.068	0.036
TLTRO*HerfindahI Index	6 527	23	141	2 810	96	307
Total assets (EUR million)	6 527	25 479	143 000	2 810	35 000	132 000
Loans over assets ratio (%)	6 527	61.25	14.92	2 810	56.22	15.87
Bad loans over loans ratio (%)	6 527	2.41	3.56	2 810	13.46	13.48
Capital ratio (%)	6 112	14.43	4.44	2 538	14.79	5.72

Source: ECB and Moody's Analytics. Calculations by the author.

Table 3: Descriptive statistics for the Portuguese banks

	PORTUGAL				
VARIABLES	Obs	Mean	Std.Dev.	Min	Max
Stock of credit (EUR million)	2762	3 580	6 682	1	26 660
Interest Rate (%)	2762	3.8	3.3	0.1	16.2
TLTRO (EUR million)	2762	204	746	0	6 410
Assets (EUR million)	2762	13 452	26 458	37	118 000
Loans over assets ratio (%)	2762	60.99	23.36	5.698	99.857
Bad loans over loans ratio (%)	2762	4.7	6.2	0.0	109.7
Government bonds over assets ratio (%)	2762	16.3	23.9	0.0	139.4

Source: Banco de Portugal. Calculations by the author.

Table 4: Descriptive statistics for the Portuguese treated and control banks

	PORTUGAL					
	Treated			Control		
VARIABLES	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
Before						
Stock of credit (EUR million)	680	6 914	8 951	640	463	518
Interest Rate (%)	680	6.1	3.9	640	3.8	3.4
TLTRO (EUR million)	680	0	0	640	0	0
Total assets (EUR million)	680	26 628	36 722	640	1 674	2 034
Loans over assets ratio (%)	680	58.9	16.2	640	67.9	26.2
Bad loans over loans ratio (%)	680	4.4	3.5	640	5.1	7.8
Government bonds over assets ratio (%)	680	15.1	18.9	640	10.6	21.2
After						
Stock of credit (EUR million)	748	6 332	7 582	694	325	374
Interest Rate (%)	748	3.5	2.8	694	2.0	2.2
TLTRO (EUR million)	748	752	1 282	694	0	0
Total assets (EUR million)	748	22 770	29 264	694	1 359	1 501
Loans over assets ratio (%)	748	57.2	16.5	694	60.7	30.4
Bad loans over loans ratio (%)	748	4.9	4.5	694	4.6	7.8
Government bonds over assets ratio (%)	748	17.1	15.8	694	21.8	34.4

Source: Banco de Portugal. Calculations by the author.

Table 5: Transmission of TLTRO liquidity to the stock of credit for the Euro area

	Log of Stocks		
	All countries	Less vulnerable countries	Vulnerable countries
VARIABLES	(1)	(2)	(3)
Log of TLTRO x			
2014	-0.000133	-0.000530	0.000004
	(0.000276)	(0.000758)	(0.000003)
2015	0.000097	-0.000454	0.000006
	(0.000251)	(0.000929)	(0.000004)
2016	0.001095	0.001659	0.000014***
	(0.000837)	(0.001280)	(0.000005)
2017	0.001013	0.001571	0.000021***
	(0.000791)	(0.001252)	(0.000007)
Log of total assets	-0.010059	-0.019133	0.000649***
	(0.011046)	(0.021056)	(0.000174)
Loans over assets ratio	-0.000137	-0.000379	0.000010**
	(0.000149)	(0.000352)	(0.000005)
Bad loans over loans ratio	-0.000116	0.000160	-0.000001
	(0.000091)	(0.000159)	(0.000001)
Capital ratio	0.000037	-0.000020	0.000005
	(0.000151)	(0.000259)	(0.000005)
Constant	6.620874***	6.359898***	7.348251***
	(0.093916)	(0.178951)	(0.001628)
Bank F.E.	YES	YES	YES
Bank-time controls	YES	YES	YES
Observations	8 641	6 103	2 538
R-squared	0.01	0.02	0.13
Number of Bank	749	540	209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Transmission of TLTRO liquidity to the stock of credit, for large and small banks, for the Euro area

	Log of Stocks						
	All countries	Less vulnerable countries			Vulnerable countries		
	All banks	All banks	Large banks	Small banks	All banks	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log of TLTRO x							
2014	-0.000133	-0.000530	-0.000712	0.001413*	0.000004	0.000002	-0.000002
	(0.000276)	(0.000758)	(0.000675)	(0.000794)	(0.000003)	(0.000003)	(0.000004)
2015	0.000097	-0.000454	-0.000661	0.001622*	0.000006	0.000002	0.000008
	(0.000251)	(0.000929)	(0.000931)	(0.000902)	(0.000004)	(0.000004)	(0.000005)
2016	0.001095	0.001659	0.001789	0.001043*	0.000014***	0.000010**	0.000017***
	(0.000837)	(0.001280)	(0.001570)	(0.000580)	(0.000005)	(0.000005)	(0.000005)
2017	0.001013	0.001571	0.001726	0.000691	0.000021***	0.000018***	0.000022***
	(0.000791)	(0.001252)	(0.001513)	(0.000420)	(0.000007)	(0.000007)	(0.000005)
Log of total assets	-0.010059	-0.019133	-0.026252	0.005995	0.000649***	0.000665***	0.000657***
	(0.011046)	(0.021056)	(0.027268)	(0.007818)	(0.000174)	(0.000228)	(0.000151)
Loans over assets ratio	-0.000137	-0.000379	-0.000647	0.000033	0.000010**	0.000011**	0.000010***
	(0.000149)	(0.000352)	(0.000561)	(0.000242)	(0.000005)	(0.000006)	(0.000003)
Bad loans over loans ratio	-0.000116	0.000160	0.000168	0.000107	-0.000001	-0.000000	-0.000000
	(0.000091)	(0.000159)	(0.000324)	(0.000128)	(0.000001)	(0.000001)	(0.000001)
Capital ratio	0.000037	-0.000020	-0.000091	0.000215	0.000005	0.000004	0.000003
	(0.000151)	(0.000259)	(0.000301)	(0.000200)	(0.000005)	(0.000005)	(0.000005)
Constant	6.620874***	6.359898***	7.453454***	4.844463***	7.348251***	8.067648***	5.445451***
	(0.093916)	(0.178951)	(0.266928)	(0.040894)	(0.001628)	(0.002287)	(0.001046)
Bank F.E.	YES	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES	YES
Observations	8 641	6 103	3 467	2 636	2 538	1 843	695
R-squared	0.01	0.02	0.02	0.01	0.13	0.13	0.41
Number of Bank	749	540	290	250	209	143	66

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: TLTROs and competition for the Euro area

	Log of Stocks		
	All countries	Less vulnerable countries	Vulnerable countries
VARIABLES	(1)	(2)	(3)
Log of TLTRO x			
2014	-0.000280	-0.000862	0.000010
	(0.000536)	(0.001187)	(0.000007)
2015	-0.000185	-0.000832	0.000006
	(0.000691)	(0.001452)	(0.000005)
2016	0.001661	0.002151	0.000019**
	(0.001280)	(0.001671)	(0.000007)
2017	0.001586	0.002053	0.000029***
	(0.001273)	(0.001669)	(0.000011)
Log of TLTRO x HI x			
2014	0.000908	0.004284	-0.000083
	(0.003020)	(0.006419)	(0.000061)
2015	0.002554	0.005482	-0.000012
	(0.005646)	(0.008445)	(0.000039)
2016	-0.010631	-0.010524	-0.000074
	(0.008503)	(0.008622)	(0.000051)
2017	-0.010746	-0.010703	-0.000106
	(0.009126)	(0.009440)	(0.000076)
Log of total assets	-0.011738	-0.020187	0.000644***
	(0.012665)	(0.022082)	(0.000166)
Loans over assets ratio	-0.000163	-0.000398	0.000010**
	(0.000160)	(0.000365)	(0.000005)
Bad loans over loans ratio	-0.000091	0.000175	-0.000001
	(0.000073)	(0.000171)	(0.000001)
Capital ratio	0.000001	-0.000074	0.000005
	(0.000181)	(0.000301)	(0.000005)
Constant	6.635999***	6.369800***	7.347056***
	(0.107937)	(0.188330)	(0.001552)
Bank F.E.	YES	YES	YES
Bank-time controls	YES	YES	YES
Observations	8 641	6 103	2 538
R-squared	0.01	0.02	0.14
Number of Bank	749	540	209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Transmission of TLTRO liquidity to the quarterly net lending for the Euro area - Robustness

	Quarterly net lending		
	All countries	Less vulnerable countries	Vulnerable countries
VARIABLES	(1)	(2)	(3)
TLTRO x			
2014	0.0051	0.0034	0.0258
	(0.0245)	(0.0319)	(0.0403)
2015	0.0203**	0.0496***	0.0149
	(0.0088)	(0.0116)	(0.0123)
2016	0.0257***	0.0485**	0.0221***
	(0.0059)	(0.0189)	(0.0077)
2017	0.0273***	0.0440***	0.0233***
	(0.0056)	(0.0153)	(0.0070)
Total assets	-0.0001	-0.0000	0.0028
	(0.0013)	(0.0015)	(0.0027)
Loans over assets ratio	0.3526	-1.5821	1.4531
	(0.8730)	(1.8410)	(0.9814)
Bad loans over loans ratio	0.1785	0.6478	0.6636*
	(0.3565)	(0.7474)	(0.3756)
Capital ratio	0.6958	0.3875	2.2724
	(0.7674)	(0.7367)	(1.6407)
Constant	-0.9637	118.5160	-227.9959
	(65.7532)	(107.4987)	(146.3598)
Bank F.E.	YES	YES	YES
Bank-time controls	YES	YES	YES
Observations	8 641	6 103	2 538
R-squared	0.13	0.14	0.17
Number of Bank	750	541	209

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Transmission of TLTRO liquidity to the stock of credit for Portugal

	Log of Stocks					
	Binary treatment			Continuous treatment		
	All	Large banks	Small banks	All	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log of TLTRO x						
2014	0.0771	0.0774	0.2552	-0.0213	0.0043	0.0814
	(0.0740)	(0.0714)	(0.1892)	(0.0158)	(0.0111)	(0.1349)
2015	0.0555	0.0482	0.3208	-0.0154	0.0041	0.0607
	(0.1132)	(0.0860)	(0.3109)	(0.0152)	(0.0086)	(0.1078)
2016	0.0587	0.0871	0.2841	-0.0114	0.0108	0.0323
	(0.1170)	(0.0875)	(0.3371)	(0.0153)	(0.0083)	(0.0984)
2017	0.0381	0.0916	0.2069	-0.0146	0.0125	-0.0349
	(0.1155)	(0.1008)	(0.3225)	(0.0152)	(0.0092)	(0.0597)
Interest rate	0.0943	0.0004	0.1642	0.1496	0.0100	0.2375
	(0.0916)	(0.1004)	(0.1274)	(0.1001)	(0.0969)	(0.1430)
Log of total assets	0.6241***	0.4746***	0.6530**	0.6442***	0.4751***	0.7060***
	(0.2030)	(0.1371)	(0.2302)	(0.2033)	(0.1421)	(0.2357)
Loans over assets ratio	0.0076	0.0148***	0.0034	0.0077	0.0147***	0.0033
	(0.0049)	(0.0036)	(0.0059)	(0.0050)	(0.0036)	(0.0060)
Bad loans over loans ratio	0.0008	-0.0048	0.0022	0.0014	-0.0032	0.0019
	(0.0053)	(0.0105)	(0.0050)	(0.0053)	(0.0096)	(0.0052)
Government bonds over assets ratio	-0.0004	-0.0013	-0.0013	-0.0006	-0.0012	-0.0019
	(0.0031)	(0.0030)	(0.0036)	(0.0032)	(0.0030)	(0.0035)
TLTRO period	-0.0000	0.0228	-0.0111	-0.0021	0.0227	-0.0149*
	(0.0144)	(0.0157)	(0.0065)	(0.0155)	(0.0163)	(0.0077)
Constant	0.9445	2.3018*	0.3766	0.7981	2.3010*	0.1081
	(1.7032)	(1.2653)	(1.3656)	(1.7064)	(1.3072)	(1.4421)
Bank F.E.	YES	YES	YES	YES	YES	YES
Time F.E.	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES
Observations	2 762	1 597	1 165	2 762	1 597	1 165
R-squared	0.25	0.16	0.39	0.24	0.16	0.36
Number of Bank	35	20	15	35	20	15

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Transmission of TLTRO liquidity to the cost of credit for Portugal

	Interest Rate					
	Binary treatment			Continuous treatment		
	All	Large banks	Small banks	All	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log of TLTRO x						
2014	-0.3047	-0.6136**	-0.4080	0.0231	-0.0285	0.4637
	(0.2222)	(0.2807)	(0.5176)	(0.0581)	(0.0656)	(0.4643)
2015	-0.6711	-0.9549*	-0.6736	-0.0704	-0.1061	-0.0591
	(0.4060)	(0.5105)	(0.9266)	(0.0512)	(0.0650)	(0.3111)
2016	-1.2344***	-1.3370**	-2.1078**	-0.1447***	-0.1638**	-0.3131
	(0.3727)	(0.5037)	(0.7719)	(0.0483)	(0.0620)	(0.1902)
2017	-1.7084***	-1.6292***	-2.9541***	-0.2136***	-0.2103***	-0.6608**
	(0.3887)	(0.5371)	(0.9541)	(0.0528)	(0.0664)	(0.2853)
Log of total assets	0.5713	0.2985	0.8540**	0.4204	0.2520	0.6791
	(0.3814)	(0.7370)	(0.3978)	(0.4305)	(0.7443)	(0.4559)
Loans over assets ratio	0.0249***	0.0372*	0.0165	0.0241***	0.0378*	0.0132
	(0.0077)	(0.0204)	(0.0096)	(0.0080)	(0.0209)	(0.0091)
Bad loans over loans ratio	0.0323	0.1310	0.0058	0.0316	0.1184	0.0077
	(0.0260)	(0.0953)	(0.0141)	(0.0260)	(0.0929)	(0.0154)
Government bonds over assets ratio	-0.0041	-0.0039	-0.0079	-0.0023	-0.0030	-0.0050
	(0.0090)	(0.0097)	(0.0124)	(0.0099)	(0.0099)	(0.0142)
TLTRO period	-1.4057***	-1.2012**	-1.5714***	-1.6495***	-1.3793***	-1.9542***
	(0.3615)	(0.4838)	(0.4275)	(0.3472)	(0.4400)	(0.4505)
Constant	-1.1748	-0.8884	-0.5944	0.0096	-0.5080	0.5990
	(3.0987)	(7.8469)	(2.1339)	(3.4911)	(7.8629)	(2.5235)
Bank F.E.	YES	YES	YES	YES	YES	YES
Time F.E.	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES
Observations	2 762	1 597	1 165	2 762	1 597	1 165
R-squared	0.29	0.39	0.22	0.28	0.39	0.21
Number of Bank	35	20	15	35	20	15

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Transmission of TLTRO liquidity to the cost of credit for Portugal – Robustness

	Interest rate					
	Binary treatment			Continuous treatment		
	All	Large banks	Small banks	All	Large banks	Small banks
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
TLTRO x						
2014	-0.1753	-0.5294*	-0.2775	0.0005**	0.0003	0.0380
	(0.2588)	(0.2900)	(0.5052)	(0.0002)	(0.0003)	(0.0382)
2015	-0.4610	-0.8162	-0.4998	-0.0000	-0.0001	0.0038
	(0.4476)	(0.5658)	(0.8575)	(0.0002)	(0.0002)	(0.0159)
2016	-1.0226**	-1.1991**	-1.9576**	-0.0002*	-0.0002**	-0.0082
	(0.4182)	(0.5499)	(0.7307)	(0.0001)	(0.0001)	(0.0047)
2017	-1.4773***	-1.4735**	-2.8158***	-0.0002*	-0.0003**	-0.0285***
	(0.4363)	(0.5758)	(0.9370)	(0.0001)	(0.0001)	(0.0088)
Total assets	0.0000	0.0000**	0.0012**	0.0000	0.0000	0.0010*
	(0.0000)	(0.0000)	(0.0005)	(0.0000)	(0.0000)	(0.0005)
Loans over assets ratio	0.0251***	0.0357**	0.0125	0.0250***	0.0409**	0.0069
	(0.0082)	(0.0147)	(0.0106)	(0.0085)	(0.0183)	(0.0089)
Bad loans over loans ratio	0.0307	0.1343	0.0043	0.0334	0.1354	0.0057
	(0.0268)	(0.0936)	(0.0141)	(0.0262)	(0.0862)	(0.0168)
Government bonds over assets ratio	-0.0007	-0.0030	-0.0070	0.0000	0.0002	-0.0074
	(0.0082)	(0.0094)	(0.0117)	(0.0083)	(0.0098)	(0.0123)
TLTRO period	-1.5513***	-1.2268**	-1.5945***	-1.9280***	-1.7285***	-2.0589***
	(0.3865)	(0.5821)	(0.4214)	(0.2851)	(0.3845)	(0.4471)
Constant	2.9589***	1.2082	4.1172***	2.9305***	0.8424	4.5476***
	(0.6201)	(1.3460)	(0.8083)	(0.6804)	(1.4808)	(0.6914)
Bank F.E.	YES	YES	YES	YES	YES	YES
Time F.E.	YES	YES	YES	YES	YES	YES
Bank-time controls	YES	YES	YES	YES	YES	YES
Observations	2 762	1 597	1 165	2 762	1 597	1 165
R-squared	0.28	0.40	0.22	0.26	0.38	0.20
Number of Bank	35	20	15	35	20	15

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1