Unconventional Monetary Policies and Bank Credit in the Eurozone: An Events Study Approach*

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Abstract

We study the impact of the unconventional monetary policies implemented by the ECB on bank credit to Eurozone general governments and to households. The database is a macro panel of the 19 Eurozone countries over the period between January 2008 and May 2016. Using an events study approach, we create two dummy variables that reflect the timing and changes of unconventional and conventional monetary policy measures, which we use as key determinants in panel regression models. Our results suggest that unconventional monetary policies have a positive lagged impact on bank credit, with much more to general governments (1.2% per month) than to household consumers (0.2%). All other variables in the models, such as the interest rates, the Industrial Production Index, and the inflation rate have the expected estimated signs. Finally, we estimate the unobserved country-specific fixed effects measured in terms of credit growth rates. The monthly growth rates of loans to households in Ireland are about 0.74% below the average country, which is closely related to its post-2008 banking crisis. Moreover, the net purchases' impact under the Public Sector Purchase Program (PSPP) of loans of Monetary Financial Institutions (MFIs) to general governments was much larger for countries that were hit by the financial and economic crisis.

Keywords: Unconventional monetary policy, Quantitative easing, Bank credit, Events study approach, Eurozone, Panel Data.

JEL Codes: C23, C51, E51, E52, E58.

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1 Introduction

The present work analyzes the impact of unconventional monetary policies, implemented by the European Central Bank (ECB), on bank credit in the 19 Eurozone countries, using an events study approach. We model the total amount of credit concession, the loans to Eurozone general governments, and also the credit to households (total, as well as disaggregated for consumer credit and house purchase credit).

In order to achieve low and stable inflation rates, the ECB and other central banks alike usually use conventional monetary instruments, e.g., the reference interest rate. However, in the aftermath of the financial crisis, the reference interest rate in many developed economies reached the Zero Lower Bound (ZLB), due to low inflation and anemic growth. Additionally, there were also disruptions in financial markets, generating losses and affecting liquidity. Conventional monetary policy measures started to be ineffective in stimulating economic growth and in providing financial stability, which made central banks think of new policy tools, named unconventional monetary policies. 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. In this channel the improvement of liquidity persuades banks to finance more new loans. However, during the last financial crisis, the risk aversion by banks increased, leading to the failure of the mechanism and shrinking of credit available to the private sector (Olmo and Sanso-Navarro, 2014).

Unconventional monetary policies may arise in three different ways: by changing expectations relative to medium and long term interest rates; by changing the composition of the balance sheet of the central bank, and by increasing the size of the central bank's balance sheet. These policies affect the cost and amount of funding to the financial sector, families, governments, and non-financial firms. One specific type of unconventional monetary policy - Quantitative Easing (QE) - consists of a large-scale asset purchase program (APP), which means that central banks expand the left side of the balance sheet through the purchase of public sector debt and private assets with longer maturities, although typically consists of buying government bonds (Driffill, 2016). The large-scale asset purchases affect the interest rate through various transmission channels, changing the willingness of companies to invest, households to consume, and banks to lend. These changes influence the inflation rate and economic growth.

The relationship between unconventional monetary policies and bank credit is a relatively recent topic and literature about it is still scarce, especially in the case of the Eurozone. Most empirical studies about unconventional monetary policies are for the USA, the UK, and the Japanese economies, focusing on the impacts on financial and bond markets, and/or are usually studies produced by Central Banks using data not available outside these institutions. We have found just a few examples of works that include the Eurozone.

Albu *et al.* (2014) analyze the impact of the unconventional monetary policy, specifically QE, issued by four major central banks on credit risk in nine countries of Central and Eastern Europe.[1] They use daily data in an ARMA-GARCH model and two variables: credit default closing prices and dates of the announcements of QE policies. The range of influence of QE on credit risk is similar between the ECB and the Bank of Japan (BoJ). On the other hand, the influence of QE by the Bank of England and the Federal Reserve is lower (and identical between them). Moreover, the QE policies of the ECB and the Federal Reserve determine both surges and falls in credit risk, while for the Bank of England and the BoJ the trend of reduction is greater than that of growth. Using event based regressions, Szczerbowicz (2015), analyzes the impact of the ECB unconventional monetary policies on the money, covered bonds, and sovereign bonds markets, finding that some measures have reduced the costs and tensions in the money market that influence the covered bonds and sovereign bonds markets. In order to analyze the

[1] QE issued by the ECB, the Bank of England, the Federal Reserve, and the Bank of Japan. The nine countries are: Turkey, Russia, Germany, Poland, Hungary, Ukraine, Austria, Bulgaria, and Romania.

QE's effects on prices and yields, Driffill (2016) collected the dates of announcements and actions to examine the changes around those dates. The effects are diverse, depending on the date and country of interest, so that some countries are more sensitive to announcements than others (e.g., the fall in the 10-year Government bond yields was greater in Portugal - 57.75 basis points - than in Germany, France and Greece - 23.20; 15.00, and 5.06, respectively).

The Expanded Asset Purchase Program (EAPP) was introduced to improve lending conditions to the private sector (firms and households). From the related literature, it is possible to claim that there is little evidence on the impact of this policy on lending conditions. This may be due to lack of information about asset purchases and interest rates, while there is ample evidence on bond yields (Blattner *et al.*, 2016). The authors study the effect of the EAPP through new comprehensive loan-level data from Portugal, and find some positive evidence of its impact on banks exposed to QE via both lower prices and larger quantities. 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 EAPP and that the dependence of the private sector for bank credit is considerable. Carpinelli and Crosignani (2017) study the effect of the 3-year Long-Term Refinancing Operations (LTRO) of the ECB on bank credit supply in Italy. These authors find that the unconventional monetary policy measure of the ECB had a positive effect on bank credit supply.

This paper uses data from Bloomberg, Thomson Reuters DataStream, Eurostat, and the ECB to study how unconventional monetary policies affect bank credit in the Eurozone. A macro panel dataset was created of the 19 countries of the Eurozone during a period of 101 months (January 2008 until May 2016). In order to capture the impact of unconventional monetary policies on bank credit, a dummy variable was created using the events study approach, as well as a real-valued variable measuring the monthly net purchases under the Public Sector Purchase Program (PSPP). Additionally, we use as credit determinants some interest rates, the inflation rate, and the Industrial Production Index (IPI), besides a dummy variable that reflects the periods in which there were changes in conventional monetary policy. We fill a gap in the literature on the relationship between the unconventional monetary policy of the ECB and the concession of credit, which until now was rarely analyzed. Since unconventional monetary policies of the ECB just started in recent years, the lack of data is compensated by the use of the events study approach. Namely, we estimate this relationship for the total and also by disaggregating for several types of credit, which sheds light on differences between very different economic agents - families and the government. We also perform the estimations for all 19 Eurozone member countries, giving a general result for the Eurozone. Additionally, existing literature was seldom concerned about other macroeconomic determinants of the concession of credit and we use these variables in our estimations, namely GDP and inflation.

In general, we conclude that unconventional monetary policies have a positive impact on credit that takes place one or three months after its implementation. This impact is greater on general governments (1.2% per month) than on household consumers (0.2%). Taking PSPP as the main driver in the model, we observe that an increase of 1% of the monthly amount of net purchases of sovereign bonds from Eurozone governments and securities from European supranational institutions and national agencies has a positive impact of 0.008% on the Eurozone governments' loans concession.

This work is organized in the following way. In the next section we briefly describe the timeline of the surge of unconventional monetary policy in the Eurozone and present the possible transmission channels of QE. Section 3 describes the data and the methodology that we use in this empirical exercise. In section 4 we discuss the results and Section 5 concludes.

2 Unconventional Monetary Policy in the Eurozone - An Overview

In order to respond to the financial and the sovereign debt crises that began in 2008, the ECB implemented some measures to provide liquidity in the economic system. The programs implemented were:

- Long-Term Refinancing Operations (LTROs) in October 2008 – LTROs are three-month liquidity-providing operations (in euros), one of the two regular open market operations. Through this program, the ECB provides financing to Eurozone banks.
- Covered Bond Purchase Program (CBPP) in May 2009 and a 2nd CBPP in October 2011 – The purchase of covered bonds helps to improve the functioning of the monetary policy transmission mechanism as well as to support lending conditions in the Eurozone.
- Securities Market Program (SMP) in May 2010 – ECB's interventions in public and private debt securities markets in the Eurozone in order to restore monetary policy transmission mechanism, making monetary policy more efficient-oriented toward price stability in the medium term.

However, none of these programs were enough to provide liquidity and give confidence to the investors about the default risk on the sovereign debt of some countries like Portugal, Spain, Italy, and Greece (Driffill, 2016). So, after Japan, the United States, and the United Kingdom, it was the turn of the ECB to announce, in September 2014, the Expanded Asset Purchase Program (EAPP), the unconventional monetary policy formally designated as "QE". The first QE Program announcement and implementation was the Third CBPP and the Asset-Backed Securities Purchase Program (ABSPP). On the 22^{nd} of January 2015, another type of QE Program was announced, the first Public Sector Purchase Program (PSPP), this time specifically to purchase sovereign bonds from Eurozone governments and securities from European supranational institutions and national agencies. Therefore, the PSPP came after the CBPP3 and the ABSPP, as we can see in Table 1.

Table 1 - QE Announcement and Implementation Dates

Program	Announcement	Implementation
CBPP3	4^{th} September 2014	20^{th} October 2014
ABSPP	4^{th} September 2014	21^{st} November 2014
PSPP	22^{nd} January 2015	9^{th} March 2015

Source: ECB

The ABSPP is the smallest of the three programs and the PSPP is the largest of all instruments (Claeys *et al.*, 2015). The original PSPP corresponded to €60 billion worth of monthly purchases until September 2016 with the following purchases allocation: (1) €10 billion *per* month of asset-backed securities and covered bonds; (2) €44 billion *per* month of government and national agency bonds (divided among holdings of the ECB and the National Central Banks); and (3) €6 billion *per* month of supranational institutions located in the Eurozone. On the 3^{rd} of December 2015, Mario Draghi announced an extension of the program, leading to changes in the initial guidelines (Claeys and Leandro, 2016). On its website, the ECB claimed that: The initial program changed in March 2016, changing the monthly amount of purchases from 60 to €80 billion and changing its end to March 2017 or until the Governing Council sees a sustained adjustment in the inflation, which means the observation of at least a trajectory to the inflation target. According to the Governing Council, one of the reasons to announce the EAPP was the historical low rates in most indicators of actual and expected inflation in the Eurozone. This program can stimulate the economy and ease monetary and financial conditions, which makes access to finance cheaper for firms and households.[2]

[2] See Table A1 for a detailed list of the announcements of the ECB regarding unconventional monetary policy measures.

The Transmission Mechanism of Unconventional Monetary Policy The large-scale asset purchases affect the interest rate and credit through various transmission channels, changing the willingness of companies to invest, households to consume, and banks to lend. These changes ultimately influence the inflation rate and economic growth.

The signaling channel affects the interest rate across the yield curve and the effects depend on bond maturities. The unconventional monetary policy measures, specifically QE measures, increase the liquidity of the banking system, leading to a reduction in the liquidity price premium and an increase in government bond yields. However, this effect persists only if central banks purchase assets (Krishnamurthy and Vissing-Jorgensen, 2011). Under the QE asset purchases push up asset prices by lowering expectations about the future short-term interest rate and reducing the term premium. Higher asset prices increase the net wealth of asset holdings and reduce the cost of borrowing, boosting nominal spending in the private sector, helping to achieve a higher inflation rate, stimulate economic growth, and reduce the unemployment rate. The asset price channel may have an impact through the bank lending and confidence channels: (1) in the bank lending channel, the improvement of liquidity persuades banks to finance more new loans (however, there are restrictions due to the weak financial system); (2) the confidence channel may encourage investment and spending directly or further boost asset prices by reducing the risk premium. Hausken and Ncube (2013) analyzed the channels through which QE may support investment and spending. 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. However, during the latest financial crisis, risk aversion by banks increased, leading to the failure of the mechanism and shrinking the credit available to the private sector (Olmo and Sanso-Navarro, 2014). As mentioned above, the crisis led to a strong economic contraction worldwide and for this reason Central Banks announced unconventional monetary policies in order to stimulate the economy (Joyce *et al.*, 2012). Olmo and Sanso-Navarro (2014) argue that the goal of unconventional monetary policies is also to restore the bank lending channel and, after that, to reestablish the other transmission mechanisms. They developed a bank-based model to connect the money stock, interest rates, and real income and highlight the importance of competition in the banking sector.

Peersman (2011) analyzed, among other monetary policy measures, changes in credit supply due to monetary policy measures not related to the interest rate, using a Structural VAR (SVAR) model of the Euro Area with monthly data (1999:01-2009:12). He found a similar effect of these type of measures on the economy, than those caused by conventional measures, on GDP and on inflation. However, the transmission mechanisms of conventional and unconventional monetary policy measures seem to be different. Specifically, with unconventional measures, the effects on GDP and inflation take space at a latter 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 decreases; if it is caused by an unconventional measure that increases the balance sheet, the credit multiplier decreases.

As one can see, theory and former empirical evidence in other countries seem to find an important role for these transmission channels under the unconventional monetary policy framework. Therefore, it is relevant to analyze the most important variables related to these transmission channels for explaining credit at the Eurozone.

3 Empirical Approach

In this section we describe the data and the econometric methodology that we use in our estimations.

3.1 Data

We analyze the impact of the ECB's unconventional monetary policy on bank credit in the 19 Eurozone (EZ) countries.[3] The relevance of this choice is justified by the small empirical evidence on the impact of the unconventional monetary policy on credit for several different economic agents of the EZ member countries, namely households and the government, when compared with others economies where unconventional monetary policy programs were also implemented, such as Japan, the USA, and the United Kingdom. A panel data model is estimated using monthly data, covering the period between January 2008 and May 2016 (101 time observations across 19 cross-sections). With this sample period it is possible to study the impacts of unconventional monetary policies on credit since the time they started, although in the EZ they were not formally designated as unconventional monetary policies until September 2014.

Dependent Variables We model each of several variables related to credit, namely loans of Monetary Financial Institutions (MFIs) to Eurozone residents, and their source is the Thomson Reuters DataStream database. These include:

- Total loans of MFIs to EZ residents, both private and public (**TOT**);
- Loans of MFIs to EZ general governments (**GOV**), a subset of TOT;
- Loans of MFIs to households consumer credit and for house purchase (**HOUSE),** another subset of TOT;
- Loans of MFIs to households consumer credit **(HCC**);
- Loans of MFIs to households for house purchase (**HIH**);

Table 2 presents the credit values for each country of the EZ averaged over time. As expected, the larger the economy is, the more credit (total value) is conceded. Additionally, loans of MFIs to governments have the highest percentage in Italy (more than 10% of the total) and to consumers in Portugal, Slovakia, Finland, and Greece (almost 40% of the total). Of these four countries, it is Portugal that has the largest percentage of loans for house purchase (about 90% of the loans of MFIs to households). See Table A1 in the Appendix for further descriptive statistics.

[3] The 19 Eurozone economies are: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain.

Table 2 - Arithmetic Mean for Credit Variables by Country

Country	TOT	GOV	HCC	HIH	HOUSE
Austria	581525	28120	23403	82035	105438
Belgium	545485	25681	8753	96942	105695
Cyprus	71432	1045	3384	11070	14454
Estonia	16727	427	663	6003	6666
Finland	241019	8918	12859	80272	93131
France	4208911	293635	152713	796231	948944
Germany	4602594	377981	177845	995206	1173051
Greece	270676	9696	29521	71371	100892
Ireland	494117	22672	17331	94726	112057
Italy	2451557	257385	60490	333906	394396
Latvia	18724	114	792	5874	6666
Lithuania	18939	795	852	5915	6767
Luxembourg	440803	4313	1944	20438	22282
Malta	14055	140	371	2938	3309
Netherlands	1305919	52973	25036	384768	409804
Portugal	306501	8626	13958	108078	122036
Slovakia	40205	942	3114	12759	15873
Slovenia	35264	1285	2557	4708	7265
Spain	2074302	83735	76034	629434	705468

Note: values in Euro (millions). Authors' own calculations.

We conducted several standard panel unit root tests and found evidence of nonstationarity for all of these five variables, TOT, GOV, HOUSE, HCC, and HIH.[4] This nonstationarity is visible in the cross-sections averages over time, as shown in Figures A1 to A5 in the Appendix. Due to the nonstationarity of the series, we model the credit's percentage changes through first differences of logs. As a consequence, the model for HOUSE is not the same as the sum of models HCC and HIH since the log-difference of the sum is not the same as the sum of the log-differences. In sum, we are able to specify a model for TOT, then find differences between GOV and HOUSE, and finally, between HCC and HIH.

Independent Variables Structural factors that affect the banking system are linked with the determinants of credit supply and demand. According to the literature, the determinants of credit are largely derived from the variables related with the demand for credit, due to the strain in measuring supply variables (see Calza *et al.*, 2003 and ECB, 2007). In this work we use a comprehensive list of independent variables, based on the significant results of previous literature. These are defined below starting with two that were built in order to capture the effect of the unconventional monetary policies on credit (UNCONV and PSPP), which is the main focus of the paper, then we present several variables related with monetary policy, and ending with other covariate controls.

- **Unconventional Monetary Policy Initiatives (UNCONV)** – This is a dummy variable that captures the effect of unconventional monetary policy, which includes announcements regarding QE-related events, on the dependent (credit) variables and is the same for all countries. In order to perform an events study, we made a list with the ECB's unconventional monetary policy

[4] We computed common unit root tests (Levin, Lin, and Chu, 2002, Breitung, 2000, and Hadri, 2000) and individual unit root tests (Im, Pesaran, and Shin, 2003, and Fisher-ADF and Fisher-PP tests of Maddala and Wu, 1999, and Choi, 2001). The results are not presented here due to space considerations, but are available upon request.

announcement dates (see Table A2 in the Appendix), thereby updating the databases in Rogers *et al.* (2014) and Haistma *et al.* (2016). For our sample period, the first announcement by the ECB concerning unconventional monetary policies (UMP) was on the 28th of March 2008. This variable is defined as =1 if a UMP was announced in that month, and =0 otherwise. Announcements correspond to 20% of the sample period. Contrary to Rogers *et al.* (2014) and Haistma *et al.* (2016) we do not examine the daily effects of unconventional monetary policies on bond yields, stock markets and, exchange rates. We use monthly data because credit, more than the referred variables, depends on macroeconomic variables, in particular on GDP and inflation, for which the lowest data frequency is monthly.

- **Quantitative Easing (PSPP)** – This variable is the monthly net purchases under the Public Sector Purchase Program (PSPP), by country. Given its nature, we consider PSPP only for modelling GOV. Data are available since March 2015, when the program started, until May 2016. However, there are no data for Greece or Cyprus. The explanation for the absence of data for Greece is that the ECB cannot buy Greek sovereign bonds as part of its QE program. The Greek rating was too low and the Governing Council decided that countries that have bond yields lower than the deposit rate are excluded from the purchases. Concerning Cyprus, the reason is that it became eligible for the EAPP of the ECB only on October 2015. The negative net purchase in Cyprus in March 2016 is the result of transactions conducted to ensure continued compliance within the limit framework, reflecting buyback operations by the Cypriot Public Debt Management Office. The source for monthly net purchases was the ECB and according to the panel unit root tests, PSPP is not stationary. The countries' time averages are shown in Table 3.

Table 3 - Arithmetic Mean of PSPP by Country

Country	**PSPP**	**Country**	**PSPP**	**Country**	**PSPP**
Austria	1393	Belgium	1755	Cyprus	67
Estonia	7	Finland	892	France	10127
Germany	12759	Greece	n.a.	Ireland	811
Italy	8749	Latvia	62	Lithuania	111
Luxembourg	106	Malta	37	Netherlands	2839
Portugal	1180	Slovakia	456	Slovenia	232
Spain	6273				

Note: values in Euro (millions). Authors' own calculations.

- **Conventional Monetary Policy (CONV)** – This dummy variable was also built using the events study approach, taking into account the moments when there were changes in conventional monetary policy (CMP) at the time of regular Governing Council meeting (see Table A3 in the Appendix). In Table A2 in the Appendix, the last column also shows whether conventional monetary policy measures were announced on the same day as UMP measures, i.e., whether there were changes in the short-term policy interest rate on the same day. This variable is defined as =1 if a CMP was changed in that month, and =0 otherwise, and corresponds to 20% of the sample period. This dummy variable tries to capture the effect of CMP changes on bank credit in the Euro Area.

- **Zero Lower Bound (ZLB)** – This dummy variable intends to capture the effect of the period since the ZLB started (February 2012 – May 2016). This variable is defined as =1 if it is the ZLB period, and =0 otherwise, and corresponds to 50% of the sample period. This distinction between the ZLB period and the previous period was important to be made, since UMP measures became

even more pressing after the traditional monetary policy instrument, the reference interest rate, reached the ZLB, becoming ineffective.

- **Target for Inflation (INFLT2)** – This dummy variable defines the period when the ECB was concerned in controlling for the inflation rate (above the target of 2%). This variable is defined as =1 if between January 2008 and December 2012, and =0 otherwise, and corresponds to 50% of the sample period. This is a period where the ECB was also concerned with its primary goal, achieving price stability, besides being worried with the effects of the financial and the sovereign crisis.

Interest rates appear in the literature (Calza et al., 2003, Égert et al., 2006, ECB, 2007) as having a negative (significant) relationship with credit. With an increase in the interest rate, the cost of credit increases and hence the willingness to demand more credit decreases.

- **EURIBOR, Euro Interbank Offer Rates** – The EURIBOR is based on average interest rates established by a group of around 50 European banks that lend and borrow from each other. We have data for EURIBOR 3 months (**EUR03M**) and 6 months (**EUR06M**). We obtained the data from Bloomberg. Both variables are found to be stationary.

- **Interbank Offered Rate (INTRATE)** – The interbank rate is the rate of interest charged on short-term loans made between banks, which can borrow or lend money in the interbank market in order to control for liquidity. There is a broad range of interbank rates (e.g., LIBOR (London), LISBOR (Lisbon), and VIBOR (Vienna)). These rates are set taking into account the average rates on loans made within that interbank market. Thomson Reuters DataStream database was the source for all these rates. The Interbank Offered Rate is a stationary variable, according to the appropriate tests.

The other covariates are listed below.

- **Industrial Production Index (IPI)** – In the literature about credit, GDP is one of the variables that influences (positively) credit, since when the economy is booming, economic agents tend to demand more credit (Calza et al., 2003, Égert et al., 2006, ECB, 2007). Since we are using monthly data, we use the IPI as a proxy for GDP. IPI measures output in manufacturing, mining and electric, and gas utilities, taking values between 0 and 100. The source of these data was the Thomson Reuters DataStream database. This variable showed evidence of seasonality in all its cross-sections (countries), so in order to remove this component we used the X-12-ARIMA procedure, with a multiplicative decomposition. The IPI is considered to be stationary according to the panel unit root tests.

- **Inflation Rate (INFL)** – High inflation is usually associated with high interest rates (to try to decrease the high inflation), hence, we expect that the relationship between the inflation rate and bank credit to be negative (Calza et al., 2003, Égert et al., 2006, ECB, 2007). The annual inflation rate, as a percentage, is measured by the Harmonized Index of Consumer Prices (HICP): the change of the HICP between a month and the same month of the previous year. The source for this variable was the Thomson Reuters DataStream database. The panel unit root tests provide contradictory results. For the Levin *et al.* (2002) and Im *et al.* (2003) tests, the variable is stationary, while for the ADF-Fisher and PP-Fisher tests is non-stationary. Since INFL is the percentage annual inflation rate, we considered it to be stationary.

- **Risk-Free Rate (GOV10Y)** – To represent the risk-free rate we chose the 10-year Government Bond Yield, for each country in the analysis. Usually a government bond is issued by a national government and is denominated in the country's currency. The source for this variable was the Eurostat. GOV10Y is non-stationary according to panel unit root tests. When the risk-free rate increases usually credit can increase, since financial and market conditions are improving.

We have also looked at the issue of multicollinearity between covariates. The only case of correlations near one is when considering EUR03M and EUR06M. Thus, we never take both simultaneously in the models.

3.2 Methodology

In order to analyze the relationship between the amount of bank credit and the announcements of unconventional monetary policy measures, after controlling for several other important determinants, we use an events study approach by creating two dummy variables that capture the timings and changes of unconventional and conventional monetary policies. We estimate our models through panel data regression methods, since we observe 19 Eurozone economies and cover the period between January 2008 and May 2016. Our dataset can be regarded as a macro-panel because the number of time periods (101) clearly dominates over the number of countries (19).

The five different types of credit previously defined - TOT, GOV, HOUSE, HCC, and HIH - are considered as the dependent variable y_{it}, interchangeably. To determine the effect of unconventional monetary policy measures on credit we write our general model as follows:

$$y_{it} = \beta_0 + X_t\beta_1 + Z_{it}\beta_2 + UNCONV_t\beta_3 + PSPP_{it}\beta_4 + CONV_t\beta_5 + ZLB_t\beta_6 + INFLT2_t\beta_7 + u_{it}, \quad (1)$$

for cross-sections $i = 1, \ldots, N$ and periods $t = 1, \ldots, T$. The $\beta's$ are the model's coefficients, X_t is a K_X - dimensional vector representing the "external" time-varying explanatory variable, i.e., equal for all countries and exogenous (internationally determined), namely EUR03M or EUR06M, and Z_{it} is $K_Z \times 1$ representing the "internal" explanatory variables, i.e., determined at each country's level, INFL, IPI, GOV10Y, and INTRATE. The other covariates (UNCONV, PSPP, CONV, ZLB, and INFLT2) were defined above. For the case of GOV, either β_3 or β_4 is set equal to zero and for TOT, HOUSE, HCC, and HIH, $\beta_4 = 0$. Finally, u_{it} is the error term and includes all unobserved components that also affect y_{it}.[5]

Following the standard approach in panel data regression models, we also test for the existence of country-specific effects at u_{it} and, in the event of its presence, we further test for the random effects against fixed effects hypotheses using the Hausman (1978) test statistic. It may be the case that under fixed effects, one or more covariates in the estimated equations are correlated with u_{it} through the individual country effect. For details about modeling, estimation, and inference in panel data models, see, for example, the textbooks Cameron and Trivedi (2005), Wooldridge (2010), or Baltagi (2013).[6]

4 Results

In the next subsections we analyze the results drawn from our macro-panel regression models for credit conceded to different entities (and purposes) and total, TOT, GOV, HOUSE, HCC, and HIH. In terms

[5] In the estimations, we also considered interactions of the announcements dummy variables with other covariates, lags and/or nonlinearities in some particular regressors, and a deterministic time trend.

[6] In the case of panels where N is small and T is large, the cross correlations can also be modelled using the SURE framework. We estimated SURE models but barely found coefficients that were statistically significant.

of model specification, we tested for the existence of individual effects and found evidence of no effects for the case of GOV and of fixed-type effects for the remaining models. The *p-values* of the tests are in Table 4.

Table 4 - Tests for Individual Effects (p-values)

Dependent Variable	**Redundant Effects**	**Hausman Test**
TOT	0.0001	0.0026
GOV (with PSPP)	0.9732	n.a.
GOV (with UNCONV)	0.9672	n.a.
HOUSE	0.0000	0.0012
HCC	0.0000	0.0004
HIH	0.0000	0.0093

We kept in our models only those regressors that were found to be statistically significant and conclude that all important determinants of bank credit, such as the IPI (a proxy for GDP), interest rates, and the inflation rate have estimated coefficients with the expected signs. The results are in Table 5[7]. Below we discuss the results in detail.

Table 5 - Results for Bank Credit

Variable	**TOT**	**GOV**	**GOV**	**HOUSE**	**HCC**	**HIH**
UNCONV(-1)	0.004*** (0.001)				0.003** (0.001)	
UNCONV(-3)			0.012* (0.007)	0.002*** (0.001)		0.001* (0.001)
D(LOG(PSPP))		0.008*** (0.003)				
LOG(IPI)	0.037*** (0.006)		0.067** (0.029)	0.012*** (0.003)	0.011* (0.006)	0.013*** (0.003)
LOG(IPI(-1))		0.047*** (0.010)				
EUR06M(-3)		−0.138** (0.062)				
ZLB*EUR06M	−0.006*** (0.002)			−0.003*** (0.001)	−0.005** (0.002)	−0.003*** 0.001
ZLB*INTRATE			−0.025** (0.011)			
CONV(-3)*D(GOV10Y)	0.010*** (0.002)					
CONV(-2)*INFL			0.005** (0.002)			
INFLT2*INFL				0.0004*** (0.0001)	0.001*** (0.0003)	0.0004*** (0.0001)
Intercept	−0.169*** (0.029)	−0.210*** (0.049)	−0.306** (0.135)	−0.055*** (0.014)	−0.055** (0.027)	−0.058*** (0.014)

Note: All dependent variables are in growth rates, i.e., log differences D(LOG(.)); (-l), l=1,2,3 means "l" periods lagged; and *,**,*** stands for statistically significant at 10%, 5%, 1% levels, respectively.

4.1 Unconventional Monetary Policy

The first three lines of Table 5 show that the implementation of unconventional monetary policies has affected the amount of loans (credit) positively. Based upon the ECB's unconventional monetary

[7] We also considered the first-differences estimator as an alternative to the fixed-effects estimator but the results do not change significantly. The results are available upon request.

policy announcements (UNCONV), the greatest increase occurred to general governments (GOV) in the amount of about 1.2% in a month, *ceteris paribus*.[8] This impact takes effect only three months after the announcement. Governments' decisions usually take more time to be implemented, since they have to pass for several bureaucratic processes. Moreover, one month after the implementation of measures of unconventional monetary policy, there was an increase of 0.4% and 0.3% in total credit (TOT) and in credit to households' consumer credit (HCC), respectively. For the other credit variables, the unconventional monetary policy measures have a smaller impact (with a delay of three months), but still positive, in credit to households for house purchase (HIH) and total households (HOUSE) of 0.1% and 0.2%, respectively. Credit to households for house purchase (HIH) is a type credit that takes time to implement, since banks have sometimes a lengthy process to evaluate the financial conditions of the borrower, before they render a decision to loan money, hence the three month delay. Additionally, the impact of HOUSE is much more significant than the HCC, since it corresponds to the bigger slice of HOUSE credit, so the three month delay on HOUSE is justified by the weight of HIH in HOUSE.

As an alternative to the dummy variable UNCONV, we considered the PSPP variable, in the GOV bank credit estimation, since this program has a direct impact on loans to governments – the biggest percentage of monthly asset purchases by the Eurosystem is allocated to the PSPP. We conclude that for a 1% increase of monthly net purchases (PSPP) there is a small positive impact on loans to Eurozone governments of 0.008%.

In sum, unconventional monetary policies were responsible for an increase in credit, much more to general governments (1.2%) than to household consumers (0.2%). For the latter, credit to consumption increased more and took less time to be effective when compared to house purchases.

4.2 Other Determinants

In order to capture the effect of unconventional monetary policies on bank credit, we must control for several different key variables. The bottom lines of Table 5 present the marginal impacts of the industrial production index (IPI), the 6-months EURIBOR (EUR06M), the risk-free rate (GOV10Y), the interbank offered rate (INTRATE), the inflation rate (INFL), the conventional monetary policy announcements (CONV), the zero lower bound period (ZLB), and the 2%-target for inflation period (INFLT2) on TOT, GOV, HOUSE, HCC, and HIH.

Results for the IPI are in accordance with the literature, i.e., economic growth leads to economic agents demanding more credit, and it occurs in the same month (contemporaneous). The only exception is GOV using PSPP for the unconventional monetary policy, in which there is a one-month delay. In our models the estimated coefficients range from 1.1% (HCC) to 6.7% (GOV), the impact on GOV is greater than on HOUSE, and with HCC and HIH with similar effects.

For the case of TOT, HOUSE, HCC, and HIH, the INTRATE was not found to be statistically significant, but the 6-months EURIBOR had a (contemporaneous) negative impact (as expected) on credit but only during the zero lower bound period (February 2012 to May 2016). After the financial crisis, the lending conditions that banks offer were much worse than in the period before the crisis, and bank spreads increased significantly. In particular, during those six years, a 1% increase of EURIBOR penalized more loans to households consumer credit (-0.5%) than for house purchase (-0.3%). On the contrary, bank credit to GOV depends negatively on INTRATE (during ZLB) when UNCONV is the explanatory variable for the unconventional monetary policy and on EURIBOR with a lag of 3 months (-13.8%) when PSPP takes the place of UNCONV.

Each of the remaining determinants to the concession of bank credit influence loans of only a certain kind. First, three months after an announcement of conventional monetary policy, a 1% increase of the

[8] The *ceteris paribus* assumption is implicit in the interpretation of the model's estimated coefficients.

risk-free rate (GOV10Y) implied a change in the total credit (TOT) to Eurozone residents by the same amount.

The positive sign of the relationship between inflation and bank credit variables, contrary to what previous referred literature uncovered, may be reflecting the fact that economic agents are waiting for an interest rate rise due to inflation rate rises, leading agents to acquire more credit at the current moment. For the case of loans to Eurozone governments (using UNCONV and not PSPP), inflation's impact occurs only during the periods when conventional monetary policy changed. Two months after the ECB changes the conventional monetary policy, the increase of inflation leads to a small increase in loans (GOV). Finally, in the case of loans to households (HCC, HIH, and HOUSE), the inflation level was important only during the INFLT2 period (when the ECB was concerned in controlling the inflation rate). In particular, the uppermost impact is in HCC (consumer credit), with 0.1%, and for HIH (house purchase). Despite the fact that INFL interact with different time dummies for the models GOV and HOUSE, we observe that the INFL's estimated coefficient is much larger for the case of GOV (0.005) than for HOUSE (0.0004).

4.3 Country Effects

Previously, we found strong evidence of fixed-type effects in the bank credit models TOT (total credit), HOUSE (loans to the households), HCC (consumer credit), and HIH (house purchase credit). The estimates of the country-specific fixed effects, measured in terms of credit growth rates, are of particular interest because they help to explain the amount of credit conceded in each economy due to its specific unobserved characteristics such as the credit market size and the dynamics and the competition across financial (supply-side) and non-financial (demand-side) institutions. Moreover, we are also interested in finding the differences between the conceded credit in crisis versus non-crisis economies in the Eurozone. Those countries that were hit hard by the financial and economic crisis include Cyprus, Greece, Ireland, Italy, Portugal, and Spain.

From the fixed-effects estimation procedure, we can obtain and rank the various individual estimated country effects. For each model, the five countries with the highest and lowest values and the crisis countries are listed in Table 6.

Table 6 - Estimated Country-specific Effects

TOT		**HOUSE**		**HCC**		**HIH**	
Highest		Highest		Highest		Highest	
Finland	0.0082	Slovakia	0.0084	Slovakia	0.0125	Slovakia	0.0074
Cyprus	0.0079	Malta	0.0049	Luxembourg	0.0072	Malta	0.0047
Malta	0.0052	Luxembourg	0.0045	Italy	0.0059	Cyprus	0.0046
Netherlands	0.0033	Cyprus	0.0034	Malta	0.0041	Slovenia	0.0044
Italy	0.0024	Italy	0.0026	Finland	0.0031	Luxembourg	0.0039
Lowest		Lowest		Lowest		Lowest	
Ireland	−0.0090	Latvia	−0.0079	Latvia	−0.0095	Latvia	−0.0081
Latvia	−0.0053	Ireland	−0.0069	Lithuania	−0.0066	Ireland	−0.0074
Lithuania	−0.0040	Spain	−0.0031	Ireland	−0.0050	Estonia	−0.0032
Belgium	−0.0023	Estonia	−0.0029	Spain	−0.0042	Spain	−0.0032
Slovenia	−0.0018	Lithuania	−0.0025	Estonia	−0.0040	Portugal	−0.0022
Crisis Countries		Crisis Countries		Crisis Countries		Crisis Countries	
Cyprus	0.0079	Cyprus	0.0034	Italy	0.0059	Cyprus	0.0046
Italy	0.0024	Italy	0.0026	Cyprus	0.0012	Italy	0.0018
Greece	0.0020	Greece	−0.0013	Portugal	0.0001	Greece	−0.0013
Portugal	−0.0011	Portugal	−0.0017	Greece	0.0001	Portugal	−0.0022
Spain	−0.0013	Spain	−0.0031	Spain	−0.0042	Spain	−0.0032
Ireland	−0.0090	Ireland	−0.0069	Ireland	−0.0050	Ireland	−0.0074

For total credit (TOT), the maximum growth rate is for Finland (0.8% above country average) and the minimum is for Ireland (0.9% below average). That is, differences across countries' credit growth rates due to their intrinsic unobserved characteristics are of at most 1.7% which, for a monthly frequency, can be considered a significant quantity. With respect to loans to the households (total and *per* type of credit), the maximum value is for Slovakia and the minimum is for Latvia. Regardless of the type of credit to households, Slovakia, Malta, and Luxembourg are always among the top-5 and Latvia, Ireland, Estonia, and Spain in the bottom-5.

Interestingly enough, Ireland, Spain, and Portugal, three EZ nations that were considered weaker economically following the financial crisis, belong to the bottom-5 list of estimated individual effects explaining house purchase credits (HIH). For example, Ireland's country-specific characteristics are such that HIH monthly growth rates were 0.74% below the average country, after controlling for all covariates in the model. This is most likely related to its post-2008 banking crisis, in which a number of Irish financial institutions faced near collapse. In fact, not all of the six coutries that were hit by the financial and economic crisis shut down credit payments. Other than GOV, Cyprus and Italy had credit growth rates from 0.8% to 0.1% above country average. On the contrary, Spain and Ireland those were from 0.1% to 0.9% below average.

We also ran panel regressions for GOV, without fixed effects (see Table 5 above), adding to the list of covariates a time-invariant dummy that takes the value of 1 if a country is any of the six. We find no statistical differences for the GOV model with UNCONV, but there are significant differences between crisis versus non-crisis countries for GOV with PSPP. More specifically, the estimated PSPP elasticity of GOV credit equals 0.007 for non-crisis countries whereas for the crisis countries it amounts 0.199. That is, the net purchases under the PSPP elasticity was 28 times larger for crisis countries, revealing a higher dependency of these countries to this unconventional monetary policy measure.

5 Conclusion

This work analyzes the relationship between bank credit and the unconventional monetary policy measures implemented by the ECB, which affect Eurozone countries. We model the total amount of credit concession, the loans to Eurozone general governments, and also the credit to households, total and for consumer credit or house purchase credit. For that purpose, we use an events study approach, creating two dummy variables that reflect the timing and changes of unconventional and conventional monetary policy measures, which we use as the main determinants in our panel regression models. The database is a macro-panel of the 19 Eurozone countries over the period between January 2008 and May 2016.

Japan was the first country to implement the unconventional monetary policy, in 2001. Thereafter, and due to the financial crisis, this policy was implemented by the UK and the USA after 2008. The ECB responded to the financial crisis by implementing several programs to provide liquidity into the Eurozone economies. However, none of these measures were enough, and so the ECB announced the EAPP in September 2014 and the specific program for purchase of Eurozone sovereign bonds (PSPP) in January 2015. According to the literature, the large-scale asset purchases programs affect distinct financial and economic variables through the different transmission channels. However, little is known about the impact on the credit market of unconventional monetary policy measures, contrary to what happens, for example, in the case of the impact on bonds and/or financial markets.

Overall, it is possible to conclude that unconventional monetary policies have a positive impact on credit, despite the fact that it is not always immediate, taking place one or three months after its implementation. In particular, the impact is greater to general governments (1.2% per month) than to household consumers (0.2%) and, for the latter, credit to consumption increased more and took less time to be effective when compared to house purchases. Taking PSPP as a determinant in the model, we observe that an increase of 1% of the monthly amount of net purchases of sovereign bonds from Eurozone governments and securities from European supranational institutions and national agencies has a positive impact of 0.008% on the Eurozone governments' loans concession.

Our results also show that the Industrial Production Index always has a positive impact on credit concession; and the two different interest rates - the EURIBOR and the Interbank Offered Rate - have a negative impact, like it was found in previous literature. Some other variables interact with period dummies. The risk-free rate (10-year Government Bond Yield) impacts total credit in the amount of 1.019% when there is a conventional monetary policy. The inflation rate acts during the period when the ECB was concerned in controlling for it. Economic agents expect that interest rates rise due to an increase of inflation rates, thus leading them to acquire more credit at the present moment.

Finally, we estimate the unobserved country-specific fixed effects measured in terms of credit growth rates. Regardless of the type of credit to households, Slovakia, Malta, and Luxembourg are always among the top-5 of credit growth rates and Latvia, Ireland, Estonia, and Spain are in the bottom-5. We estimate monthly growth rates of loans to households in Ireland that are about 0.74% below the average country, which we believe to be closely related to its post-2008 banking crisis. Moreover, the estimated net purchases 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, like Cyprus, Italy, Greece, Portugal, Spain, and Italy.

Although this research has reached its aims, there are some unavoidable limitations. An important one is related to the fact that the Asset Purchase Program is relatively recent, leading to a lack of available data. We used in this paper an events study with panel data to minimize this problem. Nevertheless, extending the time period of the analysis should be a goal for future research.

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6 Appendix

Table A1 - Descriptive Statistics for Credit Variables by Country

Country	TOT		GOV		HCC		HIH		HOUSE	
	median	st.dev.	median	st.dev.	median	st.dev.	median	st.dev.	median	st.dev.
Austria	590416	34013	28264	1365	23462	2017	84176	8552	107713	6611
Belgium	533731	57658	24669	4554	8745	484	91053	16267	99823	16110
Cyprus	71246	8768	1003	138	3352	519	11656	1604	14642	1386
Estonia	16399	1452	439	78	621	91	5980	154	6634	210
Finland	261566	44968	8581	2643	12909	654	82004	8981	94910	9604
France	4320604	221448	204582	14061	153130	3551	829443	76112	985161	74292
Germany	4577120	136912	372823	19966	176843	5209	979029	38734	1164877	38040
Greece	266268	35214	8950	2405	28919	3147	70327	5015	98258	7694
Ireland	495025	131341	12428	24177	16179	5197	84525	16610	98099	21361
Italy	2453123	52294	261234	13356	59201	6059	359584	42211	419018	45747
Latvia	18168	2822	93	59	851	240	5939	924	6790	1160
Lithuania	18753	1117	888	322	689	220	5969	199	6694	267
Luxembourg	432048	43176	4314	424	1950	323	20254	3602	22149	3920
Malta	14796	1871	131	30	378	27	2936	545	3311	568
Netherlands	1284117	75630	53470	6615	24987	2635	387761	15470	412188	13929
Portugal	318941	30836	7793	2870	14468	1486	107804	4904	121784	5972
Slovakia	39452	3293	958	122	3237	1017	12420	3629	15658	4621
Slovenia	36816	4060	1336	457	2683	315	5188	843	7533	647
Spain	2217633	241507	88559	21681	68664	16776	646402	34953	722903	47988

Note: values in Euro (millions)

Table A1 - Descriptive Statistics for Credit Variables by Country (cont.)

Country	TOT		GOV		HCC		HIH		HOUSE	
	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
Austria	636927	527704	30865	25547	26735	19960	96934	66568	116894	93115
Belgium	733738	469940	36911	18657	9989	7957	132828	74609	141017	84076
Cyprus	93840	51577	1260	839	4770	2774	12772	7093	16113	10196
Estonia	21232	14657	540	211	855	577	6357	5665	7074	6404
Finland	337739	163320	13612	5412	14110	11274	92028	62574	106093	73848
France	4488729	3706623	226092	172869	159461	144669	889242	647830	1042501	803324
Germany	4937298	4368244	453093	353880	187386	167300	1087045	953998	1264074	1128405
Greece	355316	220902	18209	5893	36277	24847	80563	63952	116772	92078
Ireland	687704	303378	107022	1240	29206	11430	127849	76511	149683	87941
Italy	2676462	2322977	276758	225274	81574	51662	367815	256259	443241	310595
Latvia	23562	13906	241	29	1127	437	7219	4472	8346	4930
Lithuania	21665	16732	1207	240	1304	632	6202	4944	7320	6024
Luxembourg	556937	378782	5275	3336	2572	1377	26661	14800	29233	16177
Malta	16523	9436	209	108	407	286	3959	2032	4363	2318
Netherlands	1467303	1187498	67505	40281	29238	19781	426211	340513	445992	369493
Portugal	342205	249656	19298	5085	15846	11794	115430	98078	130880	110244
Slovakia	47888	35258	1152	679	4823	1386	19901	6884	24725	8270
Slovenia	40048	27121	1928	476	2929	2017	5536	2739	7956	5507
Spain	2338770	1666902	123690	41543	106498	56005	665222	551589	762225	611966

Note: values in Euro (millions). Authors' own calculations.

Table A2 - Announcements of UMP Decisions

Date	Announcement	After Governing Council
22 August 2007	Supplementary LTRO	No
23 August 2007	Allotment LTRO	No
28 March 2008	Six-month LTRO	No
07 May 2009	One-year LTRO and CBPP	Yes
04 June 2009	Details CBPP	Yes
03 December 2009	Amendments to LTRO	Yes
04 March 2010	Amendments to LTRO	Yes
10 May 2010	Securities Markets Program (SMP)	No
03 March 2011	Fixed Rate Full Allotment Refinancing Operations	Yes
04 August 2011	SMP	Yes
06 Ocotber 2011	Second CBPP	Yes
08 December 2011	New LTRO; Reduced Reserve Ratio; Increased Collateral Availability	Yes
21 December 2011	LTRO Results	No
09 February 2012	National CB Credit Claims Approvals	Yes
28 February 2012	Second LTRO Results	No
26 July 2012	London "Whatever it takes" Speech	No
02 August 2012	Outright Monetary Transactions (OMT)	Yes
06 September 2012	Details OMT	Yes
22 March 2013	Amendments to Collateral Rules	No (15.00)
05 June 2014	TLTRO; preparatory work on ABSP	Yes
03 July 2014	Details TLTRO	Yes
4 September 2014	Third CBPP and the ABSPP	Yes
18 September 2014	M. Draghi makes a speech to the European Parliament Economic and Monetary Affairs Committee The ECB alloted €82.6 billion to 255 counterparties in the first of eight LTRO	No
22 January 2015	EAPP; Interest Rate Changes for LTRO ECB announces a modification to the interest rate applicable to future LTRO	Yes
09 March 2015	The beginning of PSPP; QE	No
23 September 2015	Eurosystem adjusts purchase process in ABSPP	No
09 November 2015	Eurosystem increase the PSPP issue share limit, making the higher issue limit effective	No
03 December 2015	Eurosystem decides to extend the APP until March 2017	Yes
10 March 2016	Eurosystem decides to increase monthly purchases from €60 billion to €80 billion, starting in April	Yes
10 March 2016	ECB announces a new series of four LTRO	Yes
10 March 2016	ECB adds Corporate Sector Purchase Program (CSPP) to the APP and announces changes to APP	Yes
21 April 2016	Started the expand monthly purchases under the APP to €80 billion	Yes
21 April 2016	ECB announces details of the CSPP	Yes
03 May 2016	ECB publishes legal acts relating to the second series of TLTRO	No

Source: Rogers *et al.* (2014), Haistma *et al.* (2016), and ECB website. The table shows announcements of unconventional monetary policy decisions. The third column shows whether the decisions were taken during a regular Governing Council meeting.

Table A3 - Dates of Changes in Conventional Monetary Policy

Dates
03 July 2008
06 November 2008
04 December 2008
15 January 2009
05 March 2009
02 April 2009
07 May 2009
07 April 2011
07 July 2011
03 November 2011
08 December 2011
05 July 2012
02 May 2013
07 November 2013
08 May 2014
04 September 2014
03 December 2015
10 March 2016

Source: ECB