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DE LISBOA

THE MACROECONOMIC EFFECTS OF THE UNCONVENTIONAL MONETARY POLICY OF THE ECB ON CREDIT CHANNEL: THE CASE OF PORTUGAL

Carolina Teresa Silvestre Fontes

Dissertation submitted as partial requirement for the conferral of Master in Monetary and Financial Economics

Supervisor: Prof. Ricardo Barradas, Assistant Professor,

ISCAL-IPL

Co-Supervisor: Prof. Sérgio Lagoa, Assistant Professor, Department of Political Economy,

Iscte – Instituto Universitário de Lisboa

October, 2020

CIÊNCIAS SOCIAIS
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Acknowledgments

I would like to take this opportunity to warmly thank to Professor Ricardo Barradas not only for accepting to be my supervisor, but also for his support, availability and knowledge transmitted me during the period of research and writing of this dissertation.

Also, I would like to thank to my family for the support, patience and comprehension that I have needed throughout my academic life.

Finally, I would like to thank to my friends and professional colleagues that have encourage and support me to conclude this project and accomplish my goals.

Thank you very much to all!

Resumo

De forma a controlar a inflação, o BCE aplica medidas de política convencional. Contudo, em resultado da crise de 2008, as taxas de juro atingiram 0% e foi necessário aplicar medidas de política monetária não convencional.

Este estudo avalia os efeitos macroeconómicos da política não convencional no crédito concedido em Portugal entre janeiro de 2008 e março de 2019, através de um modelo ARDL. Baseia-se em dados mensais e estima seis equações para o crédito (total; a sociedades não financeiras; às administrações públicas; aos particulares; à habitação; ao consumo e outros fins), usando seis variáveis independentes: Euribor a 3 meses, taxa de inflação, produção industrial, taxa das obrigações do Tesouro a 10 anos, uma *dummy* para as alterações convencionais e uma *dummy* para as alterações não convencionais.

Os resultados sugerem que a política não convencional tem um efeito positivo na concessão de crédito, contudo apenas para crédito aos particulares (causando um aumento de 0.13%) e, particularmente, no crédito à habitação (causando um aumento de 0.15%). Para os restantes créditos, não existe evidência de uma relação estatisticamente significativa.

Por último, verifica-se que a produção industrial e a taxa de juro das obrigações do Tesouro a 10 anos apresentam os sinais expectáveis. Contudo, a Euribor a 3 meses e a taxa de inflação apresentam efeitos positivos na concessão de crédito, contrariamente à literatura. Este facto pode sugerir que os agentes económicos antecipam a sua procura por crédito sempre que são expectáveis futuros aumentos das taxas de juro por parte do BCE.

***Palavras-Chave*:** Política Monetária Não Convencional, Crédito, Portugal, ARDL Model, Quantitative Easing

JEL Codes: C22, E51

Abstract

With the purpose of controlling inflation, the ECB applies conventional monetary policy measures. However, in the aftermath of the crisis in 2008, interest rates reached 0% and the conventional measures were no longer available, leading to a period of unconventional monetary policy.

This study evaluates the macroeconomic effects of the unconventional monetary policy on the credit channel in Portugal between January 2008 and March 2019, under an ARDL econometric model. It relies on monthly data and estimates six equations for credit granted (total loans, loans to non-financial corporations; loans to general government; loans to households; loans for house purchase; loans for consumption and other lending), using six independent variables: Euribor 3 months, HIPC, IPI, Risk Free Rate of 10-years Government Bonds, a dummy for changes on conventional monetary policy and a dummy for changes on unconventional monetary policy.

The findings suggest that changes on unconventional monetary policy have a positive effect on the credit concession, but only with regard to household (where it causes an increase of 0.13%) and, particularly, to house purchase (where it causes an increase of 0.15%). For the remaining types of credit, there is no evidence of a statistically significant relationship.

Finally, the results indicate that IPI and YIELD have the expected impact on credit. However, Euribor 3 months and HIPC have a positive effect on credit concession, contrary to the literature. This might suggest that economic agents may expect further increases in the interest rate by the ECB and therefore anticipate their demand by credit.

Keywords**:** Unconventional Monetary Policy, Credit, Portugal, ARDL Model, Quantitative Easing

JEL Codes: C22, E51

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List of Abbreviations

ABSPP: Asset-Backed Securities Purchase Programme
APP: Asset purchase programme
BoE: Bank of England
CBPP3: Third Covered Bond Purchase Programme
CONV: Conventional Monetary Policy
CSPP: Corporate Sector Purchase Programme
ECB: European Central Bank
EUR3M: EURIBOR 3 Months
Fed: US Federal Reserve
GDP: Gross Domestic Product
GOV: Loans of MFIs to General Government
HCC: Loans of MFIs for consumption and other lending, households and non-profit institutions serving households
HH: Loans of MFIs to Households and non-profit institutions serving households
HIH: Loans of MFIs for house purchase, households and non-profit institutions serving households
HIPC: Harmonised Index Consumer Prices
MBS: Mortgage-Backed Securities
MFIs: Monetary Financial Institutions
NFC: Loans of MFIs to Non-Financial Corporations
OMT: Outright Monetary Transactions
PSPP: Public Sector Purchase Program
SMP: Securities Markets Programme
TLTRO: Targeted longer-term refinancing operations
TOTAL: Total loans of MFIs to Domestic Economy, private and public
UNCON: Unconventional Monetary Policy
USA: United States of America
VLTRO: Very Long-Term Refinancing Operation
YIELD: Risk Free Rate 10-years Government Bond Yield
ZLB: Zero Lower Bound

1. Introduction

Since 2007, the world economies have faced a series of transformations that lead to the well-known subprime crisis, marked by the collapse of the Lehman Brothers in September 2008. This crisis quickly spreads across almost all advanced economies in the world, generating a global financial crisis, despite some authors identify the beginning of it in the United States of America (USA).

As an immediate plan to control the risks of deflation and the deterioration of the economic outlook, the Central Banks acted with Conventional Monetary Policy measures, controlling and cutting their interest rates, until reaching the Zero Lower Bound (ZLB). However, at the time of the ZLB policy, it was understood by the Central Banks that Conventional Monetary Policy was no longer working as an efficient measure and therefore they reacted with new tools to stimulate the economy – the Unconventional Monetary Policy. While there is empirical evidence that the non-standard measures adopted by Central Banks in the financial crisis provided temporary support to their economies (Gambacorta *et al.*, 2014), those actions were not simultaneous between the main Central Banks across the world as well as the effects of the crisis were not recorded at the same time in all the countries.

According to Dell'Ariccia *et al.* (2018), the Unconventional Monetary Policy conceptual framework comprises three important forms of Unconventional Monetary Policy: (i) Forward Guidance, where policymakers inform the market agents about the expected future action in terms of interest rate policy; (ii) Quantitative Easing, involving the large-scale purchase of securities by the Central banks, contributing to an expansion of the balance sheets of the Central Banks; and (iii) Negative Interest Rates, where the Central Banks "charge, rather than pay, interest rates on the reserves that commercial banks hold at the central bank" (Dell'Ariccia *et al.*,2018, pp151).

Most studies focused on Unconventional Monetary Policy are often about a comparison on the impacts in the economy among the main Central Banks: US Federal Reserve (Fed), European Central Bank (ECB), Bank of England (BoE) and Bank of Japan or regarding the impacts of the unconventional monetary policy on financial markets. However, less available are studies about the comparison of those impacts for specific countries, particularly for Portugal. The multi-country nature of the monetary union, makes the study of specific countries particularly interesting, since the outcomes could be different, even when the political and economic measures are the same for all countries, which could be the case of ECB policy.

In parallel, another important event was crucial for the path followed by the ECB in terms of Quantitative Easing policy and really significant for the country selected in this work: the sovereign debt crisis that particularly hit Greece, Ireland and Portugal in 2010 and that had created even more incentives for ECB embarked on a large-scale asset purchase program.

Also, as explained by Peersman (2011, pp7), the banking sector is particularly important in the Eurozone: “in contrast to economies where securities markets play a crucial role in the funding of the private sector, borrowing and lending in the Euro Area predominantly take place through the intermediation of the banking sector”. To understand better this relevance, it is important to bear in mind that ECB estimated that the external financing of private sector is 85% provided by bank loans (Peersman, 2011).

Capinelli *et al.* (2017) proved the interconnectivity between monetary policy and banking channel: they confirm that a negative funding shock causes banks to reduce their credit supply and showed how a positive funding shock – namely the central bank liquidity injection – can restore bank credit supply.

Therefore, considering that the Unconventional Monetary Policy measures taken by the Eurosystem, as a response to the crisis, were in part developed to foment the banking system, this work intends to analyse the impacts of Unconventional Monetary Policy on the Credit Channel caused by adjustments on the size of the balance sheet in one European Country: Portugal. What were the impacts on the bank credit concession? Did the Unconventional Monetary Policy changes performed by the ECB have impact for credit granted in Portugal? The different types of credit were impacted in the same way? Those are important questions that urge to be clarified with this study in order to understand the effects of non-standard measures on the credit available in the market for families, companies and public sector.

This work uses publicly available data (from Thomson Reuters DataStream Database, ECB data and ECB Statistical Data Warehouse) for Portugal and for a period of 135 months (from January 2008 until March 2019). In terms of non-standard measures, it is based on announcements of Unconventional Monetary Policy. Therefore, it was estimated six equations for the several types of credit (Total loans of MFIs to Domestic Economy, private and public (TOTAL), Loans of MFIs to Non-Financial Corporations (NFC); Loans of MFIs to General Government (GOV); Loans of MFIs to Households and non-profit institutions serving households (HH); Loans of MFIs to households and non-profit institutions serving households for house purchase (HIH); Loans of MFIs to households and non-profit institutions serving households for consumption and other lending (HCC)), using six independent variables to take into account the macroeconomic effects, namely Euribor 3months, Harmonized Index Consumer Prices, Industrial Production Index, Risk Free Rate of 10-years Government Bonds, a dummy to reflect the shocks performed with changes of the conventional monetary policy and a dummy to reflect the shocks performed with changes of the unconventional monetary policy. Since there are a mixture of variables stationary in levels and others stationary in the first differences, the econometric methodology adopted was the ARDL model.

Overall, it is possible to conclude that changes/announcements on unconventional monetary policy has a positive effect on the credit concession in Portugal, but only with regard

to households (HH) (where the increase is of 0.13%) and, particularly to house purchase (HIH) (where the impact is 0.15%).

The results indicate that IPI and YIELD have the expected impact on credit, which is a positive impact in the case of IPI and a negative impact in the case of YIELD. However, Euribor 3 months and HIPC always have a positive effect on credit concession, contrary to the literature. This could be related with the fact that economic agents may expect further increases in the level of interest rate. This happens probably due to the strictly mandate of the ECB to control inflation. In that situation, economic agents tend to anticipate their demand by credit. Other factors intrinsic to the specific case of Portugal at that period (such as the sovereign debt crisis in 2010 and the bailout program in May 2011) could also help to explain some changes on the actions of the economic agents, causing the anticipation of their demand by credit.

This dissertation is organised as follows: Section 2 contains a literature review, with a description about the economic situation and includes a brief presentation about the non-standard policies of the main Central Banks. On Section 3, it is described the data used and the sources of this information. Section 4 contains the methodology followed and on Section 5 the analysis of the results is presented. Finally, on Section 6 are presented the conclusions, final remarks and proposals for future researches around this topic.

2. Literature Review

According to the ECB (2019)[1], the main goal of the ECB's monetary policy is to maintain price stability, by controlling the inflation rates of below, but close to, 2% over the medium term. In that way, the Governing Council, commits itself to avoid "both inflation that is persistently too high and inflation that is persistently too low". As a secondary objective, the ECB trajectory follows the accomplishment of the general economic policies of the European Union, namely the "full employment" and "balanced economic growth".

In order to ensure those objectives, the ECB controls the functioning of the market: "It is the sole issuer of banknotes and bank reserves, which implies that ECB represents the monopoly supplier of the monetary base and can set the conditions at which banks borrow from the central bank. Therefore, it can also influence the conditions at which banks trade with each other in the money market" (ECB, 2019)[2].

In terms of Conventional Monetary Policy, ECB uses key interest rates to affect financing conditions in the economy, through: (i) main refinancing operations, where the banks can borrow liquidity from the Eurosystem against collateral on a weekly basis, at a pre-determined interest rate; (ii) deposit facility, where banks uses overnight deposits with the Eurosystem at a (pre-set) rate lower than the main refinancing operations rate; (iii) marginal lending facility, which ECB offers overnight credit to banks from the Eurosystem at an interest rate (also pre-set) above the main refinancing operations rate. (ECB 2019)[3].

The application of the Conventional Monetary Policy techniques, including the ZLB interest rates, in the aftermath of the financial crisis of 2008 were the main tool of all the Central Banks. However, the inflation target was not responding as the Central Banks expected. Two main reasons were appointed to the failure of those policies: (i) the fact that the interest rates reached the ZLB and was no more stimulating the economy; (ii) the fact that liquidity and solvency of banks and borrowers were threatened due to the losses caused by the disruptions in the financial markets (Joyce *et al.,* 2012).

2.1 Transmission Mechanism of Monetary Policy

When the ECB makes use of the Conventional Monetary Policy, it changes, in the short run, the money market interest rates, which sets a number of mechanisms and actions by economic agents and could, in last case, result in economic developments (e.g., changes in output and prices), allowing the Central Bank to control the inflation and to

[1] Source - ECB Website: https://www.ecb.europa.eu/mopo/html/index.en.html
[2] Source - ECB Website: https://www.ecb.europa.eu/mopo/intro/role/html/index.en.html
[3] Source – ECB Website: https://www.ecb.europa.eu/mopo/decisions/html/index.en.html

achieve its goal, as presented in the figure of Appendix A. All these mechanisms and actions are defined as the monetary policy transmission mechanism, which is characterised by long, variable and uncertain time lags, turning the effects of monetary policy vulnerable to all this mechanism. The transmission works through various channels, most of which aim at a further flattening of the yield curve by directly targeting medium to long-term rates (ECB 2019)[4].

Quantitative Easing (QE) measures, as one of Unconventional Monetary Policies, can take the form of changes in the size, composition and duration of the central bank's balance sheet, including the portfolio or the collateral requirements. Those interventions provide liquidity to the banking system, contributing to increases in aggregate demand and inflation (Driffill, 2015; Fiedler *et al*., 2016). A large-scale asset purchase tends to affect the interest rate through many channels, changing the willingness of companies to invest, households to consume and banks to lend, influencing the inflation rate and the economic growth. This purchase increases bank's liquidity by reducing the liquidity price premium and increasing the government bond yields. Nevertheless, these effects persist if central banks continue to purchase assets. Fiedler *et al*. (2016) argue in favour of this idea, confirming that this mechanism allows to lowering lending rates and interest rate charged by banks and thus boosts credit demand and supply. The subsequent improvement in the balance sheet position of investors and banks eases leverage constraints and allows banks to extend more credit at lower costs to the private sector leading to the bank lending channel. However, as argued by Filardo *et al.* (2018), by incorporating the unconventional monetary policy transmission link trough bank lending rates, the unconventional monetary policy had a declining impact on economies over time.

As pointed out by Clayes *et al* (2016, pp4), "in terms of inflation, monetary measures take time to materialise in prices and it is very difficult to know what can be attributed exactly to QE, but, for instance, the basket share of the consumer price index in deflation declined from 40% at the beginning of 2015 to 25% at the start of 2016".

As explained by Martins *et al.* (2018, pp1213), based on SVAR model of a study from Peersman (2011), "the transmission mechanism of conventional and unconventional monetary policy measures seems to be different: with unconventional measures, the effects on GDP and inflation take space at a later date. Bank spreads decline after an unconventional measure, while increasing after a conventional one. Lastly, if the increase in bank credit is caused by the interest rate, the credit multiplier

[4] Source: ECB Website: https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html

decreases; if it is caused by an unconventional measure that increases the balance sheet, the credit multiplier decreases".

However, the importance of the credit channel on each economy is broadly accepted within the literature. According to Korab (2017, pp521), "access to bank credit is crucial for economic recovery and stresses credit conditions are an important factor constraining the pace of the recovery (Kannan, 2012). On average it takes about eight years to reach the pre-crisis level of growth (Reinhart and Rogoff, 2014)". Driffill (2015, pp4) argues that a "direct effect of the QE may in principle come about via bank's lending". Also, Martins *et al.* (2018), argued that "the main transmission mechanism between monetary policy instruments (e.g., the official interest rate and the monetary base) and the real economy is the bank lending channel".

2.2 Conceptual Framework of Unconventional Monetary Policy

Forward Guidance

According to Fiedler *et al.* (2016), forward guidance consists in the communication by the Central Banks to the financial market participants and the general public with information about its future monetary policy actions. Depending on how credible this information is, the agents will adjust their expectations and behaviour accordingly.

This strategy is based on the evolution of macroeconomic indicators and taking into consideration the importance of expected future short-term interest rates. It can come in two forms: (i) the Central Bank aims to clarify how monetary policy will evolve in the future depending on its own expectations for economic activity or inflation; (ii) the Central Bank commits to keeping interest rates low even if economic conditions improve in the future and warrant a monetary tightening, which could turn this second form of forward guidance even more powerful than the first one (Dell'Ariccia *et al.,* 2018).

Negative Interest Rate

The negative interest rate consists in "charging, rather than paying, interest rates on the reserves that commercial banks hold at the Central Bank" (Dell'Ariccia *et al.*, 2018, pp151). ECB and Bank of Japan have implemented this strategy with the objective that banks will reduce lending rates, increase credit supply and thus contributing to boost prices. This is only possible if banks reduce their excess reserves by increasing lending and purchasing other financial assets (Dell'Ariccia *et al*., 2018).

Quantitative Easing (QE)

As described by Dell'Ariccia *et al.* (2018), in theory this type of Unconventional Monetary Policy involves the large-scale purchase of securities by the Central Bank, generally through the acquisition of long-term government bonds financed by an increase in the reserves accounts that commercial banks hold at the Central Bank. However, QE could include not only government securities, but also privately issued securities and is usually implemented by announcing a specific timeline and amount of purchase. While purchase of private securities can reduce the borrowing costs faced by private agents and stimulate the economy, they expose the Central Banks to credit risk and potential losses.

Several studies have appointed the pros and cons of this programmes, in particular Dell'Ariccia *et al.* (2018) presenting the following: in one hand, QE can help to convince markets that Central Bank is committed to keeping a loose policy stance with the purchase of large quantities of government bonds, which could be seen as complement measure to forward guidance. On the other hand, in a model with no financial market frictions and in which investors move freely across asset categories, QE should not have any effects on bond yields, because financial markets and arbitrageurs will reposition their portfolio offsetting the effects of Central Banks purchases.

Also, Clayes *et al.* (2016) raised concerns about the potential adverse consequences of the extension of the QE programme. They argued that while its benefits outweigh its possible negative implications for financial stability or for inequality, there are still some ECB's credibility risks of not reaching its 2% inflation target, leading to expectations becoming disanchored.

2.3 Unconventional Monetary Policy in Euro Area: Portugal and the Quantitative Easing Program

In order to achieve the inflation target established by the ECB on the Treaty on the Functioning of the European Union, as a response to the financial crisis of 2008 and to the sovereign debt crisis of 2010, the ECB first focused on liquidity injections in order to help the banking activity and then, on the targeted purchase of sovereign bonds. The use of unconventional monetary policy measures is mainly related with two purposes: supporting the banking money market intermediation and introducing liquidity in lack to the banking system, avoiding its blockage caused by the accumulation of illiquid assets.

"Only in mid-2014, in the context of anaemic growth and below-target inflation, the ECB adopted the own large-scale asset purchase program" (Dell'Ariccia *et al*., 2018, pp147).

- 1st phase (September 2008 to end-2009): Fixed-rate full allotment - ECB provided unlimited credit to banks at a fixed interest rate. Not only the maturity of those operations was extended, but also the range of eligible assets that could be used as collateral in refinancing operations was extended.
- 2nd phase (early 2010 to late-2012): with the purpose to reduce differences in financing conditions faced by companies and households in different euro area countries, to restore market functioning and to restore the transmission mechanism of monetary policy, this phase included:
    - Purchase Debt Securities (Securities Markets Programme - SMP);
    - Very Long-Term Refinancing Operation (VLTRO);
    - Outright Monetary Transactions (OMT).

This period was marked by the eruption of the sovereign debt crisis, particularly by the bailout package for Greece on May 2010, leading to the first SMP launched by the ECB, which included government debt issued by Greece, Ireland and Portugal. Later on, the ECB had also decided to purchase Italian and Spanish government bonds. Following a Governing Council decision on 6 September 2012 to initiate outright monetary transactions, the SMP was terminated. According to the ECB, as of 22 April 2019, the outstanding amount of SMP at amortised cost was about €63 billion.

Nevertheless, programs implemented so far were not enough to provide confidence and to calm sovereign debt markets in the euro area. As observed in the study from Dell'Ariccia *et al.* (2018), between 2010 and 2014, while the government borrowing costs of Germany and France were around 2% to 3%, the same costs for Portugal and Ireland were about 6% to 12% on the same period (or even around 30% for Greece). In opposition, the Bund Yield was, at that time, quite low when compared with some other European countries and had, inclusively, decreased after the beginning of the financial crisis, even though the ECB's programs were available to all euro area countries at the same time.

Besides the Greek turbulence, also Ireland requested a joint monetary help from IMF and EU in December 2010 and Portugal received a bailout program in May 2011. As argued by Martins *et al.* (2018, pp1211), "Portugal is a good example to study the transmission of QE through the bank lending channel, because the size of purchases is large relative to the size of the market, thus suggesting a significant impact of Expanded Asset Purchase Programme and that the dependence of the private sector for bank credit is considerable". In fact, in the study of Martins *et al.* (2018, pp1219), it was concluded that "the estimated net purchase under the PSPP elasticity of loans of MFIs to general governments was

28 times larger for countries that were hit by the financial and economic crisis, such as Cyprus, Italy, Greece, Portugal and Spain".

- 3rd phase (started in mid-2013): marked by the period of ZLB interest rates, this phase intended to influence the whole interest rates that are relevant for financing conditions in the euro area. It is considered the most important phase in terms of measures implemented by the ECB to improve credit conditions. Those measures include:
    - Forward guidance, announced in July 2013 with ECB President Mario Draghi statement: "The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time" (ECB, 2013)[5];
    - Negative interest rate on the deposit facility, announced in June 2014 at -0,1%;
    - Targeted longer-term refinancing operations (TLTROs), firstly announced in June 2014, to support bank lending to companies and households;
    - Asset purchase programme (APP) formally designated as QE, announced in September 2014, it involved private and public sector securities, to put downward pressure on the term structure of interest rates.

    The net purchase phase of this program ended in December 2018 and since then Governing Council announced that it "intends to continue reinvesting, in full, the principal payments from maturing securities purchased under the APP for an extended period of time past the date when it starts raising the key ECB interest rates, and in any case for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation" (ECB, 2018)[6]. APP includes the following programmes:
    - Corporate Sector Purchase Programme (CSPP), since June 2016 to December 2018;
    - Public Sector Purchase Programme (PSPP), since March 2015 to December 2018;
    - Asset-Backed Securities Purchase Programme (ABSPP), since November 2014 to December 2018;
    - Third Covered Bond Purchase Programme (CBPP3), since October 2014 to December 2018.

[5] Source – ECB Website: https://www.ecb.europa.eu/press/pressconf/2013/html/is130704.en.html
[6] Source – ECB Website: https://www.ecb.europa.eu/press/pr/date/2018/html/ecb.mp181213.en.html

Several authors agree that only the massive purchases included in the APP was an effective measure for the European economy: “the combined effect of all the measures implemented since the summer of 2013 reduced benchmark lending rates for households and companies in the euro area from 3% in the summer of 2013 to 1.7% in the fall of 2017” (Dell’Ariccia *et al*., 2018, pp160).

Appendix B and C demonstrate the significant importance of the PSPP programme, compared with the remaining programmes included in the APP. In all months, since the beginning of this particular program, purchases of public sector bonds are the most material for the Eurosystem. As of December 2018, “government bonds and recognised agencies make up around 90% of the total Eurosystem portfolio of PSPP, while securities issued by international organisations and multilateral development banks account for around 10%” of the total PSPP (ECB, 2019)[7].

With the introduction of the PSSP program, as the most material and expressive monetary help, it turned the composition of the ECB program into the following scheme of monthly purchases (Appendix D): (i) €10 billion of asset-backed securities and covered bonds (ABSPP + CBPP); (ii) €50 billion (PSPP) divided in €44 billion of government and national agency bonds and €6 billion of supranational institutions located in the Euro Area. This approach changed in March 2016, with the ECB changing the monthly amount of purchases to €80 billion until the inflation adjusted its trajectory to the target.

According to the panel data study for the 19 Eurozone countries, performed by Martins *et al.* (2018), the unconventional monetary policies have a positive impact on credit lending, however, with a lag of 1 to 3 months, impact which is larger on loans granted to general governments (1.2% per month) than to households (0.2% per month). Additionally, considering the PSPP impact, an increase of 1% of the monthly amount of net purchase of sovereign bonds from Eurozone governments and securities from European supranational institutions and national agencies has a positive impact of 0.008% on the loan’s concession to general governments.

Also, a study from Garcia-Posada *et al.* (2016), based on the impacts of VLTROs on the credit supply to non-financial companies particular for the case of Spain, suggested that VLTROs had a positive moderate-sized effect on the supply of bank credit to companies in the twelve months after the first VLTROs,

[7] Source – ECB Website: https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html

arguing in favour of the existence of a “bank lending channel” in the context of unconventional monetary policy. This effect was grater for illiquid banks and driven by credit to small and medium enterprises, while there was no evidence of impacts to large firms.

While Joyce *et al.* (2012) founded that unconventional monetary policy does have an effect on the economy, it was not so clear which should be the size, duration and precise channel through which it works. Therefore, recommended that Central Banks and Regulators still need to work together to improve their macro and micro prudential framework.

As an important final remark for this subsection, Dell’Ariccia *et al.* (2018) highlighted a study from Burriel and Galesi (2016) where the effects from LTRO and APP (even when empirical evidence confirms the positive impacts and stimulus for the euro area economy) can be substantially heterogeneous on euro area member countries. This means that while the most productive countries influenced ECB to stay still, in the opposite, the sinking ones created incentives to pull the trigger, implemented a great pressure on the way of the actions taken by ECB.

2.4 Brief Description of the Unconventional Monetary Policy throughout the World: USA, UK and Japan

The financial crisis of 2008 hit the majority of economies in several ways and force the main Central Banks to act accordingly. Throughout the Appendix E, it is possible to confirm that the first Central Bank to react with permanent decreases of interest rates was the Federal Reserve. At the time of the first decrease on the key interest rates (beginning of 2008) of Fed, the ECB and the BoE (although only latter hit by the crisis) were still increasing their own interest rates, which can be read as a signal of opposite measures took in the beginning of the crisis by the several Central Banks. Only by the end of 2008, in a coordinated and jointly decision of several Central Banks (in which is included Fed, ECB and BoE), the key interest rates were cut and drastically reduced (dropped from levels between 4% and 5%) to levels between 1% and 0% in a relatively short space of time.

With regard to USA, the Federal Reserve implemented three phases of QE measures: (i) in December 2008, the Central Bank acted with open market operations ($500 billion as initial measure complemented with $100 billion as second measure). In 2009, the purchases increased to $1.25 trillion of mortgage-backed securities (MBS), plus $200 billion of housing purchases and $300 billion in purchase of long-term

Treasury securities. Those measures taken in 2009 were clearly marked as the first significant increase on the total assets of the Fed; (ii) between November 2010 and June 2011, Fed invested $600 billion of long-term Treasury securities; (iii) between September 2012 and October 2014, Federal Reserve acquired $1.7 trillion of long-term Treasury securities and MBS. This purchase was the main increase of the total assets of the Fed.

The unconventional monetary stimulus in the United Kingdom has passed through three main phases: (i) in 2009-2012 with QE1 programs of large-scale purchases in order to stop the recession and support the economic rebound; (ii) new set of QE programs around 2012 (QE2 and QE3) and forward guidance announcements in 2013 and 2014, clarifying the intention of the BoE to not raise policy rates; (iii) QE extension occurred when the United Kingdom voted to for Brexit in 2016.

Comparing to other Central Banks, Japan was the last one to answer to the crisis, with a response broadly considered by investigators as relatively weak. The stimulus from Bank of Japan is divided into three main phases: (i) 2010-2012 with forward guidance announcements and limited asset purchases; (ii) a stronger monetary stimulus was performed after the election of the Prime Minister Shinzo Abe in 2012, by adopting a 2% inflation target and launching very large quantitative easing programs in 2013 (QQE1) and 2014 (QQE2), with the goal of introduce liquidity in the banking system, maintain the overnight rate near zero, encouraging bank lending; (iii) 2016, the Bank of Japan introduced the "yield curve control" framework and charged negative interest rates on central bank reserves (Dell'Ariccia *et al*., 2018).

As a result of the several strategies adopted by the main Central Banks, the post-crisis period was marked by unprecedent levels of expansion of the balance sheets of the Central Banks. Gambacorta *et al.* (2014) argue that between 2009 and 2013 the assets of the Central Banks increased significantly, more precisely: the balance sheet of Fed and BoE tripled, the Eurosystem doubled and the Bank of Japan increased only mildly over the crisis period. According to the same authors, while there was a high degree of convergence in terms of Central Banks' response to the crisis, there was also a considerable degree of heterogeneity in the design of Central Banks' balance sheet policies.

Claeys *et al.* (2015) argue that Fed and BoE decided very quickly, in the beginning of the crisis, to respond to the economic fragility's trough implementing a more radical and non-standard path in terms of large-scale asset purchase programmes. The author estimates the sizes of these programmes as very significant in USA and UK (grossly equivalent to 20-25% of GDP).

Generally, it is considered that the Fed was not only faster, but also more effective than ECB in responding to the economic and financial crisis. However, ECB faced an extraordinary factor due to heterogeneity across the 19 countries that comprise the euro area, which represents a much more challenging factor for ECB than for any other Central Bank, when deciding the right time to implement measures.

3. Data

In this section, it will be described the data used in the model, the sources and also the definition of each variable and the time period used in the model.

This work uses publicly available data (from Thomson Reuters DataStream Database, ECB data and ECB Statistical Data Warehouse) for Portugal and for a period of 135 months (from January 2008 until March 2019).

3.1 Dependent variables

The dependent variables used in this model are the ones related to credit, namely loans of Monetary Financial Institutions (MFIs) and the source is the ECB Statistical Data Warehouse, based on a Year-on-Year (YoY) rate of change, which includes:

- Total loans of MFIs to Domestic Economy, private and public (TOTAL), which is the sum of the following variables:
    - Loans of MFIs to Non-Financial Corporations (NFC);
    - Loans of MFIs to General Government (GOV)[8];
    - Loans of MFIs to Households and non-profit institutions serving households (HH), which is the sum of the following variables:
        - Loans of MFIs to households and non-profit institutions serving households for house purchase (HIH);
        - Loans of MFIs to households and non-profit institutions serving households for consumption and other lending (HCC)

3.2 Independent variables

For the purpose of this study it was selected a range of independent variables which are considered as possible determinants of the effects caused in the credit granted.

- **EURIBOR 3 Months (EUR3M)** – The EUR3M represents the average interest rate for 3 months that is established by a group of 50 European banks that usually lend and borrow between each other. The source of this variable is Thomson Reuters DataStream Database. The expected effect of an increase in Euribor is a decrease in the credit demand. The selection of the 3M interest rate (and not other term) is

[8] General Government includes loans to Central Government (e.g. State, Public Corporations of Central Government, and Non Profit Institutions of Central Government), Regional Government, Local Government and Social Security Funds granted by other Monetary Financial Institution (https://www.bportugal.pt/en/page/list-institutions-statistical-purposes). Differently from this definition is the credit concession to General Government granted by the ECB or National Central Banks, which is forbidden according to the Treaty on European Union (https://europa.eu/european-union/sites/europaeu/files/docs/body/treaty_on_european_union_en.pdf).

supported by the fact that most of the credit operations in Portugal are associated with short-term interest rates (Castro *et al*., 2010).

- **Harmonised Index Consumer Prices (HIPC)** – The HIPC allows to deduct the annual inflation rate, which measures the change of the HIPC between a month and the same month of the previous year. The source of this variable is Thomson Reuters DataStream Database. According to the literature, the inflation rate is usually positively linked to the interest rate and therefore it is expected a negative relationship between inflation rate and the concession of credit to the economy (Martins *et al.*, 2018). Also, as argued by Castro *et al*. (2010), based on Fritzer and Reiss (2008), the inflation rate is an explicative factor of the loans granted to the private sector in the long run.
- **Industrial Production Index (IPI)** – The IPI is usually used as a proxy for Gross Domestic Product (GDP), which measures the value of goods and services produced in a certain country. Since no monthly data is available for that variable, we use IPI. Similarly, IPI, as a monthly series, measures the output in manufacturing, mining, electric and gas in a scale between 0 and 100, and it was calculated on a Year-on-Year (YoY) rate of change. The source of this variable is Thomson Reuters DataStream Database. According to the literature, the influence of this variable in the credit concession is positive and therefore when the economy is growing, it is expected that companies and individual demand more credit (Martins *et al.*, 2018). Also, as argued by Castro *et al*. (2010), several studies support a stable long-term relation between GDP and loans.
- **Risk Free Rate (YIELD)** – This variable corresponds to the 10-years Government Bond Yield, issued by the national government of Portugal. The source of this variable is Thomson Reuters DataStream Database. As presented for EUR3M, the expected effect of an increase in the risk-free rate is a decrease in the credit demand: as argued by Joyce *et al.* (2012), the decline in yields may make it easier for many companies to raise funds, easing credit conditions.
- **CONV (Dummy)** – This dummy intends to give a shock every time a change on the conventional monetary policy was taken during the regular meetings of the Governing Council. The source of this variable is the ECB website. The dummy is defined as:

$$Dummy = \begin{cases} 1, if\ a\ conventional\ monetary\ policy\ change\ occured\ on\ that\ month \\ 0, otherwise \end{cases}$$

Table G in the Appendix provides a time view of the changes in conventional monetary policy.

- **UNCONV (Dummy)**[9] – This dummy intends to give a shock every time a change on the unconventional monetary policy was taken. The source of this variable is the ECB website. The dummy is defined as:

$$Dummy = \begin{cases} 1, if\ a\ unconventional\ monetary\ policy\ change\ occured\ on\ that\ month \\ 0, otherwise \end{cases}$$

Table H in the Appendix provides a time view of the announcements of unconventional monetary policy decisions. In the same table it is possible to check if the decision of unconventional monetary policy has occurred in the same day as a conventional monetary policy decision has been taken. This table is an update of database in Martins *et al.* (2018).

Proxies and sources for each variable under study are resumed in Table 1.

Table 1 - The proxies and sources of each variable

Variable	Proxy	Source
EUR3M	Euro Interbank Offer Rate 3 months (%)	DataStream
HIPC	Harmonized Index of Consumer Prices (YoY rate of change)	DataStream
IPI	Industrial Production Index (YoY rate of change)	DataStream
YIELD	10-year Government Bond Yield (%)	DataStream
TOTAL	Total loans of Monetary Financial Institutions to Domestic Economy (YoY rate of change)	ECB DataWareHouse
NFC	Loans of Monetary Financial Institutions to Non-Financial Corporations (YoY rate of change)	ECB DataWareHouse
GOV	Loans of Monetary Financial Institutions to General Governments (YoY rate of change)	ECB DataWareHouse
HH	Loans of Monetary Financial Institutions to Households (YoY rate of change)	ECB DataWareHouse
HIH	Loans of Monetary Financial Institutions to Households for House Purchase (YoY rate of change)	ECB DataWareHouse
HCC	Loans of Monetary Financial Institutions to Households Consumer Credit (YoY rate of change)	ECB DataWareHouse
CONV	Conventional Monetary Policy changes	ECB Website
UNCONV	Unconventional Monetary Policy changes	ECB Website

Table 2 exhibits the descriptive statistics of each variable, Table 3 presents the correlations between variables and the Figure F in the Appendix corresponds to the plots of dependent and independent variables.

Table 2 - The descriptive statistics of each variable

Variable	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
EUR3M	0.007161	0.002234	0.051131	-0.003304	0.013791	2.043392	6.485014
HIPC	0.012252	0.009000	0.040000	-0.018000	0.013623	0.216799	2.354398
IPI	-0.007259	-0.000823	0.084406	-0.164714	0.050555	-0.525545	2.958037
YIELD	0.049624	0.042510	0.138490	0.013350	0.029853	1.266125	3.855581
TOTAL	-0.010566	-0.025169	0.113100	-0.072141	0.051995	0.833109	2.586337
NFC	-0.024919	-0.051834	0.139750	-0.129591	0.066989	1.090485	3.196771
GOV	0.092618	0.078614	1.734590	-0.433575	0.314980	1.549602	7.988684
HH	-0.003867	-0.018651	0.106461	-0.046614	0.039257	1.090879	3.529169
HIH	-0.002838	-0.016026	0.098235	-0.044625	0.038506	0.982312	2.876490
HCC	-0.007392	-0.008067	0.142630	-0.090504	0.055187	0.784068	3.623470

Table 3 - The correlations between variables

	EUR3M	HIPC	IPI	YIELD	TOTAL	NFC	GOV	HH	HIH	HCC
EUR3M	1.000									
HIPC	0.410***	1.000								
IPI	-0.380***	-0.089	1.000							
YIELD	0.256***	0.590***	-0.316***	1.000						

[9] This approach was used considering the unavailability of public data for the several APP amounts by country for the period in study. According to the information provided by email by the ECB, it is not published this type of information by country, except in the case of PSPP (which only started in March 2015).

TOTAL	0.810***	0.244***	-0.356***	0.046	1.000					
NFC	0.824***	0.138	-0.486***	0.109	0.940***	1.000				
GOV	0.202**	0.257***	0.062	0.105	0.479***	0.231***	1.000			
HH	0.786***	0.317***	-0.274***	-0.015	0.950***	0.849***	0.390***	1.000		
HIH	0.783***	0.342***	-0.287***	0.109	0.937***	0.837***	0.434***	0.982***	1.000	
HCC	0.596***	0.172**	-0.165*	-0.382***	0.768***	0.682***	0.184**	0.825***	0.702***	1.000

Note: *** indicates statistical significance at 1% level, ** indicates statistical significance at 5% level and * indicates statistical significance at 10% level

While the variable EUR3M is statistically significant to all the types of loans, the HIPC and IPI are not statistically significant for NFC and GOV, respectively. Also, a note for the fact that the variable YIELD is only statistically significant for the behaviour of the loans of MFIs for consumption and other lending (HCC). All the correlations between the variables EUR3M and HIPC with the concession of credit are positive, while the correlation of the IPI (with the exception of GOV) and YIELD are negative.

To choose the most suitable econometric methodology, it is necessary to assess the order of integration of the variables in our study by performing the conventional augmented Dickey and Fuller (1979) (ADF) unit root test and the Phillips and Perron (1998) (PP) unit root test, both presented at Table 4 and Table 5, respectively.

Table 4 - P-values of the ADF unit root test

Variable	Level			First Difference		
	Intercept	***Trend and Intercept***	***None***	***Intercept***	***Trend and Intercept***	***None***
EUR3M	0.000	0.000*	0.000	0.0089	0.0044*	0.0017
HIPC	0.1170*	0.2381	0.1266	0.0031	0.0246	0.0001*
IPI	0.0195	0.0252*	0.0014	0.0000	0.0000	0.0000*
YIELD	0.5496	0.5577	0.2632*	0.0020	0.0097	0.0001*
TOTAL	0.2026*	0.8914	0.1273	0.0408	0.0393*	0.0047
NFC	0.0079*	0.6572	0.0764	0.0026	0.0003*	0.0005
GOV	0.0914	0.138	0.013*	0.0287	0.1109	0.0021*
HH	0.4976	0.9956*	0.2426	0.0000	0.0000*	0.0000
HIH	0.4955	0.9968*	0.2052	0.0001	0.0001*	0.0000
HCC	0.6176	0.6236*	0.2536	0.0040	0.0001*	0.0002

Note: The lag lengths were selected automatically based on the AIC criteria and * indicates the exogenous variables included in the test according to the AIC criteria

Table 5 - P-values of the PP unit root test

Variable	Level			First Difference		
	Intercept	***Trend and Intercept***	***None***	***Intercept***	***Trend and Intercept***	***None***
EUR3M	0.0781	0.3823	0.0022*	0.0005	0.0030	0.0000*
HIPC	0.1779	0.4594	0.0512*	0.0000	0.0000	0.0000*
IPI	0.0000	0.0000*	0.0000	0.0001	0.0001	0.0000*
YIELD	0.7116	0.7371	0.3337*	0.0000	0.0000	0.0000*
TOTAL	0.0981*	0.8692	0.0301	0.0000	0.0000*	0.0000
NFC	0.2113*	0.8654	0.1190	0.0000	0.0000*	0.0000
GOV	0.0148	0.0346	0.0010*	0.0000	0.0000	0.0000*
HH	0.0352	0.7568*	0.0053	0.0000	0.0000*	0.0000
HIH	0.0651	0.8428*	0.0093	0.0000	0.0000*	0.0000
HCC	0.0839	0.4412*	0.0128	0.0000	0.0000*	0.0000

Note: * indicates the exogenous variables included in the test according to the AIC criteria

At the conventional levels of significance, it is possible to conclude the existence of a mixture of variables that are integrated of order zero and variables that are integrated of order one, by both unit root tests (ADF and PP).

4. Methodology

Following the conclusions reached on the unit root tests in previous Section, in which there are a mixture of variables integrated in order zero and one, the ARDL estimator will be applied. This estimator was proposed by Pesaran (1997) and extended by Pesaran and Shin (1999) and Pesaran *et al* (2001).

In order to proceed with the ADRL estimators, four stages needed to be taken into consideration:

(i) corresponds to the analysis of the number of lags that should be included in the estimates following the results of the different information criteria. Please note that this estimator models the behaviour of the dependent variables through the lagged values of itself and with both the contemporaneous and the lagged values of the independent variables.

(ii) entails the determination if there is a cointegration relationship between all variables, by performing the bounds test methodology studied by Pesaran, Shin and Smith (2001). The interpretation of this test is the following:

- The null hypothesis of no cointegration is rejected, if the F-statistic is above the upper critical value;
- The null hypothesis of no cointegration is not rejected, if the F-statistic is below the lower critical value;
- The null hypothesis of no cointegration is inconclusive, if the F-statistic stands between the upper and the lower critical value.

(iii) involves the elaboration of diagnosis tests to ensure the adequacy, completeness and reliability of the estimates. The four diagnosis tests are: Breusch-Godfrey Serial Correlation LM test to verify if the residuals are not serially correlated; Jarque-Bera test to verify if the residuals are normal; Breusch-Pagan-Godfrey test to assess if the residuals are homoscedastic; Ramsey's RESET test to assess if the model is specified correctly in its functional forms.

(iv) requires the study of the long-term estimates and short-run estimates of the credit concession.

5. Results

In this section, the results of the study are presented following the structure explained in the previous section.

Saying that, the first step comprises the analysis of the optimal number of lags according to the different information criteria. Table 6 provides the results of the optimal lag number for the total loans granted and its respectively sub-components.

Table 6 - Values of the information criteria by lag

Model	Lag	LR	FPE	AIC	SC	HQ
TOTAL	0	N/A	4.65e-18	-25.71960	-25.38021	-25.58172
	1	1518.584	1.60e-23	-38.29896	-37.39390*	-37.93128
	2	100.8567	9.75e-24	-38.79946	-37.32874	-38.20199*
	3	28.78171	1.12e-23	-38.66845	-36.63206	-37.84117
	4	51.80700	1.02e-23	-38.77636	-36.17431	-37.71929
	5	21.57420	1.23e-23	-38.59878	-35.43107	-37.31190
	6	54.55288	1.04e-23	-38.79174	-35.05837	-37.27507
	7	26.24909	1.19e-23	-38.69346	-34.39442	-36.94698
	8	56.60094	9.35e-24	-38.98371	-34.11901	-37.00744
	9	30.78767	9.94e-24	-38.98355	-33.55319	-36.77748
	10	40.37145*	9.15e-24*	-39.14427*	-33.14824	-36.70840
NFC	0	N/A	4.64e-18	-25.72263	-25.38146	-25.58404
	1	1405.921	3.79e-23	-37.43940	-36.52964	-37.06983
	2	159.0035	1.36e-23*	-38.46864	-36.99027*	-37.86809*
	3	36.16697	1.45e-23	-38.40661	-36.35964	-37.57508
	4	47.16772	1.38e-23	-38.47040	-35.85481	-37.40788
	5	20.84056	1.69e-23	-38.28426	-35.10007	-36.99077
	6	49.76430	1.50e-23	-38.42789	-34.67510	-36.90342
	7	19.73898	1.85e-23	-38.25419	-33.93279	-36.49874
	8	49.13702	1.59e-23	-38.45759	-33.56759	-36.47116
	9	30.02814	1.70e-23	-38.44948	-32.99087	-36.23206
	10	42.08806*	1.53e-23	-38.63904	-32.61183	-36.19064
	11	29.62823	1.62e-23	-38.68473*	-32.08891	-36.00535
GOV	0	NA	1.72e-16	-22.11257	-21.76962	-21.97327
	1	1221.881	6.26e-21	-32.33112	-31.41659	-31.95964
	2	120.3989	3.16e-21	-33.01915	-31.53304*	-32.41550*
	3	27.96952	3.66e-21	-32.87902	-30.82133	-32.04319
	4	44.51494	3.56e-21	-32.91767	-30.28839	-31.84966
	5	17.31252	4.54e-21	-32.69340	-29.49254	-31.39322
	6	55.22384	3.79e-21	-32.90050	-29.12805	-31.36814
	7	23.48926	4.48e-21	-32.77034	-28.42631	-31.00581
	8	49.58097	3.80e-21	-32.98360	-28.06799	-30.98689
	9	32.23064	3.96e-21	-33.00683	-27.51964	-30.77795
	10	46.10723	3.34e-21	-33.25900	-27.20023	-30.79795
	11	35.17927	3.24e-21	-33.39372	-26.76337	-30.70049
	12	38.33934*	2.93e-21*	-33.62620*	-26.42427	-30.70080
HH	0	NA	1.34e-18	-26.96501	-26.62206	-26.82571
	1	1574.675	2.28e-24	-40.25134	-39.33680	-39.87986
	2	156.8558	8.24e-25*	-41.27079	-39.78468*	-40.66714*
	3	23.70273	9.93e-25	-41.09003	-39.03233	-40.25420
	4	48.32974	9.31e-25	-41.16682	-38.53754	-40.09882
	5	16.13831	1.20e-24	-40.93020	-37.72934	-39.63001
	6	51.26145	1.05e-24	-41.09326	-37.32082	-39.56091
	7	26.54691	1.19e-24	-40.99908	-36.65505	-39.23454
	8	55.73910	9.39e-25	-41.28931	-36.37370	-39.29260
	9	22.09637	1.12e-24	-41.17742	-35.69024	-38.94854
	10	49.12086*	9.06e-25	-41.47265	-35.41388	-39.01159
	11	30.10496	9.50e-25	-41.52930	-34.89894	-38.83606
	12	31.13707	9.67e-25	-41.64174*	-34.43981	-38.71634
HIH	0	NA	1.41e-18	-26.91282	-26.56987	-26.77351
	1	1550.861	2.95e-24	-39.99206	-39.07753	-39.62058
	2	148.1502	1.16e-24*	-40.93238	-39.44626*	-40.32872*
	3	24.73785	1.38e-24	-40.76147	-38.70377	-39.92564
	4	46.60369	1.32e-24	-40.82100	-38.19172	-39.75300
	5	14.84217	1.72e-24	-40.57073	-37.36987	-39.27055
	6	54.54021	1.45e-24	-40.77023	-36.99779	-39.23787

	7	32.20973	1.54e-24	-40.74266	-36.39864	-38.97813
	8	47.87568	1.34e-24	-40.93461	-36.01900	-38.93790
	9	23.16074	1.57e-24	-40.83691	-35.34972	-38.60803
	10	50.75589*	1.24e-24	-41.15549	-35.09672	-38.69443
	11	33.45153	1.24e-24	-41.26363	-34.63327	-38.57039
	12	35.71858	1.17e-24	-41.45243*	-34.25050	-38.52702
HCC	0	NA	2.95e-18	-26.17498	-25.83203	-26.03567
	1	1436.429	1.67e-23	-38.25916	-37.34463	-37.88768
	2	157.5845	6.00e-24*	-39.28524	-37.79913*	-38.68158*
	3	25.37324	7.12e-24	-39.12039	-37.06269	-38.28455
	4	46.49024	6.79e-24	-39.17878	-36.54951	-38.11078
	5	15.22345	8.85e-24	-38.93253	-35.73167	-37.63234
	6	50.78305	7.77e-24	-39.09028	-35.31784	-37.55792
	7	25.26262	8.99e-24	-38.98098	-34.63696	-37.21645
	8	57.55618*	6.91e-24	-39.29393*	-34.37832	-37.29722
	9	18.22624	8.68e-24	-39.13044	-33.64325	-36.90156
	10	30.38855	9.17e-24	-39.15806	-33.09929	-36.69700
	11	18.56082	1.15e-23	-39.03711	-32.40675	-36.34387
	12	22.44594	1.35e-23	-39.00470	-31.80277	-36.07929

Note: * indicates the optimal lag order selected by the respective information criteria

The criteria to read the optimal number of lags to be incorporated in each model is the majority of the information criteria, taken into consideration that the software used selected automatically the optimal number of lags up to the specified maximum.

According to the majority of results obtained, the optimal lag for the total loans granted is 10, while the optimal lag for the loans granted to General Government is 12. Despite these two results, for all other types of loans granted (NFC, HH, HIH and HCC) the optimal number of lags indicates 2.

The second step entails the determination if there is a cointegration relationship between all variables. The results of the bounds test procedure are presented in Table 7.

Table 7- Bounds test for cointegration analysis

Model	F-Statistic	Critical Value	Lower Bound Value	Upper Bound Value
TOTAL	12.08152	1% 2,5% 5% 10%	3.07 2.62 2.26 1.9	4.44 3.9 3.48 3.01
NFC	5.653271	1% 2,5% 5% 10%	3.07 2.62 2.26 1.9	4.44 3.9 3.48 3.01
GOV	7.578835	1% 2,5% 5% 10%	3.07 2.62 2.26 1.9	4.44 3.9 3.48 3.01
HH	10.53747	1% 2,5% 5% 10%	3.07 2.62 2.26 1.9	4.44 3.9 3.48 3.01
HIH	7.148072	1% 2,5% 5% 10%	3.07 2.62 2.26 1.9	4.44 3.9 3.48 3.01
HCC	3.186006	1% 2,5% 5% 10%	3.07 2.62 2.26 1.9	4.44 3.9 3.48 3.01

The computed F-statistics are higher than the upper-bound critical value for all the types of loans at the conventional significance levels (1% of significance level for all the loans, except for HCC which is 10% significance level), which strongly confirm that variables are cointegrated.

The third step involves the elaboration of diagnosis tests to ensure the adequacy, completeness and reliability of the estimates and the results are presented in Table 8.

Table 8 - Diagnostic tests for ARDL estimates

Model	Diagnostic Test	F-Statistic	*P-value*
TOTAL	**Breusch-Godfrey**	0.000430	0.9835
	Jarque-Bera	40.01458	0.000
	Breusch-Pagan-Godfrey	1.521246	0.0628
	Ramsey's RESET	2.194829	0.1419
NFC	**Breusch-Godfrey**	0.602443	0.4391
	Jarque-Bera	485.3738	0.000
	Breusch-Pagan-Godfrey	0.538953	0.8252
	Ramsey's RESET	0.627726	0.4297
GOV	**Breusch-Godfrey**	1.398977	0.2403
	Jarque-Bera	32.94594	0.000
	Breusch-Pagan-Godfrey	2.859646	0.0000
	Ramsey's RESET	29.06700	0.0000
HH	**Breusch-Godfrey**	0.222543	0.6380
	Jarque-Bera	96.59004	0.000
	Breusch-Pagan-Godfrey	2.393652	0.0101
	Ramsey's RESET	5.641723	0.0191
HIH	**Breusch-Godfrey**	0.105285	0.7461
	Jarque-Bera	332.6770	0.000
	Breusch-Pagan-Godfrey	2.065759	0.0278
	Ramsey's RESET	1.553791	0.2150
HCC	**Breusch-Godfrey**	2.84E-05	0.9958
	Jarque-Bera	150.1593	0.000
	Breusch-Pagan-Godfrey	0.797429	0.6193
	Ramsey's RESET	0.713169	0.4000

Note: Breusch-Godfrey tests were conducted with 1 lag and Ramsey's RESET tests were performed with 1 fitted term, albeit results do not change if we had used more lags and more fitted terms, respectively

Analysing the results obtained, it is possible to exclude the presence of autocorrelation in residuals. Although, other econometric problems arise and therefore some remedy actions are needed.

A closer look for the Jarque-Bera results confirm that the hypothesis that residuals are normal is rejected for all the models in the study. In that particular case, any remedy action will be needed as the central limit theorem ensures that residuals are indeed normal due to the presence of a sample with more than 30 observations (Barradas, 2020). Also, the normality hypothesis is rarely satisfied in economic applications, which does not nullify the global robustness of estimates or the statistical inference (Hendry and Juselius, 2000). It is also rejected the null hypothesis that residuals are homoscedastic for the cases of the models TOT, GOV, HH and HIH. To proceed, the Newey-West estimator was applied to produce the final estimator of these models, which does not modify the conclusions of the remaining diagnosis tests. Lastly, for the models GOV and HH, the null hypothesis on the right functional form is rejected. However, the Ramsey's RESET test should only be applied when estimates are

obtained through an OLS estimator, which is not applied in the case of this study (Agung, 2009).

Therefore, by taking those remedial actions explained above and by confirming the remaining diagnostic tests for the models in study, no additional or serious econometric problems persist and it is possible to proceed with the analysis of the long-term estimates (Table 9) and short-term estimates (Table 10) of the credit concession.

Table 9 - The long-term estimates of the linear growth models

Variable	TOTAL	NFC	GOV	HH	HIH	HCC
EUR3M	5.498478*** (1.677168) [3.278431]	2.365545 (1.492650) [1.584795]	22.49474*** (6.546861) [3.435958]	-83.44426 (945.1696) [-0.088285]	-28.82847 (122.1840) [-0.235943]	-1.124187 (2.693590) [-0.417356]
HIPC	2.383402* (1.222942) [1.948908]	3.243748 (2.331645) [1.391184]	8.860045** (3.677203) [2.409452]	-60.66499 (681.0832) [-0.089071]	-23.80301 (97.78334) [-0.243426]	0.6380768 (1.879754) [0.339447]
IPI	1.482781** (0.591948) [2.504919]	0.095955 (0.399002) [0.240488]	-0.121061 (0.644088) [-0.187957]	2.107489 (22.61330) [0.093197]	-1.572855 (6.962140) [-0.225915]	0.095562 (0.442240) [0.216088]
YIELD	-1.996046*** (0.5184408) [-3.850094]	-2.383100*** (0.8910923) [-2.674358]	-2.748608** (1.144363) [-2.401868]	5.654837 (71.81523) [0.078741]	1.226342 (8.719265) [0.140647]	-1.052724* (0.5718402) [-1.840941]

Note: Standard errors in (), t-statistics in [], *** indicates statistical significance at 1% level, ** indicates statistical significance at 5% level and * indicates statistical significance at 10% level

In the long-term and regarding the total concession of credit (TOTAL), all the variables are statistically significant at the traditional significance levels. This conclusion cannot be taken for the remaining models and they change significantly. Regarding to the credit granted to non-financial corporations (NFC), only the 10-years Government Bond Yield seems to have statistical significance, while the proxy of GDP is the only not statistically significant for credit granted to general government (GOV). Regarding the credit granted to households (HH), the variables in study are not statistically significant, with the exception of the 10-years Government Bond Yield in the case of loans for consumption (HCC), but only at significant level of 10%.

Regarding the expected signals and impacts of each variable, the results differ significantly from the expectations of the literature.

In the case of Euribor 3 months, which is only statistically significant in the case of total credit (TOTAL) and in the case of loans to general government (GOV), the results demonstrate that an increase of interest rates will cause an increase in the concession of credit. This controversial result might be related with the fact that economic agents may expect further increases in the interest rate due to the strictly mandate of the ECB to control inflation and therefore anticipate their demand by credit. Other factors intrinsic to the specific case of Portugal at that period (such as the sovereign debt crisis in 2010 and the bailout program in May 2011) could also help to explain some changes on the actions of the economic agents, causing the anticipation of their demand by credit.

Regarding the effects caused by changes on inflation rate, the results are not according to the expected in the literature (higher the inflation rate, higher will be the interest rate and thus less will be the credit granted to the economy) and the relation obtained is positive. Again, and as suggested by Martins *et al*. (2018), this might be a reflection of an anticipation of the actions by the economic agents and thus they will demand more credit before the reaction of the Central Banks to changes in the interest rate.

The results observed for IPI are according to the literature in the case of the total credit granted to the economy. This is because increases in economic growth leads to economic agents demanding more credit, as previously corroborated by Martins *et al.* (2018).

Lastly, the 10-years Government Bond Yield seems to be the variable that is more often statistically significant for the several models. The results seem to be aligned with the expectations, where increases in yields may suggest a worst economic feeling and thus a less dynamic economy, contributing to an encouragement for the economic agents to reduce and shrink their demand of credit.

The different results obtained above, support the conclusion that the determinants of credit concession might be particularly different depending on the specific credit granted.

Table 10 - The short-term estimates of the linear growth models

Model	Variable	Coefficient	Standard Error	T-Statistic
TOTAL R2 = 0.551698 Adjusted R2 = 0.426913	**ΔTOTALt-2**	-0.331886***	0.082233	-4.035910
	ΔTOTALt-3	-0.244259***	0.084663	-2.885092
	ΔTOTALt-4	-0.435004***	0.090327	-4.815887
	ΔTOTALt-5	0.004686	0.085571	0.054766
	ΔTOTALt-6	-0.021365	0.080335	-0.265947
	ΔTOTALt-7	-0.030847	0.081887	-0.376701
	ΔTOTALt-8	0.041762	0.082459	0.506457
	ΔTOTALt-9	-0.318981***	0.080605	-3.957337
	ΔEUR3M t-1	3.450893***	0.707813	4.875430
	Δ EUR3M t-2	-3.229139***	0.811342	-3.979995
	Δ EUR3M t-3	0.699120	0.802830	0.870819
	Δ EUR3M t-4	0.188482	0.804182	0.234378
	Δ EUR3M t-5	-1.360719*	0.818021	-1.663427
	Δ EUR3M t-6	1.006504	0.787935	1.277394
	Δ EUR3M t-7	0.419137	0.791495	0.529551
	Δ EUR3M t-8	-1.267036	0.788608	-1.606675
	Δ EUR3M t-9	-0.140502	0.777311	-0.180755
	Δ EUR3M t-10	-1.179581**	0.562832	-2.095794
	ΔHIPCt-1	-0.004003	0.145727	-0.027470
	ΔHIPC t-2	-0.281842*	0.151498	-1.860369
	ΔHIPC t-3	-0.288577*	0.148068	-1.948947
	ΔIPIt-1	0.020803	0.016047	1.296393
	ΔIPIt-2	-0.061091***	0.016276	-3.753361
	ΔYIELDt-1	0.225379*	0.130324	1.729371
	ΔYIELDt-2	0.213012	0.135294	1.574437
	CONV	0.003424*	0.001949	1.756639
	UNCONV	-7.31E-05	0.001191	-0.061420
	ECTt-1	-0.081426***	0.010258	-7.937617
NFC R2 = 0.203341 Adjusted R2 = 0.184956	**ΔYIELDt-1**	0.141250	0.183669	0.769049
	CONV	0.009549***	0.002486	3.840874
	UNCONV	0.000441	0.001687	0.261276
	ECTt-1	-0.054903***	0.010166	-5.400343
GOV R2 = 0.663189 Adjusted R2 = 0.533057	**ΔGOVt-2**	0.101810	0.106437	0.956528
	ΔGOVt-3	0.286007***	0.097527	2.932588
	ΔGOVt-4	-0.115231	0.102518	-1.123999
	ΔGOVt-5	0.285237***	0.103830	2.747144
	ΔGOVt-6	0.276906***	0.094458	2.931523

	∆GOVt-7	0.194464**	0.096470	2.015805
	∆GOVt-8	0.463578***	0.094765	4.891882
	∆GOVt-9	0.111756	0.092906	1.202888
	∆GOVt-10	0.457309***	0.087104	5.250132
	∆GOVt-11	0.455833***	0.091131	5.001936
	∆GOVt-12	0.318513***	0.093080	3.421909
	∆EUR3Mt-1	151.2833***	39.87765	3.793686
	∆EUR3Mt-2	-143.4845***	43.96781	-3.263399
	∆EUR3Mt-3	38.34531	40.13514	0.955405
	∆EUR3Mt-4	-0.566382	20.69513	-0.027368
	∆EUR3Mt-5	-17.14539	19.91154	-0.861078
	∆EUR3Mt-6	-10.58831	18.42878	-0.574553
	∆EUR3Mt-7	8.860963	18.35460	0.482765
	∆EUR3Mt-8	-36.14011*	18.57376	-1.945762
	∆EUR3Mt-9	-33.22066	20.58529	-1.613806
	∆EUR3Mt-10	58.83578***	21.61270	2.722278
	∆EUR3Mt-11	-64.25312***	21.51350	-2.986642
	∆EUR3Mt-12	26.40718*	14.52957	1.817479
	∆HIPCt-1	6.412633*	3.686732	1.739381
	∆HIPCt-2	-1.195944	3.428945	-0.348779
	∆HIPCt-3	1.825883	3.387584	0.538993
	∆HIPCt-4	10.20595***	3.396207	3.005104
	∆HIPCt-5	2.735482	3.450938	0.792678
	∆HIPCt-6	7.646649**	3.402452	2.247393
	∆HIPCt-7	11.56568***	3.558267	3.250369
	∆HIPCt-8	8.554053**	3.741842	2.286054
	∆HIPCt-9	6.188046*	3.594414	1.721573
	CONV	0.036082	0.047217	0.764173
	UNCONV	0.041010	0.029404	1.394693
	ECTt-1	-0.608563***	0.096587	-6.300687
	∆HIPCt-1	0.053165	0.068529	0.775806
	∆HIPCt-2	0.235280***	0.067665	3.477102
HH	**∆IPIt-2**	0.004983	0.007282	0.684341
R2 = 0.403026	**∆IPIt-2**	0.015672**	0.007000	2.238955
Adjusted R2 = 0.374599	**CONV**	-0.000584	0.000859	-0.680070
	UNCONV	0.001342**	0.000583	2.301185
	ECTt-1	-0.001204***	0.000163	-7.376639
	∆HIPCt-1	0.018979	0.079896	0.237551
	∆HIPCt-2	0.262412***	0.079332	3.307783
HIH	**∆IPIt-1**	0.005939	0.008561	0.693792
R2 = 0.325589	**∆IPIt-2**	0.023257***	0.008152	2.852905
Adjusted R2 = 0.293474	**CONV**	-0.000651	0.001002	-0.649360
	UNCONV	0.001479**	0.000684	2.163274
	ECTt-1	-0.003095***	0.000509	-6.075539
	∆EUR3Mt-1	3.244292***	0.696653	4.656969
HCC	**∆EUR3Mt-2**	-2.025528***	0.654912	-3.092823
R2 = 0.263373	**CONV**	0.002430	0.002120	1.146206
Adjusted R2 = 0.240353	**UNCONV**	0.001511	0.001352	1.117948
	ECTt-1	-0.038492***	0.009492	-4.055108

Note: ∆ is the operator of the first differences, *** indicates statistical significance at 1% level, ** indicates statistical significance at 5% level and * indicates statistical significance at 10% level

With regard to short-term estimates five conclusions should be addressed. Firstly, the coefficients of the error correction terms are strongly statistically significant, have an expected negative signal and vary between 0 and -2, implying that the models converge to the long-term equilibrium. However, the results (8%, 5%, 0.1%, 0.3% and 4% for TOT, NFC, HH, HIH and HCC, respectively) indicate a relatively low speed of adjustment and any disequilibrium in the long-term is not mostly corrected in one month. The exception is the loans granted to general government in which the speed of adjustment implies that 61% of any disequilibrium in the long term is corrected in one month. Secondly, the lagged values of the total credit granted and also of the loans to general governments tend to be statistically significant, being mostly negative for TOT and mostly positive for GOV. The case of TOT might be related with the fact that higher the previous requests of credit, lower will be the need to appeal for further credits,

suggesting that economic agents face credit constrains. However, the case of GOV, where the lags have positive signals, might be related with the social character of the general governments to finance the economy, contributing to its over-indebtedness over time. Thirdly, the short-term results obtained for the remaining variables seem to be mostly aligned with the long-term results in terms of statistically significance. However, the signals do not have exactly the same behaviour, which is particularly true in the case of TOT, where most of the signals revert, which could be related with the time needed by the economic agents to adapt their demand of credit to the macro economic conditions, which could be more than a few months horizon time of the short-term estimation. Fourthly, the results obtained for the dummies seem to be surprising. In one hand, the dummy that capture the changes in conventional monetary policy is only statistically significant for the cases of TOT and NFC and has positive coefficients. This might indicate that the fluctuations in the interest rate performed by the ECB, cutting the interest rate, have, generally, a positive effect on the credit granted to the economy and to non-financial corporations. On the other hand, the dummy that captures the changes in unconventional monetary policy in only statistically significant for the cases of HH and HIH and has positive coefficients. This suggests that increases in the programs of unconventional monetary policy have, generally, contributed to increases in the loans for households and for house purchase. This result is also corroborated by Martins *et al.* (2018, pp1216), where “the unconventional monetary policy measures have a smaller impact (with a delay of 3 months), but still positive in credit to households for house purchase (HIH) and total households (HOUSE) of 0.1% and 0.2%, respectively”. Fifthly, the models developed describe relatively well the evolution of bank credit. This conclusion is particularly true in the case of TOT and GOV, where the R-squared and adjusted R-squared values are in the range of 55%-66%. This is naturally a consequence of the number of lags used in those two models, when compared with the other models that used 2 lags: 10 lags for TOT and 12 lags for GOV.

6. Conclusions

This study constitutes an empirical analysis of the macroeconomic effects of the unconventional monetary policy of the ECB on the credit channel and their relationships in Portugal, by performing a time series econometric analysis of the monthly period between January 2008 and March 2019.

Therefore, there were estimated six equations for the several types of credit (TOTAL, NFC, GOV, HH, HIH, HCC), using six independent variables to take into account the macroeconomic effects, namely EUR3M, HIPC, IPI, YIELD, a dummy to reflect the shocks performed with changes of the conventional monetary policy (CONV) and a dummy to reflect the shocks performed with changes of the unconventional monetary policy (UNCONV). Since there are a mixture of variables stationary in levels and others stationary in the first differences, the econometric methodology adopted was the ARDL model.

Overall, it is possible to conclude that the unconventional monetary policy applied in the Euro Area between January 2008 and March 2019 has a positive effect on the credit concession in Portugal, but only with regard to credit for households and non-profit institutions serving households (HH) and, in particular, credit for house purchase (HIH). In particular, the impact is very similar for both cases: the measures taken of an unconventional monetary policy point of view have an increase of 0.13% on credit granted to households and an increase of 0.15% on the credit granted for house purchase. For the remaining types of credit, this model does not evidence a statistically significant relation with unconventional monetary policy.

Our results also show that EUR3M and HIPC always have a positive effect on credit concession, contrary to the literature. There are two factors that might help to explain these controversial results: in one hand, the situation that Portugal was passing through during this period, the sovereign debt crisis in 2010 and a bailout program in May 2011; on the other hand, economic agents may expect further increases in the interest rate due to the strictly mandate of the ECB to control inflation and therefore anticipate their demand by credit. However, with regard to IPI and YIELD the results are according to the literature: increases in economic growth leads to economic agents demanding more credit and increases in yield may suggest a worst economic feeling and thus a less dynamic economy, contributing to an encouragement for the economic agents to reduce and shrink their demand of credit.

Despite the studies already developed in terms of the impacts of unconventional monetary policy on bond and/or financial markets, less studies have focused on the impacts on the credit concession. These results emphasized the need to study the impacts of unconventional monetary policy by country and the possibility to apply different measures particularly designed by country (for example, in terms of size, composition, duration of the programme and in terms of criteria of distribution by countries) due to the heterogeneity of the Euro Area's economies.

Our findings might be particularly interesting in the developing of further monetary policy measures in the period of combating COVID-19 crisis. The impacts observed for Portugal might not be the same as for other countries and, therefore, this might provide insights for policy makers to adopt measure of monetary policy in the future that might be more tailored-made to all the Euro Zone countries. Some of those changes should be carefully taken into consideration by the Governing Council, since it could change the overall effects of unconventional monetary policy in the Euro Area.

Further research may have into account other factors that might influence the credit supply. For example, in the case of Portugal, during the period in analysis, it was supported by external monetary help ('Troika'), which was not taken into account in the model but in somehow it could have influenced the availability of credit in the market by the measures implemented by Troika in the country. While it cannot rule out this hypothesis, this study helped to understand and provide evidence about the linkage between unconventional monetary policy and the credit channel. Also, these results are naturally subject to a degree of uncertainty since the sample period is short, which make precise estimation more difficult.

References

Agung, I.G.N., 2009, "*Time Series Data Analysis Using Eviews*", Singapore: Jonh Wiley & Sons (Asia) Pte Ltd.

Barradas, R., 2020, "Does the financial system support economic growth in times of financialisation? Evidence for Portugal", *International Review of Applied Economics, At press.*

Carpinelli, L. and Crosignani, M., 2017, "The effect of Central Bank Liquidity Injections on Bank Credit Supply", Working Paper

Castro, G. and Santos, C., 2010, "Determinantes das Taxas de Juro e do Crédito Bancário", *Boletim Económico*, Banco de Portugal

Claeys, G., Leandro, Á. and Mandra, A., 2015, "Policy European Central Bank quantitative Easing: The detailed manual", *Policy Contribution 2015/02*, Bruegel

Claeys, G. and Leandro, Á., 2016, "The European Central Bank's Quantitative Easing Programme: Limits and Risks", *Policy Contribution 2016/04*, Bruegel

Dell'Ariccia, G., Rabanal, P. and Sandri, D., 2018, "Unconventional Monetary Policies in the Euro Area, Japan and the United Kingdom", *Journal of Economic Perspectives*, 32, pp.147-172

Dickey, D.A. and Fuller, W.A., 1979, "Distribution of the Estimators for Autoregressive Time Series with a Unit root", *Journal of the America Statistical Association*, 74 (366), pp. 427-431

Driffill, J., 2015, "Unconventional Monetary Policy in the Euro Zone", Working Paper, *Open Economies Review*

European Central Bank, October 2009, "Monetary Policy and Loan Supply in the Eura Area", *Monthly Bulletin*, pp.63-80

Fielder, S., Jannsen, N., Wolters, M., Hanisch, I. and Hallet, A.H., 2016, "Transmission channels of unconventional monetary policy in the euro area: where do we stand?", European Parliament, *Monetary Dialogue*

Filardo A., and Nkajima, J., 2018, "Effectiveness of unconventional monetary policies in a low interest rate environment", Working Paper, Bank of International Settlements

Gambacorta, L., Hofman, B. and Peersman, G., 2014, "The effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis", *Journal of Money, Credit and Banking*, pp.615-642

Garcia-Posada M. and Marchetti M., 2016, “The bank lending channel on unconventional monetary policy: The impact of the VLTROs on the credit supply in Spain”, *Elsevier – Economic Modelling*, 58, 427-441

Hendry, D.F. and K.Juselius, 2020, “Explaining Cointegration Analysis:Part II”, *Discussion Paper 00-20*, Department of Economics, University of Copenhagen.

Joyce, M., Miles D., Scott A., and Vayanos D., 2012, “Quantitative Easing and Unconventional Monetary Policy – An Introduction”, *The Economic Journal*, 122, F271-F288

Korab, P., 2017, “Access to Credit and Unconventional Monetary Policy in the Eurozone after the Financial Crisis”, *Ekonomicky Casopis*, 65, pp-520-533

Martins, L.F., Batista, J. and Ferreira-Lopes, A., 2018, “Unconventional monetary policies and bank credit in the Eurozone: am events study approach”, *International Journal of Finance and Economics*, 24, pp1210-1224

Peersman, G., 2011, “Macroeconomic effects of the unconventional monetary policy in the euro area”, *ECB Working Papers*, No.1397

Pesaran, M.H., 1997, “The Role of Economic Theory in Modelling the Long Run”, *Economic Journal*, 107 (1), pp.178-191

Pesaran, M. H. and Shin, Y. 1999. ‘An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis’. In Strøm, S. (ed.): *Econometrics and Economic Theory in The Twentieth Century: The Ragnar Frisch Centennial Symposium*. Cambridge: Cambridge University Press.

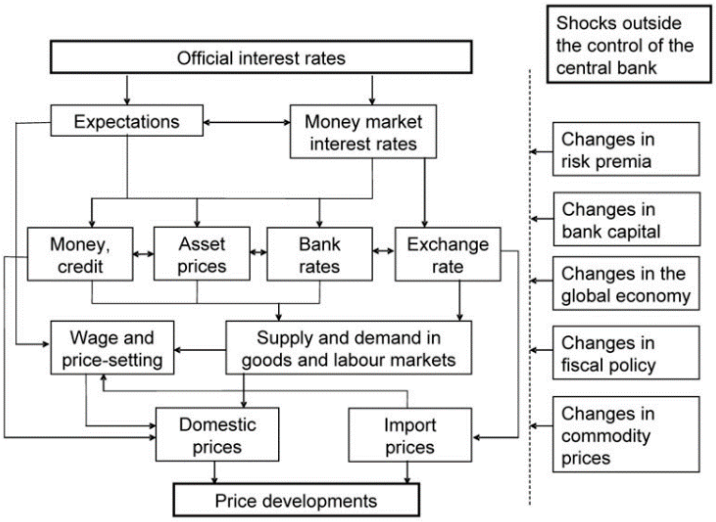
Pesaran, M. H.; Shin, Y.; and Smith, R. J. 2001. ‘Bounds Testing Approaches to The Analysis of Level Relationships’. *Journal of Applied Econometrics*. 16 (1), pp.289-326.

Philips, P.C.B. and Perron, P., 1998, “Testing for a Unit Root in Time Series Regression”, *Biometrika*, 75 (2), pp.335-346

Wooldridge, J. M. 2003. ‘*Introductory Econometrics: A Modern Approach’*. 2nd Edition. Ohio: Thomson South-Western.

Appendix

Appendix A - Transmission Mechanism of Monetary Policy



Source: ECB Website (https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html)

Appendix B- Eurosystem holdings under APP, at amortised cost (€ million)

	ABSPP	CBPP3	CSPP	PSPP
February 2019	26.137	261.992	178.188	2.101.918
March 2019	25.592	261.512	177.700	2.094.281

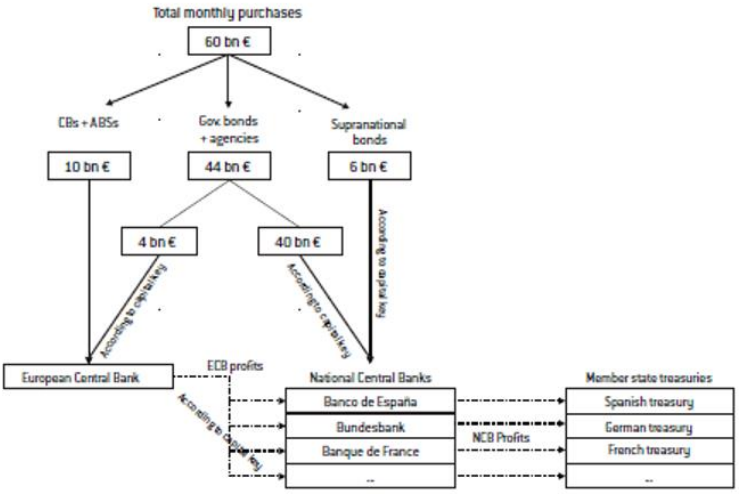
Source: ECB Website (https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html)

Appendix C - Eurosystem outright operations, at amortised cost (€ million).

	ABSPP	CBPP3	CSPP	PSPP	SMP [1]	CBPP1[1]	CBPP2[1]
22 April 2019	26.292	262.039	177.665	2.099.722	62.838	3.424	3.774

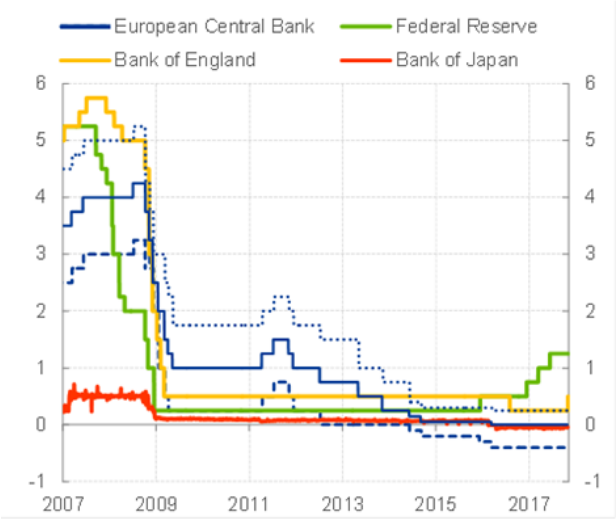
Source: ECB Website - Terminated programmes Website (https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html)

Appendix D - Division of ECB monthly asset purchases



Source: Clays *et al* (2015, pp3)

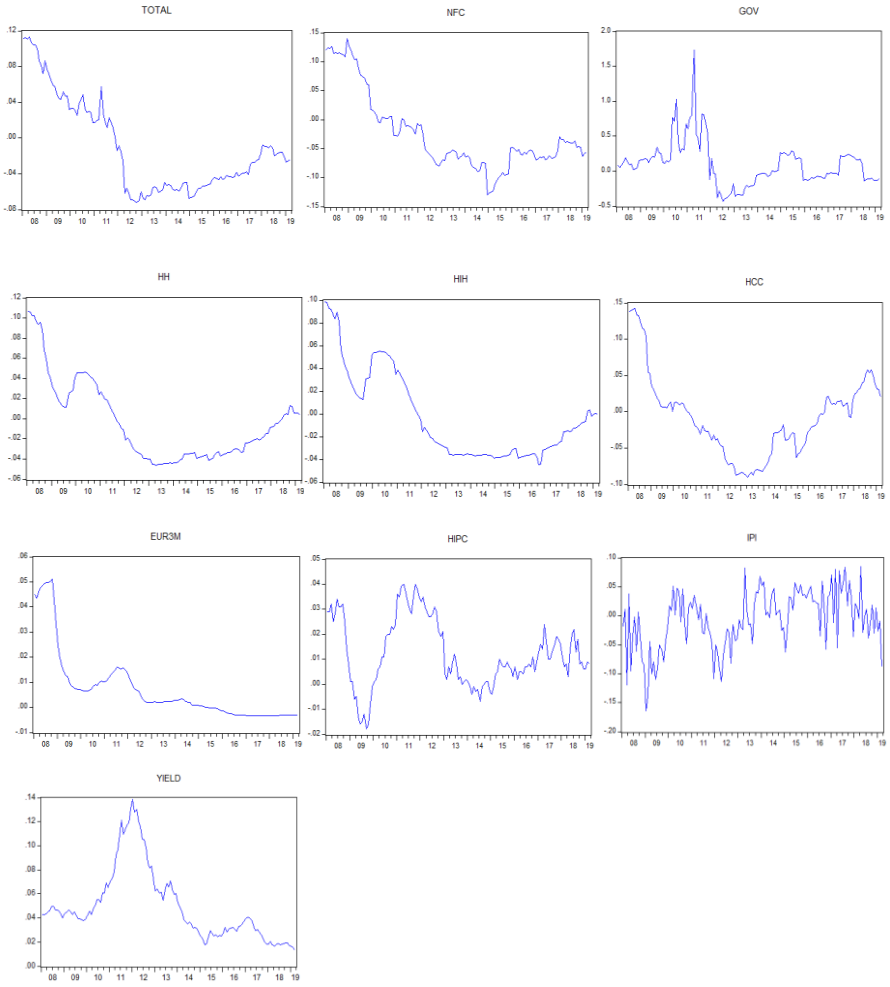
Appendix E - Key Monetary Policy Interest Rates (%)



Source: Peter Praet speech's – ECB[10] (from ECB, Federal Reserve, Bank of England and Bank of Japan)

[10] Source – ECB Website: https://www.ecb.europa.eu/press/key/date/2017/html/ecb.sp171115.en.html

Appendix F - Plots of the variables



Appendix G - Changes in the Conventional Monetary Policy

Date	Conventional Monetary Policy was changed?
July 2008	Y
November 2008	Y
December 2008	Y
January 2009	Y
March 2009	Y
April 2009	Y
May 2009	Y
April 2011	Y
July 2011	Y
November 2011	Y
December 2011	Y
July 2012	Y
May 2013	Y
November 2013	Y
May 2014	Y
September 2014	Y
December 2015	Y
March 2016	Y

Source – ECB Website: https://www.ecb.europa.eu/press/govcdec/mopo/html/index.en.html

Appendix H - Announcements of Unconventional Monetary Policy Decisions

Date	Announcement	After GovC?
August 2007	Supplementary LTRO	N
August 2007	Allotment LTRO	N
March 2008	Six-Month LTRO	N
May 2009	One-Year LTRO and CBPP	Y
June 2009	Details CBPP	Y
December 2009	Amendments to LTRO	Y
March 2010	Amendments to LTRO	Y
May 2010	Securities Markets Program (SMP)	N
March 2011	Fixed Rate Full Allotment Refinancing Operations	Y
August 2011	Securities Markets Program	Y
October 2011	Second CBPP	Y
December 2011	New LTRO; Reduced Reserve Ratio; Increased Collateral Availability	Y
December 2011	LTRO Results	N
February 2012	National Central Banks Credit Claims Approvals	Y
February 2012	Second LTRO Results	N
July 2012	London 'Whatever it takes' Speech	N
August 2012	Outright Monetary Transactions	Y
September 2012	Details Outright Monetary Transactions	Y
March 2013	Amendments to Collateral Rules	N
June 2014	TLTRO; Preparatory work on ABSP	Y
July 2014	Details TLTRO	Y
September 2014	Third CBPP3 and the ABSPP	Y
September 2014	Draghi makes a speech to the EP; ECB allotted €82.6bn to 255 counterp. in the 1st of eight TLTRO	N
January 2015	EAPP; Interest Rates Changes for LTRO; ECB modifies to the interest rate to future TLTRO	Y
March 2015	The beginning of PSPP, QE	N
September 2015	Eurosystem adjusts purchase process in ABSPP	N
November 2015	Eurosystem increase the PSPP issue share limit, making the higher issue limit effective	N
December 2015	Eurosystem decides to extend the APP until March 2017	Y
March 2016	The Eurosystem decides to increase monthly purchases from €60bn to €80bn, starting in April	Y
March 2016	ECB announces a new series of four TLTRO	Y
March 2016	ECB adds corporate sector purchase program (CSPP) to the APP and announces changes to APP	Y
April 2016	Started the expand monthly purchases under the APP to €80bn	Y
April 2016	ECB announces details of the CSPP	Y
May 2016	ECB publishes legal acts relating to the second series of TLTRO	N
June 2016	ECB announces details of the corporate sector purchase programme (CSPP), starting in 8 June	Y
June 2016	Eurosystem decides to conduct the 1st operation in new series of TLTRO, starting in 22 June	Y
December 2016	The Eurosystem decides to decrease monthly purchases from €80bn to €60bn in APP, in 04.2017	Y
December 2016	ECB adjusts parameters of its asset purchase programme (APP), in 02.01.2017	Y
December 2016	Eurosystem introduces cash collateral for PSPP securities lending facilities	N
December 2016	Eurosystem adjusts purchase process in ABS purchase programme (ABSPP)	N
April 2017	ECB confirmed the monthly purchases under the APP to €60bn	Y
October 2017	The Eurosystem decides to decrease monthly purchases from €60bn to €30bn in APP, in 01.2018	Y
January 2018	ECB confirmed the monthly purchases under the APP to €30bn	Y
June 2018	The Eurosystem decreases from €30bn to €15bn in APP, from 09.2018 to 12.2018 and then end	Y
October 2018	ECB confirmed the monthly purchases under the APP to €30bn	Y
December 2018	ECB decides on technical parameters for the reinvestment of its asset purchase programme	N
March 2019	ECB announced TLTRO-III, from 09.2019 to 03.2021, each with a maturity of two years.	Y

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