THE EFFECTS OF THE ECB'S UNCONVENTIONAL MONETARY POLICIES FROM 2011 TO 2018 ON BANKING ASSETS

2024

BANCO DE ESPAÑA
Eurosistema

Documentos de Trabajo
N.º 2416

Gerald P. Dwyer, Biljana Gilevska, María J. Nieto
and Margarita Samartín

THE EFFECTS OF THE ECB'S UNCONVENTIONAL MONETARY POLICIES FROM 2011 TO 2018 ON BANKING ASSETS

THE EFFECTS OF THE ECB'S UNCONVENTIONAL MONETARY POLICIES FROM 2011 TO 2018 ON BANKING ASSETS [*]

Gerald P. Dwyer [**]

CLEMSON UNIVERSITY

Biljana Gilevska [***]

CUNEF

María J. Nieto [****]

BANCO DE ESPAÑA

Margarita Samartín [*****]

UNIVERSIDAD CARLOS III

(*) We would like to thank to Mikel Tapia, David Martínez-Miera and Juan Ignacio Peña Sánchez de Rivera for their valuable comments and feedback. Great comments and advice have been received from Inessa Love, Renee Oyotode, Jean Adebile, Jacques Lilti, Patrick Roger, Olesya V. Grishchenko, Simón Sosvilla-Rivero, Marta Gómez-Puig, Ana Lozano Vivas, Sandro Brusco, Francisco González Rodríguez, Augusto Hasman and Iftekhar Hasan and we are very grateful for that. We highly appreciate comments from the participants of the American Southwestern Finance Association conference, French Finance Association conference, International Association for Applied Econometrics (IAAE) conference, the European Financial Management conference, Financial Management Association Annual Meeting conference and World Finance and Banking Symposium. We are also to Matías Cabrera for his valuable advice and instructions on banking data.

This research is funded by the Spanish Ministry of Science and Innovation; Project PID2020-114108GB-100. We also acknowledge the support of the Madrid Government (Comunidad de Madrid-Spain) under the Multiannual Agreement with UC3M in the line of Excellence of University Professors (EPUC3M12), and in the context of the V PRICIT (Regional Programme of Research and Technological Innovation). We express great appreciation for the IAAE travel grant awarded to present at the 2022 IAAE conference.

(**) jerry@jerrydwyer.com
(***) biljana.gilevska@cunef.edu
(****) maria.nieto@bde.es
(*****) samartin@emp.uc3m.es

Documentos de Trabajo. N.º 2416

May 2024

https://doi.org/10.53479/36595

ISSN: 1579-8666 (on line)

Abstract

We examine the effects of all three major European Central Bank (ECB) unconventional monetary policies since 2011 for euro area banks' holdings of loans, government securities and cash deposited in central banks. The three ECB policies are longer-term refinancing operations (LTROs), the asset purchase programmes and the ECB's interest rate on its deposit facility. We also compare the responses of non-crisis and crisis countries to these policies. Our evidence indicates that the ECB's unconventional monetary policy measures increased bank lending across the euro area countries. The second round of LTROs, also known as targeted LTROs (TLTROs), were conditional on banks increasing their lending. This change had a substantially larger effect on total lending by banks. The computed effects of the LTROs and TLTROs, based on average size, indicate that in non-crisis countries LTROs increased bank loans by 7.6% of assets and TLTROs increased bank loans by 16.4% of assets, whereas in crisis countries the increases were 8.4% and 14.6% for LTROs and TLTROs, respectively. We find that both LTROs and TLTROs were associated with decreases in government securities held by banks in non-crisis countries, while the LTROs were associated with increases in government securities held by banks in crisis countries.

Keywords: euro area, unconventional monetary policy, banks, financial crisis.

JEL classification: E44, E52, G01, G21.

Resumen

En este trabajo estudiamos los efectos de las tres principales políticas monetarias no convencionales del Banco Central Europeo (BCE) en los bancos de la zona del euro desde 2011. Más concretamente, nos centramos en el impacto sobre los préstamos, cartera de soberanos y depósitos en bancos centrales. Las tres políticas del BCE objeto de estudio son las operaciones de financiación a largo plazo (LTRO, por sus siglas en inglés), los programas de compra de activos y el tipo de interés del BCE en su facilidad de depósito. Asimismo, comparamos las respuestas de los países que no sufrieron la crisis soberana con las de los que sí la sufrieron. Concluimos que las medidas de política monetaria no convencionales del BCE aumentaron los préstamos a empresas en los países de la zona del euro. La segunda ronda de LTRO, también conocidas como LTRO dirigidas (TLTRO, por sus siglas en inglés), condicionó los nuevos préstamos. Este cambio tuvo un efecto sustancialmente mayor en el crédito bancario. Los efectos calculados de los tamaños promedio de las LTRO y las TLTRO indican que, en los países que no padecieron la crisis, las LTRO aumentaron los préstamos a empresas en un 7,6 % de los activos y las TLTRO aumentaron los préstamos en un 16,4 % de los activos. Estos incrementos fueron del 8,4 % y el 14,6 %, respectivamente, para las LTRO y las TLTRO en los países que soportaron la crisis. Tanto las LTRO como las TLTRO se asocian con reducciones de la cartera soberana en bancos domiciliados en países que no sufrieron la crisis, mientras que las LTRO se asocian con incrementos en la deuda soberana en poder de bancos en países que la sufrieron.

Palabras clave: área del euro, política monetaria no convencional, bancos, crisis financiera.

Códigos JEL: E44, E52, G01, G21.

1. Introduction

The Global Financial Crisis that started in 2008 transformed into sovereign debt crisis in Europe in 2010. In response to this severe economic downturn, the European Central Bank (ECB) implemented a diverse set of unconventional monetary policy measures that were effective from 2011 to 2018. These policies fit into three general categories: ECB lending operations known as long-term refinancing operations (LTROs), asset purchase programs (APPs), and the interest rate on deposits in the ECB's deposit facility. We distinguish between the effects of the first round of LTROs and targeted LTROs (TLTROs) that imposed conditionality on the availability of future low-interest rate funding for bank lending, also known as "eligible lending". The three ECB's unconventional monetary policies are different in their structure and objectives; however, they had been implemented simultaneously to complement each other in achieving the ultimate goal of the ECB: enhanced commercial lending. This paper provides a comparative analysis of how the distinct ECB's unconventional monetary policies caused assets portfolio rebalancing by banks with a central interest in bank credit.

Figure 1 summarizes the behavior of selected assets at banks in non-crisis and crisis countries in the euro area.[1] Loans over total assets fell in crisis countries and rose in non-crisis countries. Government securities followed the same trend in non-crisis and crisis countries, increasing up to 2015 and falling afterward. Cash and balances in central banks have an upward trend in both non-crisis and crisis countries. Furthermore, they exceeded holdings of government securities on banks' portfolios in non-crisis countries in 2019.[2]

Hence, there are differences between non-crisis and crisis countries. The increase in lending in crisis countries following 2014 may or may not be associated with new conditionality provisions in targeted long-term refinancing operations (TLTROs). The next question that arises is if in consequence, TLTROs played the key role in turning down the upward trend in holdings of government securities and instead turning around

[1] The crisis countries are countries downgraded below AA at the onset of the sovereign debt crisis: Cyprus, Greece, Ireland, Italy, Malta, Portugal and Spain. The remaining members of the euro area in this period – Austria, Belgium, Estonia, Finland, France, Germany, Luxembourg, the Netherlands, Slovakia and Slovenia – are the non-crisis countries.

[2] This might seem inconsistent with a negative deposit rate, but the magnitudes depend on relative interest rates. Additionally, cash and balances at central banks includes cash and balances of subsidiaries held at the Federal Reserve and these deposits count toward banks' Liquidity Coverage Ratios.

banks' incentives to investments in cash and balances in central banks. This paper attempts to shed light on these questions.

For this matter, we analyze the effects of the three ECB's unconventional monetary policies in a single analysis. The three of them had different objectives but jointly should have contributed to increased loan issuance in the euro area. The main objective of the asset purchase programs (APPs) was to increase price competitiveness in the market of illiquid assets and, consequently, to rebalance banks' asset portfolios from assets hard to be sold on the market to credit. The low interest rate environment (including the negative interest rate policy - NIRP) primarily aimed to rebalance banks' asset portfolios from liquid assets to credit. Finally, the lending programs (LTROs and TLTROs) represent the ECB's facilities that provided direct liquidity to banks in a form of loans. Their main objective was to ensure banks had enough liquidity to invest in loans once there were no incentives to hold substantial amounts of other classes of liquid or illiquid assets.

On the other hand, measuring the effects of all three major ECB's unconventional monetary policies in a single analysis is challenging for a number of reasons. One challenge appears from the fact that most of the time the different ECB's unconventional policies overlap. Another challenge, which is opposite to the first one, is that some are effective in different periods. This paper overcomes these challenges using panel vector autoregression analysis (PVAR). PVAR allows us to examine the effects over time, rather than only at a point in time, which represents another major difference between our paper and earlier papers. This feature further allows us to exploit the serial correlation of the data and to explain banks' investment choices partly by the banks' past choices while holding constant the standard factors affecting bank investment decisions. Therefore, PVAR allows us to combine the bank level variables with the country-specific and ECB policy variables. Furthermore, the PVAR methodology allows us to control for individual bank characteristics by introducing the fixed effects in the regression specification.

PVAR models have been increasingly used in applied research; however, prior studies consider either aggregated data at the macroeconomic level or bank level data in a single PVAR setting. Love and Turk Ariss (2014) manage to construct a PVAR system in which they combine both macroeconomic and bank-level variables for a single country analysis. We advance over the PVAR model of Love and Turk Ariss (2014) by combining both macroeconomic and bank-level variables in a multiple-country analysis.

We achieve this by including exogenous variables within the PVAR setting, a model that can be denoted PVARX for a PVAR with exogenous variables and that, to our knowledge is quite complex and has not been implemented in the literature yet.

Our data cover the period from 2008 through 2019. Along with the stimulative unconventional monetary policy operations over this period, liquidity provisioning through the required Liquidity Coverage Ratio gave banks an incentive to increase their holdings of liquid assets, which include balances at domestic and foreign central banks. Therefore, we include banks' cash and balances at central banks in the assets considered.

A large body of research finds that macroeconomic conditions and bank-specific factors explain banks' asset portfolios. We include the real gross domestic product (GDP), bank capital, and banks' holdings of deposits from other banks as control variables. As per the relation between bank lending and GDP growth, there is ample literature on the procyclicality of lending behavior (Berger and Udell, 2002; Huizinga and Laeven, 2019; Chen et al., 2022).Bank capital and banks' holdings of deposits from other banks are the main funding sources of banks according to the banking theory. We also include the country's level of credit default swaps to measure and control the country's sovereign-debt risk. Using the standard deviation of return on average assets (ROAA), Baziki et al. (2023) show that banks with headquarters in a country with high sovereign credit risk have riskier asset portfolios. One of the common findings in the literature on European sovereign debt crisis is that banks' incentives for investments between loans and government securities were substantially affected by this risk[3].

Several important findings follow on basis of our analysis. First, under this set of macroeconomic and bank-specific factors and the ECB's unconventional monetary policies, the ECB's lending schemes (LTROs and TLTROs) are associated with increased bank lending; however, our results suggest that the different ECB policy programs had different effects in non-crisis and crisis countries. The initial LTROs were associated with increases in banks' holdings of government securities in crisis countries. Conditional TLTROs were associated with decreases in banks' holdings of government securities in

[3] Among papers in the literature on European sovereign debt crisis see Acharya and Steffen (2015), Popov and Van Horen (2015), Drechsler et al. (2016), Altavilla et al. (2017), and Crosignani et al. (2020). Other evidence also suggests that country's sovereigns have a central role in explaining investments in sovereign debt by banks, particularly in times of stress. See Angeloni and Wolff (2012), Castro and Mencía (2014) and Lamas and Mencía (2020).

crisis countries. Both rounds of LTROs were associated with decreased holding of government securities in non-crisis countries. Nevertheless, changing the terms of LTROs into TLTROs lowered investments in government securities and increased banks' lending in both sets of countries. Hence, we find that TLTROs exerted homogeneous effects in non-crisis and crisis countries.

Our paper belongs to the literature that examines the effects of the ECB's unconventional monetary policies. More specifically, the paper contributes to this literature in several distinct ways. First, we measure the effects of all three ECB's unconventional monetary policies in a single regression specification, unlike the rest of the literature that studies ECB unconventional policy measures in isolation. These policies were implemented to complement each other, and their true effects are dependent on each other. In order to claim the value of implementing such unconventional monetary policies, we need to measure their effects simultaneously. In this matter, the results in this study represent more clear- cut results than the rest of the studies in this literature. Next, the comparative results on LTROs vs. TLTROs fill a gap in this literature. Abundant literature exists on the positive effects of lending of both LTROs and TLTROs but there is no paper that provides analysis which one is more effective and why. In this matter, this paper also provides more clear-cut results than the rest of the literature. In addition, the results on LTROs vs. TLTROs contribute significantly to the series of papers that provide evidence on the heterogeneous effects of the ECB's unconventional monetary policies on many bases (Acharya and Steffen, 2015; Drechsler et al., 2016; Altavilla et al.,2017; DeSantis and Surico, 2013; Garcia-de-Andoain et al., 2016). While majority of these papers claim the heterogeneous effects of the ECB's unconventional monetary policies, we are among the few papers to show a homogeneous effect of such policies. Our results show that the effects of the TLTROs are homogenous across non-crisis and crisis countries. This result is of high relevance for the literature on ECB's unconventional monetary policies because it suggests that the implementation choice of the program matters for the same goal to be achieved across different countries. Third, this paper adds to the literature a relatively novel empirical study that basis on a PVAR framework by including exogenous variables in the main regression specification.

Finally, the insights of this work are relevant to the current policy discussions on the local supply channel effects of unconventional monetary policies. Our results on TLTROs

indicate that the design and structure of the policy are critical in achieving the desired effects. Policymakers must impose explicitly the terms and conditions that are necessary to target the desired effects and outcomes when designing a policy. This context is also known as the "local supply channel" and appears in recent papers that examine the effects and outcomes of post-crisis unconventional monetary policies implemented in the U.S. and European Union: D' Amico and King (2013), Rodnyanski and Darmouni (2017), Di Maggio et al. (2020), Wright (2022), and Bernardini and Conti (2023).

This paper is divided into the following sections. Section two presents a brief review of the literature. Section three describes the ECB's unconventional monetary policy measures. Section four presents the data and the variables used in this paper and section five summarizes the PVAR empirical methodology and provides details on the estimation. Section six discusses the main empirical findings and the last section includes a summary of the paper and discusses some implications of the findings.

2. Review of the Literature

This paper is related to the literature on ECB's unconventional monetary policies that investigates the effects of the LTROs, TLTROs, asset purchase programs and interest rate on deposit facility on bank credit and asset portfolio allocations in general.

Abundant literature exists on the rational and actual effects of the first round of LTROs. A series of papers use loans by individual banks to individual firms to assess the effects of the first round of LTROs on bank lending. Garcia-Posada and Marchetti (2016), Andrade et al. (2019), and Carpinelli and Crosignani (2021) conclude that ECB's LTROs implemented in December 2011 and February 2012 had a positive effect on banks' supply of credit to firms in Spain, France, and Italy, respectively. On the other hand, a series of papers suggest that the ECB's non-traditional liquidity operations contributed to accumulation of sovereign debt on bank balance sheet portfolios. The empirical work of Acharya and Steffen (2015), Popov and Van Horen (2015), Drechsler et al. (2016), Altavilla et al. (2017), and Crosignani et al. (2020) suggests that European banks used ECB funding provided through LTROs to purchase government bonds instead to increase lending. They show that such behavior is exacerbated in the case of low capitalized banks and banks in countries in financial distress.

Other papers suggest that economic factors may play a central role in explaining investments in sovereign debt by banks, particularly in times of stress. Angeloni and

Wolff (2012) and Castro and Mencía (2014) study the link between sovereign yields and banks' sovereign debt holdings controlling for the macroeconomic situation in each country. Lamas and Mencía (2020) argue that Spanish banks increased their holdings of Spanish sovereign debt at the peak of the sovereign-debt crisis to hedge against the European Monetary Union breakup by matching their assets and liabilities by nation. Gennaioli et al. (2014, 2018) and Becker and Ivashina (2018) provide evidence that such increased bond holdings reduced private lending. Their main findings suggest that sovereign debt holdings negatively affect private capital formation.

Overall, the literature on the first round of LTROs (2011 – 2014) provides inconclusive evidence on the effects of LTROs on bank lending. Moreover, the European sovereign debt crisis literature shows that the large-scale purchases were made exactly when the 1st round of LTROs took place, from 2011 to 2014[4]. Under these circumstances, the ECB began the implementation of TLTROs in September 2014. Many papers provide evidence on TLTROs, examining the impact of TLTROs on bank lending rates and margins and the cost of credit or credit standards (Andreeva, 2018; Benetton and Fantino , 2021; Andreeva and García-Posada, 2021). In general, they find plausible effects of TLTROs. Perdichizzi et al. (2023) show that TLTROs did not generate beneficial effects in terms of economic development through the lending channel across provinces. They show that the average firm investment rate fell, and TLTROs were associated with worsened economic conditions for those firms performing well in the pre-TLTROs period. Distressed (zombie) borrowers saw their investment increase; however, their post-TLTRO performance did not improve.

Several papers provide evidence of the effects of TLTROs on banks' credit. Benetton and Fantino (2021) find that targeted longer-term central bank liquidity decreased rates and increased loan amounts, also avoiding some unintended consequences of untargeted measures, such as carry-trade strategies and risk shifting. Esposito et al. (2020) examine the second stream of TLTROs, TLTRO-II, using the Italian credit register. They find that TLTRO-II encouraged medium-term lending to firms and reduced credit interest rates. Laine (2019) examines the effects of TLTRO-II at the euro area level determining that TLTRO-II substantially affected bank credit to non-financial corporations and did not have any effect on interest rates and sovereign debt holdings.

[4] See Acharya and Steffen (2015), Popov and Van Horen (2015), Drechsler et al. (2016), Altavilla et al. (2017), and Crosignani et al. (2020).

Afonso and Sousa-Leite (2020) find a positive impact of TLTROs (TLTRO-I and TLTRO-II) on the amount of credit granted to the real economy at the euro area level, particularly in the less vulnerable countries.

The literature on the ECB's asset purchase programs identifies two distinct effects: announcement (stock) and implementation (flow) effects. The evidence on the announcement effects of the ECB's asset purchase programs shows that they lowered market borrowing costs for banks and governments in general. For instance, Szczerbowicz (2015), Eser and Schwaab (2016), DeSantis (2020), Zwan et al. (2022) and Altavila et al. (2021) show that asset purchase programs announcement have a declining effect on long-term government bond yields and credit spread. Furthermore, Zwan et al. (2022) show that ECB's asset purchase programs have a reassuring effect as they decrease corporate credit spreads and lower volatility in the sovereign bond markets.

Flow effects emerge with the actual implementation of APPs in the market. Among the papers that examine the implementation effects of the ECB's asset purchase programs are Casiraghi et al. (2016), Ghysels et al. (2017), Arrata and Nguyen (2017), Krishnamurthy et al. (2018), DeSantis (2020) and DeSantis and Holm-Hadulla (2020). Surprisingly or not, the implementation effects of the ECB's APP are similar to the announcement effects. The common findings are that government bond purchases compress the yield curve immediately and persistently. Bernardini and Conti (2023) develop a unified empirical dynamic framework to compare and combine announcement and implementation effects of asset purchase programs. They also find that announcement and implementation effects are similar; however, in addition they show that announcement effects are insufficient for the expected effects of the asset purchase programs and that the implementation choices matter. The paper of Lewis and Roth (2019) is among the few papers that provide evidence of the effects of the ECB's asset purchase programs on lending. Their findings suggests that lending to firms expands but does not become cheaper; however, their results are generated from data on an individual country, Germany.

The recent literature on the effects of the low interest rate policy by ECB (including the negative interest rate policy- NIRP) provides evidence on the effects on loan pricing in general (Present et al. 2023, Bottero et al. 2019 and Girotti et al. 2022). Present et al. (2022) show that an accommodative monetary policy near the zero lower bound (ZLB)

is less effective for loan pricing compared to a positive interest rate situation on a set of 10 euro area countries. If a change in monetary policy causes an increase in the deposit rate gap of 100 basis points (bps), banks increase their lending markup by around 40 bps, compared to a similar change in monetary policy in positive interest rate territory. Bottero et al. (2019) and Girotti et al. (2022) investigate the NIRP effects in Italy and France, respectively. Both papers find that NIRP cuts loan rates to firms primarily through a portfolio rebalancing channel. Bottero et al. (2019) further show that NIRP induces banks to rebalance their portfolios from liquid assets to credit; however, the previous policy rate cuts by ECB in positive territory close to ZLB and forward guidance announcements were unable to cause similar rebalancing of bank portfolios.

Compared to the rest of the studies on the ECB's unconventional monetary policies, our analysis is innovative in three important ways. Unlike the extant literature, we include all three major ECB's unconventional monetary policies in a single analysis. This approach is a key in the attempt to measure whether the ECB's strategy achieved its ultimate goal. Next, previous studies examine the effects of the first round LTROs or TLTROs in isolation. The advantage of this paper is that it distinguishes the effects of the first round of LTROs and the effects of the TLTROs in order to capture whether a borrowing constraint on banks' loan issuance introduced in targeted LTROs would affect banks' investment choices differently among loans and government securities. Moreover, we provide empirical evidence on the differences in the effects between LTROs and TLTROs separately on a set of euro area countries severely hit by the European sovereign debt crisis and a set of euro area countries that were not quite affected. This two-country sets analysis is extremely relevant in providing important policy implications on unconventional monetary policy structures. Finally, we do not distinguish between the positive territory of the ECB's interest rate on deposit facility, ZLB, or NIRP, rather we consider the interest rate on deposit facility as a continuous variable. We find this approach as relevant because it allows us to capture the effect of each of the three types of deposit interest rates over time and in a single analysis.

3. The ECB's Unconventional Monetary Policies from 2011 to 2018

Hartmann and Smets (2018) summarize the ECB's monetary policy from 1999 to 2018 including the ECB's unconventional polices and possible effects. We provide a

tabular summary of the unconventional policies undertaken by the ECB in Table 1.[5] These policies occurred as the ECB tried to deal with the euro area sovereign debt crisis, which started in 2009.

The policies divide naturally into five categories. The first category includes repurchase agreements over long periods, Long Term Refinancing Operations (LTROs). The second category includes purchases of covered bonds, for which there were three separate programs. Third, the ECB also had asset purchase programs for corporate bonds and asset backed securities. The fourth category, and the largest was purchases of euro area government bonds and related bonds. The fifth unconventional policy is the ECB's interest rate on the ECB's deposit facility which became negative on June 11, 2014.

3.1 The ECB's Long-term Refinancing Operations (LTROs)

Long Term Refinancing Operations (LTROs) were a regular part of the ECB's monetary policy before the financial crisis. These loans typically had maturities of three months, although they were lengthened to a year in June 2009. Loans for these one-year maturities continued until October 2012. The first round of unconventional LTROs, which the ECB calls simply LTRO, occurred in December 2011 and February 2012. These loans had terms of approximately three years. The interest rate was determined by the average main refinancing rate over the life the loan. Banks had the option to repay these loans after one year.

These unconventional LTROs were followed by targeted long term refinancing operations (TLTROs).[6] These are quite different from the LTROs; they were targeted at increasing lending by banks to euro area non-financial firms and households excluding loans for purchases of houses. We call these "eligible lending" for convenience.[7] The first set of operations, TLTRO I, were conducted in eight operations from September 2014 to June 2016. (ECB 2014a, ECB 2014b). The allotment was related to banks' eligible lending in reference periods. Allotments after the initial periods were limited by additional eligible lending based on benchmarks. If eligible lending was less than the

[5] ECB (2011) provides details.

6 ECB (2017) provides a summary of the TLTROs and links to related ECB documents.

7 The ECB uses the term "eligible lending" to describe lending by banks to euro area non-financial firms and households excluding loans for purchases of houses.

benchmark in April 2016, then all the borrowing had to be paid back in September 2016. The loans were limited to three times the eligible lending by banks. All loans matured in September 2018. The ECB gave banks the option to repay the loans in June 2016 when TLTRO II commenced. The interest rate was the rate on the ECB's main refinancing operations at the time of a loan plus ten basis points. The second round of TLTROs, TLTRO II, began in June 2016 with the last quarterly operation occurring in March 2017. The overall terms were similar to TLTRO I but the interest rate was more closely geared to the additional eligible lending by banks. The interest rate could be as low as the negative interest rate on the deposit facility. These loans had a maturity of four years but could be repaid after two years.

3.2 Other Unconventional Monetary Policy Measures

The ECB also engaged in unconventional purchases of assets including covered bonds, corporate bonds, sovereign debt and asset backed securities (ECB2020a, ECB 2020b). In July 2009, the ECB announced the first of three Covered Bonds Purchase Programs. In CBPP I, the ECB purchased 60 billion euros of covered bonds from July 2, 2009 to June 30, 2010. In CBPP II, the ECB purchased 16.4 billion euros of covered bonds from November 2011 to the end of October 2012. Finally, CBPP III ran from October 20, 2014 to December 19, 2018. The assets acquired in CBPP I and CBPP II will be held to maturity and the ECB is reinvesting principal payments from securities bought under CBPP III.

The ECB purchased corporate bonds under the Corporate Sector Purchase Programme (CSPP) from June 8, 2016 to December 19, 2018[8]. Principal payments were reinvested. The ECB has also purchased asset backed securities under the Asset Backed Securities Purchase Programme. These purchases occurred from November 21, 2014 to December 19, 2018. Principal payments were reinvested.

The ECB purchased government securities under the Securities Market program from May 10, 2010 to September 6, 2012. In 2020, the securities still owned under the Securities Market Program in order of amount held were issued by Italy, Spain, Portugal, Greece and Ireland and had a book value of 47.9 billion euros. These purchases were

[8] ECB (2016a) and ECB (2016b) provide details on the announcement and terms of the corporate sector purchase programme (CSPP)

sterilized and are being held to maturity. Outright Monetary Transactions were announced on the same date as the end of the Securities Market Program. Outright Monetary Transactions are conditional on a country being in an EU program, are unlimited in amount with the ECB having the same standing as private holders of the securities in the event of default. As of this writing, there have been no OMTs.[9] This does not mean the announcement had no effect. The ECB also purchased government securities under the Public Securities Purchase Programme (PSPP). This program ran from March 9, 2015 to December 19, 2018. Purchases included both nominal and inflation-indexed bonds. Besides national government bonds, the purchases included "bonds issued by recognized agencies, regional and local governments, international organizations and multilateral development banks located in the euro area." (ECB 2020b).

On June 11, 2014, the ECB took the unconventional action of lowering the interest rate on banks' deposits at the ECB to -10 basis points. It has remained negative ever since.

Figure 2 shows the magnitudes and length of time that the regular ECB LTRO operations and unconventional LTRO operations, separately, existed and Figure 3 shows the magnitudes and time length of the ECB asset purchase programs. Figure 4 shows the evolution of the ECB's interest rate at its deposit facility.

4. Data and Variables

Our dataset includes banks in the 17 countries in the euro area for the period from 2008 to 2019. The countries are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. These countries all used the euro as their national currency or had a fixed exchange rate relative to the euro for all of the period covered by our data.[10] We want to examine whether the level of sovereign distress in a country affects banks' responses to the unconventional policies. We follow Drechsler et al. (2016) and divide the data into two datasets depending on the change in the credit rating of the central government in which a bank is headquarted. The crisis countries include countries

[9] Hartmann and Smets (2018) provide more details.

[10] The countries in the European Union which joined the euro area after the euro's inception and the year of adoption are Cyprus 2008, Estonia 2011, Greece 2001, Latvia 2014, Lithuania 2015, Malta 2008, Slovakia 2009, and Slovenia 2007 (ECB 2020a).

whose government was downgraded below AA after the onset of the sovereign debt crisis: Cyprus, Greece, Ireland, Italy, Malta, Portugal and Spain. [11] The rest of the countries are the set of non-crisis countries as in Table 2.

We have data on 105 banks with their headquarters in countries in the euro area[12]. We require that a bank has three years of consecutive data available.[13] Banks´ financial information is from BankFocus based on the banks´ consolidated statements which are reported according to the International Financial Reporting Standards (IFRS). We use General Accepted Accounting Principles (GAAP) data for bank financials if IFRS financials are not available. Finally, we run the regressions on a dataset of 75 banks and 447 bank-year observations in total.[14] Table 2 provides the list of countries in the sets of non-crisis and crisis countries with the total bank-year observations and number of banks per country. Germany, Italy and Spain have more than 10 banks per country, and the prevalence of the German banks is obvious in our dataset.

Table 3 summarizes the variables used in the paper. All of the banking variables are scaled by total assets except tangible equity which is measured relative to tangible assets.[15] Tangible equity relative to tangible assets, *taneq*, is our proxy for bank capitalization.

Table 4 provides summary statistics for the bank variables. Loans are the largest share of banks' assets: 52 percent of assets in non-crisis countries and 65 percent of assets in crisis countries.

Table 5 reports the means of banking variables in non-crisis and crisis countries. There are statistically significant differences between the means in non-crisis countries and crisis countries for all of the variables except deposits from other banks (*depbks*)

The GDP data is from the World Bank's Economic Development Indicators. We use the growth rate of GDP in country *j*, $\Delta gdp_{j,t}$, for each year *t*. The data on credit default swaps is in levels and is from Thompson Reuters. The credit default swap rate for a country is measured as the ratio of the rate for a government's credit default swaps for

[11] Drechsler et al. (2016) use May 2010 as the start of the sovereign debt crisis in the European Union.
[12] The list of all banks with the corresponding names, headquarters and country is given in Table 3 in Appendix A.1.
[13] Some banks disappear between 2008 and 2019, some new ones appear and some banks do not have all of the variables used in this study available for some periods.
[14] The number of observations on the left-hand-side variables is reduced by the existence of unit roots and the use of lagged values in equations and as instrumental variables.
[15] We follow Kapan and Minoiu (2018) which conclude that tangible equity provides more robust evidence than Tier I and Total Regulatory Capital when distinguishing among banks according to their ability to sustain lending

country *j* in year t relative to the median credit default swap rate for the Eurozone countries in year t. This is denoted $cds_{j,t}$ for country *j* in year *t.*[16]

The data on unconventional monetary policy variables are daily data from the ECB's Eligible Assets Database for the entire euro area. We construct annual variables, consistent with our banking data, by constructing annual averages of these daily data. We construct variables for the two distinct LTROs. We construct one variable for the first two rounds of LTRO and another variable for the two rounds of Targeted LTROs. The LTRO and targeterd LTRO variables for each year, *ltro and tltro,* respectively, represent the quantity of LTRO (or targeted LTRO) in that year divided by the total quantity of the unconventional LTRO in years 2011 – 2018. Similarly, the variable for the Asset Purchase Programs is the quantity in the year divided by the total quantity of asset purchases in years 2009 - 2011. Construction of these variables allows for the differences in sizes but still reflects the quantity in any year. A variable can be small in the year that the program starts or ends or any year when there is less activity, which potentially makes it more informative than a dummy variable.

5. Empirical method

5.1 PVARX Model

We use a panel data vector autoregression with exogenous variables (PVARX) to analyze jointly the transmission of macroeconomic shocks, shocks to banking assets, and ECB policy shocks to the banks' choices of assets while allowing for unobserved bank heterogeneity. We specify a first-order PVARX model:

$$y_{i,j,t} = \mu_i + \Theta_{1,c} y_{i,j,t-1} + \delta_c c_{i,j,t} + \gamma_c cb_{j,t} + \varepsilon_{i,j,t} \qquad (1)$$

where $y_{i,j,t}$ is a vector of five endogenous banking variables $\{taneq_{i,j,t}, depbks_{i,j,t}, loans_{i,j,t}, govsec_{i,j,t}, depCB_{i,j,t}\}$, *i* is an indicator for each bank, *j* is an indicator for each country and *t* is an indicator for the time period.[17] We estimate separate equations for crisis and non-crisis countries, the subscript index *c* takes on the value "crisis country" and "non-crisis country." The parameter μ_i is a constant term for

[16] The summary statistics and the pairwise correlations of the macroeconomic variables are provided in Tables 1 and 2 in Appendix A.1.

[17] Every bank is uniquely classified as being headquartered in a non-crisis or crisis country, so a subscript *j* is unnecessary for any variable that has a subscript *i*.

each bank, $\Theta_{1,c}$ is a vector of coefficients of the first lags of all variables, $c_{i,c,t}$ is a vector of macroeconomic variables for each bank, δ_c is the vector of coefficients for the macroeconomic variables, cb_t is the vector of policy variables, which do not vary by bank, and γ_c is the corresponding vector of coefficients. The vector of error terms $\varepsilon_{i,j,t}$ has mean zero and the variance-covariance matrix Σ_c. We include variables of interest that we expect to be sensitive to the set of macroeconomic, banking and monetary policy shocks from 2008 to 2019.

The banking variables of particular interest are banking assets, gross loans (*loans*), government securities (*govsec)* and cash and balances in central banks (*depCB*). Loans and government securities are of interest because the unconventional policies are intended to affect loans and government securities are a close substitute.

Cash and balances in central banks (*depCB*) may require an explanation. After the financial crisis, regulation of banks' liquidity was increased with the introduction of the Liquidity Coverage Ratio (LCR). Cash and balances in central banks are an asset which satisfies that requirement. Furthermore, U.S. subsidiaries of European banks can count deposits at the Federal Reserve for the LCR. During our period, the Federal Reserve always paid a positive interest rate while deposits at the ECB and euro area government securities had negative interest rates for much of the period. Exchange risk aside, this made deposits at the Federal Reserve relatively attractive and cash and deposits at central banks may well have been an important investment vehicle for banks. Therefore, gross loans, government securities and cash and balances in central banks represent banking assets in our model by bank *I*, in country *j,* in year *t,* all measured relative to bank's assets.

The other banking variables included in the PVARX are deposits from other banks relative to total assets (*depbks*) and tangible equity relative to tangible assets ($taneq$) . They are intended to reflect banking factors corresponding to interbank market exposure and bank capital, respectively. Only lagged values of banking variables are included on the right-hand side of regressions, which can be interpreted as predetermined values.

The macroeconomic variables $c_{j,t}$ are the real GDP growth rate in country *j* in which bank *i* has its headquarters, $\Delta gdp_{j,t}$, and the relative level of government *j*'s credit default risk, $cds_{j,t}$.

The vector of variables cb_t includes the ECB unconventional policy variables in our model: the first set of untargeted LTROs (*ltro*), the targeted LTROs (*tltro*), the ECB asset purchase programs (*app)* and the ECB interest rate on its deposit facility (*ecb_intrate*), all measured in year *t*.

We allow for individual heterogeneity in the banking variables by including fixed effects, denoted by μ_i, in the model.

The advantage of the PVARX is that it combines the traditional VAR approach, which accounts for the endogeneity among the variables, with the panel-data approach, which accounts for the banks' heterogeneity by including fixed effects. The PVARX provides estimates of the response of banking assets to macroeconomic variables, banking variables and ECB policy variables.

5.2 Identification Strategy

Holtz-Eakin, Neweys and Rosen (1988) first introduced VAR in a panel-data setting leading to a panel VAR (PVAR) models.[18] A PVAR and our PVARX can be interpreted as reduced forms of structural equations.[19] Estimating the structural equations is necessary to identify shocks, for example to the quantity of loans, and the associated impulse response functions (IRFs). The PVARX is the reduced form of the set of equations. A recursive set of equations can deliver a structural representation in which contemporaneous variables appear in the equations but are not correlated with the equations' error terms. By construction, the errors across all equations are uncorrelated. We assume a recursive set of equations to identify the shocks. This orthogonalizes and identifies the impulse-response functions. Orthogonalized impulse-response functions describe the reaction of variables to the innovation in a variable while holding all other innovations constant. We use the so-called Cholesky decomposition of the variance-covariance matrix of residuals to compute orthogonal shocks. The procedure requires adopting an economic rationale roughly consistent with

[18] Their setting assume that the cross-sectional units share the same underlying data generating process, with the reduced-form parameters $A_{1,}A_{2,\ldots\ldots,}A_{p-1,}A_{p,}$ and B to be common among them. Systematic cross-sectional heterogeneity is modeled as panel-specific fixed effects.

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + \cdots . + Y_{it-p+1}A_{p-1} + Y_{it-p}A_p + X_{it}\boldsymbol{B} + \mu_i + e_{it}$$

where

$$i \in \{1,2, \ldots . N\}, \quad t \in \{1,2, \ldots . , T_i\}$$

[19] Pesaran (2015, Ch. 24) provides a more detailed discussion.

a recursive representation of the relationship between the contemporaneous values of the variables.

Our model combines a set of banking variables, macroeconomic variables and policy variables. We assume that the macroeconomic variables have a contemporaneous effect on the banking variables but the variables for individual banks do not have a contemporaneous effect on the macroeconomic variables. This is consistent with papers such as Bernanke and Blinder (1992), Carpenter and Demiralp (2012) and Love and Ariss (2014). We think it is unlikely that shocks to individual banks have contemporaneous important effects on macroeconomic variables for the countries in which they are headquartered.

In addition to macroeconomic variables, our model includes the outstanding balances of the ECB's unconventional monetary policy operations at the end of each year. These variables are assumed to be exogenous to individual banks. Each of the ECB's unconventional monetary policy interventions are the total outstanding amounts of operations. There is no reason to think that the ECB operations were substantially affected by developments at any particular individual bank. If the policy were different – if we measured policy by each banks' pickup of LTROs for example – then this measure of policy clearly would be endogenous because the bank would be choosing it. The total pickup of LTROs is not likely to be affected noticeably by the actions of any individual bank.

We consider that our arguments are relevant and consistent with the panel VAR setting of Holtz-Eakin, Newey, and Rosen (1988). Following their theoretical model, the coefficients of the bank endogenous variables are the reduced-form parameters and measure bank developments at the individual bank level. The macroeconomic and ECB's policy variables are common among bank observations and measure the developments at the country and euro area level, respectively. Consequently, the macroeconomic and ECB's policy variables are exogenous with respect to the bank level variables. Finally, in such setting, the macroeconomic and the policy variables affect banking variables directly only contemporaneously and that lagged effects occur through the interaction of the lagged banking variables.

Our recursive representation has the following ordering of the endogenous variables, $y_{i,j,t}$, in Eq.1: *taneq, depbks, loans, govsec and depCBs*. We assume that a bank's capitalization is affected by the bank's investment choice variables (*loans*, *govsec*

or *depCB*) and interbank market exposure (proxied by *depbks*) only with a lag. We assume that the effect of bank´s capitalization on *depbks* are contemporaneous because less capitalized banks are perceived as riskier and other banks would reduce their deposits in these banks. Finally, we assume that loans (or any other variable from the list of bank investment choices) affect bank-specific factors, capital (*taneq)* and deposits from other banks (*depbks)* with a lag and they are simultaneously affected by all other variables. The reasoning behind this assumption is that loans are part of the banks' assets portfolios, which by construction depend on funding sources as bank capitalization and deposits from other banks. Hence, in our specification loans (or government securities or cash and balances in CB) are the most endogenous variables in the system, capturing all available information. Furthermore, it is reasonable for us to order cash and balances in central banks and government securities holdings after loans in the endogenous setting, since they are more prone to change in the current period in response to adjustments in banks´ lending and capitalization, than vice versa.

Alternatively, the situation in which a change in loans could affect contemporaneously bank capital is only when there is a high demand for loans in the economy. Hence, if there is an economic growth and there is a high demand for loans a bank could be willing to increase its capital in order to affect positively the loans' issuance. However, we exclude this alternative because banks avoid to raise external capital in the equity and debt markets due to asymmetric information problems between the bank and outside financiers (Myers and Majluf, 1984) and a negative signaling concern (Calomiris and Wilson, 2004; Brunnermeier, 2009). Hancock et al. (1995) and Mora and Logan (2012) also apply panel VAR approach with the goal of extracting important comovements among bank's capital and a bank's portfolio. They use the same reasoning for ordering capital, loans and banks' securities holdings in a PVAR setting. In addition, the ordering between loans and banks' securities holdings that we follow is also applied in the analyses of Bernanke and Blinder (1992) and Carpenter and Demiralp (2012).[20]

Arellano and Bover (1995) developed a procedure to generate unbiased estimates of a PVAR with individual fixed effects. Individual fixed effects in the presence

[20] Bernanke and Blinder (1992) apply VAR setting using aggregated bank variables while Carpenter and Demiralp (2012) apply both VAR and panel VAR setting using aggregated and disaggregated bank variables.

of the dependent variables' lags in the PVAR causes the estimated coefficients to be biased if a standard mean-differencing procedure is used to eliminate fixed effects. Forward mean-differencing, a Helmert transformation, generates unbiased estimates. Untransformed lagged regressors can be used as instruments because the variables are forward mean differenced, and estimation can proceed by Generalized Method of Moments (GMM). Monte Carlo simulations provide estimated standard errors of the impulse-response functions and 95 percentile confidence intervals. We estimate the PVARX model using a Stata program developed by Love and Zicchino (2006) and Abrigo and Love (2016).

In the online appendix 1 we examine lag-order selection criteria and we run granger causality analysis to justify the structure of our baseline PVARX model represented by Eq. (2) for each set of countries.

5.3 Unit Roots or Not?

We examine non-stationarity due to unit roots before estimating the PVARX. We present two different unit root tests: Augmented Dickey-Fuller (ADF) tests and Phillips-Perron (PP) tests for unbalanced panel data. The null hypothesis is that all series have unit roots, and the alternative hypothesis is that one or more is does not. These tests, due to Madalla and Wu (1999) and Choi (2001), combine tests for each bank in the panel and test the null hypothesis. A unit root test is run for each bank in a panel with different parameters in the estimated autoregression for each bank. The results of the tests for each bank are combined using the inverse normal test due to Samual A. Stouffer and others (Choi 2001).[21]

It is possible that some variables on a banks' balance sheet have unit roots and others do not (especially for ratios), but it is more conservative for estimation of the PVAR to conclude that all variables have unit roots or none do. The GMM estimator used in PVARs suffers from weak instrument problems when variables being modeled have roots near one; the moment conditions become irrelevant when the variables have unit roots (Blundell and Bond 1998).

Table 6 presents the results of ADF and PP unit root tests for the banking variables in levels and first differences. The results are mixed. For non-crisis countries,

[21] Simulations suggest that the inverse normal test has good overall size and power properties in this application.

the ADF test is inconsistent with a unit root for deposits by other banks and the PP test is inconsistent with a unit root for deposits by other banks, government securities and loans. For crisis countries, the ADF is inconsistent with a unit root for government securities and deposits by other banks and the PP test is inconsistent with a unit root for deposits by other banks. While hardly definitive, the results are more consistent with all the variables having unit roots than none having unit roots. None of the tests is consistent with two unit roots.

We specify the reduced-form PVARX model using first differences for banking variables. We estimate our first order PVARX as:

$$\Delta y_{i,j,t} = \mu_i + \Theta_{1,c}\Delta y_{i,j,t-1} + \delta_c c_{i,j,t} + \gamma_c cb_{j,t} + \varepsilon_{i,j,t} \qquad (2)$$

for non-crisis and crisis countries.

6. Empirical Results

The variables of most interest are loans targeted by the ECB and the other earning assets most likely to be affected by the ECB's unconventional policies: government securities (*govsec)* and cash and balances in central banks (*depCB).* We estimate their responses to ECB policy variables, shocks to bank financing, bank capitalization *(taneq)* and deposits by other banks (*depbks),* and macroeconomic variables. We also examine whether they are different across countries in the euro area with different levels of financial distress or credit default risk.

Finally, we run our baseline PVARX model in Eq. (2) on a dataset of 75 banks and 447 bank-year observations in total. The number of banks and observations is reduced by the existence of unit roots and the use of lagged values in equations and as instrumental variables. We analyze separately the sets of non-crisis and crisis countries. We examine general bank dynamic relationships as well as the contemporaneous relationships with macroeconomic and ECB policy variables using impulse-response functions (IRFs) for both sets of countries. We present the impulse-response functions for the identified shocks in sets of graphs including five percent error bands generated by Monte Carlo simulation.[22]

[22] We report the coefficient estimates of the reduced form VARs for non-crisis and crisis countries in Tables 4 and 5 in Appendix A.2. We have the results and the complete analysis when we rerun our baseline PVAR model using combined data for non-crisis and crisis countries and are available upon request. The results for the euro area are different from those of the sample of non-crisis or crisis countries. This is additional empirical evidence that the relative financial distress of a country is an important factor to be considered in the process of designing and implementing different monetary policy measures.

We now turn to discuss IRFs for the orthogonalized shocks to the banking variables.[23] Figures 5 and 6 show the impulse-response functions for banking assets in response to increased funding by bank deposits and by bank capital. Figure 5 shows the IRFs for banks in non-crisis countries and Figure 6 shows the IRFs for banks in crisis countries. The similarity of the IRFs in non-crisis countries for shocks to bank deposits and capital is striking. This does not necessarily have to be the case; bank deposits and bank capital have different risk characteristics. In general, these are less reliably determined than for non-crisis countries with four out of the six IRFS including zero in the 95 percent confidence intervals for the first effects estimated. Government securities do increase by a statistically significant amount in the first and second period after the initial shock to bank deposits. Loans decrease after a positive shock to deposits and increase after a shock to capital. It is not obvious why the response should be different for loans in crisis countries. One possibility is that capital increases were more likely to be due to government injections rather than increases in retained earnings or sales of new stock.

Figures 7 and 8 show estimates of the responses of banking assets to the macroeconomic factors, government's credit default swap levels (CDS) and GDP growth. These variables are exogenous and therefore it is not possible to compute standard IRFs. There is no feedback from lending at individual banks to the relative size of these unconventional programs. Instead, dynamic multipliers in response to shocks to exogenous variables are presented. Banks in non-crisis countries with higher CDS levels increase government securities and decrease deposits in central banks and loans. These effects on the changes in these variables do not persist for more than a couple of periods but the effect on the levels of the series does persist since the variables have unit roots. The growth of the GDP growth has a statistically significant effect only on deposits at central banks. The mean initial effect of a shock to a crisis country's CDS is the opposite of the mean initial effect for non-crisis countries.

Figure 9 presents the responses of banking assets in non-crisis countries to the unconventional policies *ltro, tltro, app* and the *ecb_intrate* at the ECB. There is little difference in the directions of the responses of loans and government securities to

[23] The complete sets of IRFs for the non-crisis and crisis countries are provided in Figures 1 - 4 in Appendix A.2.

LTROs and TLTROs. The targeting in the latter LTROs made little difference in the shapes of the responses. The magnitudes are quite different though.

Targeted LTROs were quite successful in inducing banks in non-crisis countries to increase lending and reduce their holdings of government securities. The dynamic multipliers are estimated using a one-standard deviation shock to the relevant variable. The magnitude of the effect of the exogenous policy, though, depends on the size of the program.[24] The computed effects of the average sizes of *ltro* and *tltro* indicate that *ltro* increased bank loans by 7.6 percent of assets in the first period and *tltro* increased bank loans by 16.4 percent of assets, a substantially bigger effect. These effects are not cumulative because the effect of reducing *ltro* to zero reduced the effect of the program to zero. The directions of the effects of the Asset Purchase Programs indicate that they were not successful in increasing lending. An increase in the size of the Asset Purchase Programs decreased lending and increased banks' holdings of government securities. Variation in the ECB's deposit rate was unimportant in influencing banks' loans, government securities and deposits at central banks.[25]

Figure 10 shows the responses of banking assets in crisis countries to the unconventional policies *ltro, tltro, app* and the ECB 's interest rate on deposits at the ECB. The mean effect of the initial unconventional LTORs, *ltro,* are to increase government securities and loans and to reduce deposits at central banks. Targeted LTROs have a bigger incentive for banks to lend and banks do respond to this incentive. TLTROs raised loans and lowered government securities, with virtually zero effect on deposits at central banks, which was the stated effect desired. An increase in the asset purchase programs is associated with an increase in government securities, a decrease in loans and little effect on deposits at central banks. The effects on loans are similar to those for non-crisis countries. The initial round of LTROs increased lending by 8.4 percent of assets and the targeted LTROS increased lending by 14.6 percent of assets. As for non-crisis countries, the ECB's deposit interest rate has little effect on banks' loans and holdings of government securities.[26]

[24] The magnitudes of the dynamic multipliers for non-crisis computed by the Stata package are adjusted by the ratio of the average size of the program while it existed divided by the standard deviation of the program across observations of banks in non-crisis countries. The adjustment for crisis countries is similar.
[25] This observation holds true for the magnitudes of the effects of the negative rates as well.
[26] We also computed responses for banks that received government support. They are similar to those in crisis countries although the increase with targeted LTROs is to 7.5 %. The results are available in Appendix A.3.

Additionally, we quantify the effect of an increase of one mean in each of the factors for which we find statistically significant evidence at 1% level on loans, government securities or cash and balances in central banks. Table 7 shows the magnitudes of *ltro* and *tltro* as well as of the ECB's deposit facility rate and bank's capital and the corresponding quantified effects in percentages. The orthogonalized IRFs of non-crisis countries showed that a shock to both *ltro* and *tltro* has a positive effect on loans and a negative one on government securities. However, in Table 7 we observe that an increase of one mean in *tltro* translates to an increase of 0.46% in loans, which is double than the increase of 0.22% in loans due to *ltro*. We observe that *tltro* has also double declining impact on government securities in comparison to *ltro*, -3.67% vs. -1.56%, respectively[27].

In the set of crisis countries, we observe that an increase of one mean in *tltro* translates into about 0.33% increase in the mean of loans, while an increase of one mean in ECB's deposit facility rate and bank's capital translate into about an increase of 0.08% and 0.02%, respectively. We consider that this result particularly emphasizes the key role of TLTRO in enhancing bank credit output. Further, we observe that while one mean increase in loans in *ltro* increases the mean in government securities by 1.13%, a one mean increase in *tltro* significantly decreases the mean in government securities by 1.73%.

Regarding the effects of ECB policy programs, we can conclude that LTROs and TLTROs increased bank loans. TLTROs, which gave banks a bigger incentive to lend, had bigger effects.

The results show that the requirement of lending in order to receive additional funding in TLTRO seems to have affected asset choices by banks in crisis countries by being associated with lower growth of government securities and substantially large holdings of loans. We find very little evidence of any effect of the interest rate on deposits at the ECB on banks´ loans and investments in government securities.

6.1 Robustness

We also explore the robustness of our results to different orderings of bank endogenous variables in our PVARX baseline specification. Another alternative ordering that could

[27] We obtain the impacts using impulse response estimates in Tables 6 and 7 in Appendix A.2. For instance, we observe that the maximum impact *ltro* is 0.11200 for loans in non-crisis countries (in time 1). Then an increase of one mean in *ltro* translates to about 0.22% of one mean of loans in the crisis countries (which is equal to 0.52.)

be taken into account is if deposits from other banks *(depbks*) are considered the most exogenous and come first in the vector of bank endogenous variables. Hence, the possible alternative ordering of the vector $y_{i,j,t}$, in Eq.(2) is the following: *depbks, taneq, loans, govsec and depCB.* This would be the most reasonable alternative ordering as *depbks* and *taneq* represent bank financing sources and bank investments in loans, government securities and deposits in central bank are dependent on these financing sources. We estimate the complete set of results of Eq. (2) where the vector $y_{i,j,t}$ follows this alternative ordering. We do not find any change in the responses of bank assets to shocks in either of the bank-financing, macroeconomic or ECB policy variables. However, in order to show that our results do not dramatically change if one changes the ordering of the PVARX endogenous variables, we estimate the model given in Eq. (2) applying five different orderings in addition to the alternative ordering we discussed above. We find that the responses of bank assets to shocks in bank-financing, macroeconomic or ECB' policy variables are robust to changes in the ordering of the bank endogenous variables. We report all relevant figures of the impulse-response functions of the estimates with the alternative orderings in the online appendix[28].

Finally, we address the concern on how have the changes in TLTROs reflected on the investment behavior by euro area banks that received government capitalization and if they are different with respect to the rest of banks in our sample. The literature on the European sovereign debt crisis suggests that banks that received any form of government capitalization responded to the risky sovereign debt purchases more than other banks, which is consistent with the "moral suasion" and the "carry trade" hypotheses[29]. Moral suasion theory suggests that banks receiving government capitalization are likely to engage in risky sovereign purchases more than other banks due to established relationships with the governments. However, in order to be able to borrow from TLTROs they had to show certain fraction of loans issuance on their assets portfolios, a constraint that should attenuate the government influence. Hence, we should expect at least that they have changed positively their investments with respect to loans and in best case, they have lowered their purchases of government securities

[28] We report only the figures of the impulse-response functions since the coefficient estimates do not change with a change of the ordering.

[29] The moral suasion hypothesis is formalized by Uhlig (2014), while Gennaioli et al. (2014) also show how government defaults hurts bank balance sheets, which further limit bank credit in the economy. The carry-trade hypothesis is formalized by Acharya and Steffen (2015).

once they are exposed to shocks in TLTROs. For this purpose, we run our baseline specification in Eq. (2) on a set of euro area banks that were subject to government interventions at the peak of the Global Financial Crisis, when no centralized scheme at the European level existed for providing aid to individual banks.

In figure 11, we show impulse-responses of the ECB's unconventional monetary policies on the set of euro area countries that received government capitalization[30]. We find that these banks increased their investments in both loans and government securities in the time of the first round of LTROs, although, the coefficient of *govsec* is not statistically significant. However, their investment decisions changed dramatically in the time of TLTROs. They increase the investments in loans substantially and decrease their purchases of government securities. Identically to the results of the non-crisis countries, these banks increase deposits at central banks during the time of the TLTROs. The impulse-response functions in figure 11 show that, in this set of banks, an increase in ECB's interest rate on deposit facility is associated with an increase in deposits at central banks, while an increase in asset purchase programs is associated with an increase in government securities. Hence, the results of this particular set of banks highlight the importance of the existence of both LTROs for loans' issuance and show clearly the importance of TLTROs in turning around adverse bank investment behavior toward government securities.

The quantification results in the set of banks that received government support provided in Table 7 also show how the *tltro* is dominant in its effects on loans and government securities in comparison to the first round of LTROs. A one mean increase in *ltro* is associated with an increase of 0.19% in the average value of loans, while a one mean increase in *tltro* increases the mean of loans by 0.53 %, which is a quite difference. Then, we observe that an increase in one mean in *tltro* is associated with a decrease of 2.58% in the average value of government securities. This represents quite an enormous impact on lowering investments in government securities in this set of banks under this set of bank-financing and macroeconomic conditions and ECB's policy factors. Finally, an increase of one mean in *tltro* increases the mean of deposits at central banks by 3.02% which exceeds the increase of 0.43% achieved by the ECB's interest rate on deposit facility.

[30] The impulse-responses of the bank variables and all other relevant results for the set of banks that received government capitalization are given in Appendix A.3.

7. Conclusion

The ECB implemented a diverse set of unconventional monetary policies following the European sovereign debt crisis. A major stated goal was to stimulate bank lending. We examine the implications of all three major ECB unconventional policies, LTROs, asset purchase programs and the ECB's interest rate at its deposit facility for banks. We analyze the following banking assets: loans, government securities, and cash and balances in central banks. We compare the responses in non-crisis and crisis countries of the euro area. We examine the importance of these unconventional monetary policies holding constant bank-specific averages and macroeconomic variables affecting bank investment portfolios.

The ECB's unconventional monetary policy measures increased lending across the euro area. The targeted LTROs, which were conditional on bank lending, were associated with roughly twice as much lending as the non-targeted LTROs had been. The asset purchase programs had relatively small effects, mainly related to increases in purchases of government securities in non-crisis as well as in crisis countries and decreases in loans in non-crisis countries. The ECB´s interest rate at its deposit facility was relatively unimportant for banks' investments.[31]

Changing the terms for banks' borrowing from the ECB lending facilities from LTROs to targeted LTROs made a significant difference in banks' investment behavior in crisis and non-crisis countries. Our results show that with TLTROs, banks in crisis countries started to increase investments in loans and to decrease holdings of government securities on their balance sheets, which is consistent with the stylized facts shown in Figure 1. These results suggest that ECB's lending operations managed to turn around banks' incentives for investing between loans and government securities in crisis countries, which represented a major issue in the onset of the European sovereign debt crisis. The LTROs or the asset purchase programs did not importantly affect banks' deposits in central banks.

The results suggest that LTROs had substantial effects on banks' lending in non-crisis and crisis countries and conditionality under the TLTROs made a big difference in the program's effects. Moreover, the results show homogenous effects of TLTROs across non-crisis and crisis countries, an outcome that ECB had not achieved with the initial LTROs or the rest of unconventional policy measures.

[31] This does not imply that it had little effect on euro area economies.

References

Abrigo, Michael R. M., and Inessa Love. (2016). "Estimation of Panel Vector Autoregression in STATA". *The Stata Journal,* 16(3), pp. 778-804. https://doi.org/10.1177/1536867X1601600314

Acharya, Viral, Tim Eisert, Christian Eufinger and Christian Hirsch. (2019). "Whatever it takes: The Real Effects of Unconventional Monetary Policy". *Review of Financial Studies,* 32(9), pp. 3366-3411. https://doi.org/10.1093/rfs/hhz005

Acharya, Viral, and Sascha Steffen. (2015). "The Greatest Carry Trade Ever". *Journal of Financial Economics,* 115(2), pp. 215-36. https://doi.org/10.1016/j.jfineco.2014.11.004

Afonso, António, and Joana Sousa-Leite. (2020). "The transmission of unconventional monetary policy to bank credit supply: Evidence from TLTRO". *The Manchester School,* 88(1), pp. 151-171. https://doi.org/10.1111/manc.12335

Altavilla, Carlo, Giacomo Carboni and Roberto Motto. (2021). "Asset Purchase Programs and Financial Markets: Lessons from the Euro Area". *International Journal of Central Banking,* 17(70), pp. 1-48. https://www.ijcb.org/journal/ijcb21q4a1.pdf

Altavilla, Carlo, Marco Pagano and Saverio Simonelli. (2017). "Bank Exposures and Sovereign Stress Transmission". *Review of Finance,* 21(6), pp. 2103-2139. https://doi.org/10.1093/rof/rfx038

Andrade, Philippe, Christophe Cahn, Henri Fraisse and Jean-Stéphane Mésonnier. (2019). "Can the provision of long-term liquidity help to avoid a credit crunch? Evidence from the Eurosystem's LTRO". *Journal of the European Economic Association,* 17(4), pp. 1070-1106. https://doi.org/10.1093/jeea/jvy020

Andreeva, Desislava C. (2018). *The impact of credit easing policies on bank lending in the euro area: the case of the TLTROs.* Mimeo.

Andreeva, Desislava C., and Miguel García-Posada. (2021). "The impact of the ECB's targeted long-term refinancing operations on banks' lending policies: The role of competition". *Journal of Banking and Finance,* 122, 105992. https://doi.org/10.1016/j.jbankfin.2020.105992

Angeloni, Chiara, and Guntram B. Wolff. (2012). "Are banks affected by their holdings of government debt?". Working Papers, 2012/07, Bruegel. https://www.bruegel.org/sites/default/files/wp_attachments/WP_2012_07.pdf

Arellano, Manuel, and Olympia Bover. (1995). "Another look at the instrumental variable estimation of error-components models". *Journal of Econometrics,* 68, pp. 29-51. https://doi.org/10.1016/0304-4076(94)01642-D

Arrata, William, and Benoît Nguyen. (2017). "Price Impact of Bond Supply Shocks: Evidence from the Eurosystem's Asset Purchase Program". Working Paper Series, 623, Banque de France. https://doi.org/10.2139/ssrn.2952363

Baziki, Selva-Bahar, María J. Nieto and Rima Turk-Ariss. (2023). "Sovereign portfolio composition and bank risk: The case of European banks". *Journal of Financial Stability,* 65, pp. 1-12. https://doi.org/10.1016/j.jfs.2023.101108

Becker, Bo, and Victoria Ivashina. (2018). "Financial Repression in the European Sovereign Debt Crisis". *Review of Finance,* 22, pp. 83-115. https://doi.org/10.1093/rof/rfx041

Benetton, Matteo, and Davide Fantino. (2021). "Targeted monetary policy and bank lending behaviour". *Journal of Financial Economics,* 142(1), pp. 404-429. https://doi.org/10.1016/j.jfineco.2021.05.002

Berger, Allen, and Gregory F. Udell. (2002). "Small business credit availability and relationship lending: the importance of bank organizational structure". *The Economic Journal,* 112(477), F32-F53. https://doi.org/10.1111/1468-0297.00682

Bernanke, Ben S., and Alan S. Blinder. (1992). "The Federal Funds Rate and the Channels of Monetary Transmission". *American Economic Review,* 82(4), pp. 901-921. https://www.jstor.org/stable/2117350

Bernardini, Marco, and Antonio M. Conti. (2023). *Announcement and Implementation Effects of Central Bank Asset Purchases.* 2023 ASSA Annual Meeting, New Orleans, 6-8 January. https://www.aeaweb.org/conference/2023/program

Blundell, Richard, and Stephen Bond. (1998). "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models". *Journal of Econometrics,* 87(1), pp. 115-143. https://doi.org/10.1016/S0304-4076(98)00009-8

Bottero, Margherita, Camelia Minoiu, José-Luis Peydró, Andrea Polo, Andrea F. Presbitero and Enrico Sette. (2019). "Negative monetary policy rates and portfolio rebalancing: Evidence from Credit Register Data". IMF Working Papers, 2019/044, International Monetary Fund. https://doi.org/10.5089/9781498300858.001

Brunnermeier, Marcus K., and Yuliy Sannikov. (2014). "A Macroeconomic Model with a Financial Sector". *American Economic Review,* 104(2), pp. 379-421. https://doi.org/10.1257/aer.104.2.379

Cahn, Christophe, Julien Matheron and Jean-Guillaume Sahuc. (2017). "Assessing the Macroeconomic Effects of LTROs during the Great Recession". *Journal of Money, Credit and Banking,* 49(7), pp. 1444-1482. https://doi.org/10.1111/jmcb.12421

Calomiris, Charles W., and Berry Wilson. (2004). "Bank Capital and Portfolio Management: The 1930s 'Capital Crunch' and Scramble to Shed Risk". *Journal of Business,* 77, pp. 421-455. https://doi.org/10.1086/386525

Carpenter, Seth B., and Selva Demiralp. (2012). "Money, reserves, and the transmission of monetary policy: Does the money multiplier exist?". *Journal of Macroeconomics,* 34, pp. 59-75. https://doi.org/10.1016/j.jmacro.2011.09.009

Carpinelli, Luisa, and Matteo Crosignani. (2021). "The design and transmission of central bank liquidity provisions". *Journal of Financial Economics,* 141, pp. 27-47. https://doi.org/10.1016/j.jfineco.2020.06.025

Casiraghi, Marco, Eugenio Gaiotti, Lisa Rodano, and Alessandro Secchi. (2016). "ECB unconventional monetary policy and the Italian economy during the sovereign debt crisis". *International Journal of Central Banking,* 12(2), pp. 269-315. https://www.ijcb.org/journal/ijcb16q2a6.pdf

Castro, Christian, and Javier Mencía. (2014). "Sovereign Risk and Financial Stability". *Revista de Estabilidad Financiera - Banco de España,* 26, pp, 73-107. https://repositorio.bde.es/handle/123456789/11448

Chen, Jing, Yiwei Dou, Stephen G. Ryan and Youli Zou. (2022). *Does the Current Expected Credit Loss Approach Decrease the Procyclicality of Banks' Lending? Evidence from the COVID-19 Recession.* http://dx.doi.org/10.2139/ssrn.4110109

Choi, In. (2001). "Unit Root Tests for Panel Data". *Journal of International Money and Finance,* 20, pp. 249-72. https://doi.org/10.1016/S0261-5606(00)00048-6

Crosignani, Matteo, Miguel Faria-e-Castro and Luís Fonseca. (2020). "The (Unintended?) consequences of the largest liquidity injection ever". *Journal of Monetary Economics,* 112, pp. 97-112. https://doi.org/10.1016/j.jmoneco.2019.01.020

D'Amico, Stefania, and Thomas B. King. (2013). "Flow and stock effects of large-scale treasury stock purchases: Evidence on the importance of local supply". *Journal of Financial Economics,* 108(2), pp. 425-448. https://doi.org/10.1016/j.jfineco.2012.11.007

Darracq-Paries, Matthieu, and Roberto De Santis. (2015). "A Non-standard Monetary Policy Shock: The ECB's 3-year LTROs and the Shift in Credit Supply". *Journal of International Money and Finance,* 54, pp. 1-34. https://doi.org/10.1016/j.jimonfin.2015.02.011

Dell'Ariccia, Giovanni, Luc Laeven and Robert Marquez. (2014). "Real interest rate, leverage, and bank-risk taking". *Journal of Economic Theory,* 149, pp. 65-99. https://doi.org/10.1016/j.jet.2013.06.002

De Santis, Roberto A. (2020). "Impact of the Asset Purchase Programme on euro area government bond yields using market news". *Economic Modelling,* 86, pp. 192-209. https://doi.org/10.1016/j.econmod.2019.06.011

De Santis, Roberto A., and Fédéric Holm-Hadulla. (2020). "Flow Effects of Central Bank Asset Purchases on Sovereign Bond Prices: Evidence from a Natural Experiment". *Journal of Money, Credit and Banking,* 2020, 52(6), pp. 1467-1491. https://doi.org/10.1111/jmcb.12665

De Santis, Roberto A., and Paolo Surico. (2013). "Bank lending and monetary transmission in the euro area". *Economic Policy,* 28(75), pp. 423-457. https://doi.org/10.1111/1468-0327.12013

Di Maggio, Marco, Amir Kermani and Christopher J. Palmer. (2020). "How Quantitative Easing Works: Evidence on the Refinancing Channel". *The Review of Economic Studies,* 87(3), pp. 1498-1528. https://doi.org/10.1093/restud/rdz060

Drechsler, Itamar, Thomas Drechsel, David Marques-Ibanez and Philipp Schnabl. (2016). "Who Borrows from the Lender of Last Resort?". *Journal of Finance,* 71(5), pp. 1933-74. https://doi.org/10.1111/jofi.12421

Eser, Fabian, and Bernd Schwaab. (2016). "Evaluating the impact of unconventional monetary policy measures: Empirical evidence from the ECB's Securities Markets Programme". *Journal of Financial Economics,* 119(1), pp. 147-167. https://doi.org/10.1016/j.jfineco.2015.06.003

Esposito, Lucia, Davide Fantino and Yeji Sung. (2020). "The Impact of TLTRO2 on the Italian Credit Market: Some Econometric Evidence". Temi di Discussione (Working Papers), 1264, Bank of Italy. https://doi.org/10.2139/ssrn.3612915

European Central Bank. (2011). *ECB Announces Measures to Support Bank Lending and Money Market Activity* [Press release]. https://www.ecb.europa.eu/press/pr/date/2011/html/pr111208_1.en.html

European Central Bank. (2014a). *ECB Announces Monetary Policy Measures to Enhance the Functioning of the Monetary Policy Transmission Mechanism* [Press release]. https://www.ecb.europa.eu/press/pr/date/2014/html/pr140605_2.en.html

European Central Bank. (2014b). *ECB Announces Further Details of the Targeted Long-term Refinancing Operations* [Press release]. https://www.ecb.europa.eu/press/pr/date/2014/html/pr140703_2.en.html

European Central Bank. (2016a). Decision (EU) 2016/948 of the European Central Bank, 1 June 2016 on the implementation of the corporate sector purchase programme (ECB/2016/16). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02016D0016-20200326

European Central Bank. (2016b). "Box 2. The corporate bond market and the ECB's corporate sector purchase programme". *ECB Economic Bulletin,* 5/2016. https://www.ecb.europa.eu/pub/pdf/ecbu/eb201605.en.pdf

European Central Bank. (2017). "Box 5. The targeted longer-term refinancing operations: an overview of the take-up and their impact on bank intermediation". *ECB Economic Bulletin,* 3/2017. https://www.ecb.europa.eu/pub/pdf/other/ebbox201703_05.en.pdf

European Central Bank. (2020a). *Use of the Euro.* https://www.ecb.europa.eu/euro/intro/html/index.en.html

European Central Bank. (2020b). *Asset Purchase Programmes.* https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html [visited on June 6, 2020].

Garcia-de-Andoain, Carlos, Florian Heider, Marie Hoerova and Simone Manganelli. (2016). "Lending-of-last-resort is as lending-of-last-resort does: Central bank liquidity provision and interbank market functioning in the euro area". *Journal of Financial Intermediation,* 28, pp. 32-47. https://doi.org/10.1016/j.jfi.2016.01.003

García-Posada, Miguel, and Marcos Marchetti. (2016). "The bank lending channel of unconventional monetary policy: The impact of the VLTROs on credit supply in Spain". *Economic Modelling,* 58, pp. 427-441. https://doi.org/10.1016/j.econmod.2016.05.002

Gennaioli, Nicola, Alberto Martin and Stefano Rossi. (2014). "Sovereign Default, Domestic Banks, and Financial Institutions". *Journal of Finance,* 69(2), pp. 819-866. https://dx.doi.org/10.2139/ssrn.2023428

Gennaioli, Nicola, Alberto Martin and Stefano Rossi. (2018). "Banks, government Bonds and Default: What do the data say?". *Journal of Monetary Economics,* 98, pp. 98-113. https://doi.org/10.1016/j.jmoneco.2018.04.011

Ghysels, Eric, Julien Idier, Simone Manganelli and Olivier Vergote. (2017). "A High-Frequency Assessment of the ECB Securities Markets Programme". *Journal of the European Economic Association,* 15(1), pp. 218-243. https://doi.org/10.1093/jeea/jvw003

Girotti, Mattia, Guillaume Horny and Jean-Guillaume Sahuc. (2022). "Lost in Negative Territory? Search for Yield!". Working Paper Series, 877, Banque de France. https://www.banque-france.fr/system/files/2023-03/wp877_0.pdf

Hancock, Diana, Andrew J. Laing and James A. Wilcox. (1995). "Bank capital shocks: dynamic effects on securities, loans, and capital". *Journal of Banking & Finance,* 19(3), pp. 661-677. https://doi.org/10.1016/0378-4266(94)00147-U

Hartmann, Philipp, and Frank Smets. (2018). "The European Central Bank's Monetary Policy during its First 20 Years". *Brookings Papers on Economics Activity,* 49(2), pp. 1-146. https://doi.org/10.1353/eca.2018.0026

Head, Allen, Huw Lloyd-Ellis and Hongfei Sun. (2014). "Search, Liquidity, and the Dynamics of House Prices and Construction". *American Economic Review,* 104, pp. 1172-1210. https://doi.org/10.1257/aer.104.4.1172

Holtz-Eakin, Douglas, Whitney Newey and Harvey S. Rosen. (1988). "Estimating Vector Autoregressions with Panel Data". *Econometrica,* 56(6), pp. 1371-1395. https://doi.org/10.2307/1913103

Huizinga, Harry, and Luc Laeven. (2019). "The Procyclicality of Banking: Evidence from the Euro Area". *IMF Economic Review,* 67(3), pp. 496-527. https://doi.org/10.1057/s41308-019-00081-5

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró and Jesús Saurina. (2014). "Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking?". *Econometrica,* 82(2), pp. 463-505. https://doi.org/10.3982/ECTA10104

Kapan, Tumer, and Camelia Minoiu. (2018). "Balance sheet strength and bank lending: Evidence from the global financial crisis." *Journal of Banking and Finance,* 92(1), pp. 35-50. https://doi.org/10.1016/j.jbankfin.2018.04.011

Krishnamurthy, Arvind, Stefan Nagel and Annette Vissing-Jorgensen. (2018). "ECB Policies Involving Government Bond Purchases: Impact and Channels". *Review of Finance,* 22(1), pp. 1-44. https://doi.org/10.1093/rof/rfx053

Laine, Olli-Matti. (2019). "The effect of TLTRO-II on bank lending". Bank of Finland Research Discussion Papers, 7/2019, Bank of Finland. https://publications.bof.fi/handle/10024/48041

Lamas, Matías, and Javier Mencía. (2019). "What Drives Sovereign Debt Portfolios of Banks in a Crisis Context?". ESRB Working Paper Series, 2019/88, European Systemic Risk Board. https://data.europa.eu/doi/10.2849/619802

Lewis, Vivien, and Markus Roth. (2019). "The financial market effects of the ECB's asset purchase programs". *Journal of Financial Stability,* 43, pp. 40-52. https://doi.org/10.1016/j.jfs.2019.05.001

Love, Inessa, and Rima Turk-Ariss. (2014). "Macro-financial linkages in Egypt: A panel analysis of economic shocks and loan portfolio quality". *Journal of International Financial Markets, Institutions & Money,* 28, pp. 158-181. https://doi.org/10.1016/j.intfin.2013.10.006

Love, Inessa, and Lea Zicchino. (2006). "Financial development and dynamic investment behaviour: Evidence from panel VAR". *The Quarterly Review of Economics and Finance,* 46(2), pp. 190-210. https://doi.org/10.1016/j.qref.2005.11.007

Madalla, G. S., and Shaowen Wu. (1999). "A Comparative Study of Unit Root Tests with Panel Data and A New Simple Test." *Oxford Bulletin of Economics and Statistics,* 61(S1), pp. 631-652. https://doi.org/10.1111/1468-0084.0610s1631

Maddaloni, Angela, and José-Luis Peydró. (2011). "Bank Risk-taking, Securitization, Supervision, and Low Interest Rates: Evidence from the Euro-area and the U.S. Lending Standards". *The Review of Financial Studies,* 24(6), pp. 2121-2165. https://doi.org/10.1093/rfs/hhr015

Martinez-Miera, David, and Rafael Repullo. (2017). "Search for Yield". *Econometrica,* 85(2), pp. 351-378. https://doi.org/10.3982/ECTA14057

Mora, Nada, and Andrew Logan. (2012). "Shocks to bank capital: evidence from UK banks at home and away". *Applied Economics,* 44(9), pp. 1103-1119. https://doi.org/10.1080/00036846.2010.537639

Myers, Stewart C., and Nicholas S. Majluf. (1984). "Corporate financing and investment decisions when firms have information that investors do not have". *Journal of Financial Economics,* 13(2), pp. 187-221. https://doi.org/10.1016/0304-405X(84)90023-0

Perdichizzi, Salvatore, Andi Duqi, Philip Molyneux and Hussein Al Tamimi. (2023). "Does unconventional monetary policy boost local economic development? The case of TLTROs and Italy". *Journal of Banking and Finance,* 148, 106736. https://doi.org/10.1016/j.jbankfin.2022.106736

Pesaran, M. Hashem. (2015). *Time Series and Panel Data Econometrics.* Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198736912.001.0001

Popov, Alexander, and Neeltje Van Horen. (2015). "Exporting sovereign stress: evidence from syndicated bank lending during the euro area sovereign debt crisis". *Review of Finance,* 19, pp. 1825-1866. https://doi.org/10.1093/rof/rfu046

Present, Thomas, Mathieu Simoens and Rudi-Vander Vennet. (2023). "European bank margins at the zero lower bound". *Journal of International Money and Finance,* 131, 102803. https://doi.org/10.1016/j.jimonfin.2023.102803

Quint, Dominic, and Oreste Tristani. (2018). "Liquidity provision as a monetary policy tool: The ECB's non-standard measures after the financial crisis". *Journal of International Money and Finance,* 80, pp. 15-34. https://doi.org/10.1016/j.jimonfin.2017.09.009

Rodnyansky, Alexander, and Olivier Darmouni. (2017). "The Effects of Quantitative Easing on Bank Lending Behavior". *The Review of Financial Studies,* 30(11), pp. 3858-3887. https://doi.org/10.1093/rfs/hhx063

Szczerbowicz, Urszula. (2015). "The ECB unconventional monetary policies: Have they lowered market borrowing costs for banks and governments?". *International Journal of Central Banking,* 11(4), pp. 91-127. https://www.ijcb.org/journal/ijcb15q5a3.pdf

Uhlig, Harald. (2014). "Sovereign default risk and banks in a monetary union". *German Economic Review*, 15(1), pp. 23-41. https://doi.org/10.1111/geer.12039

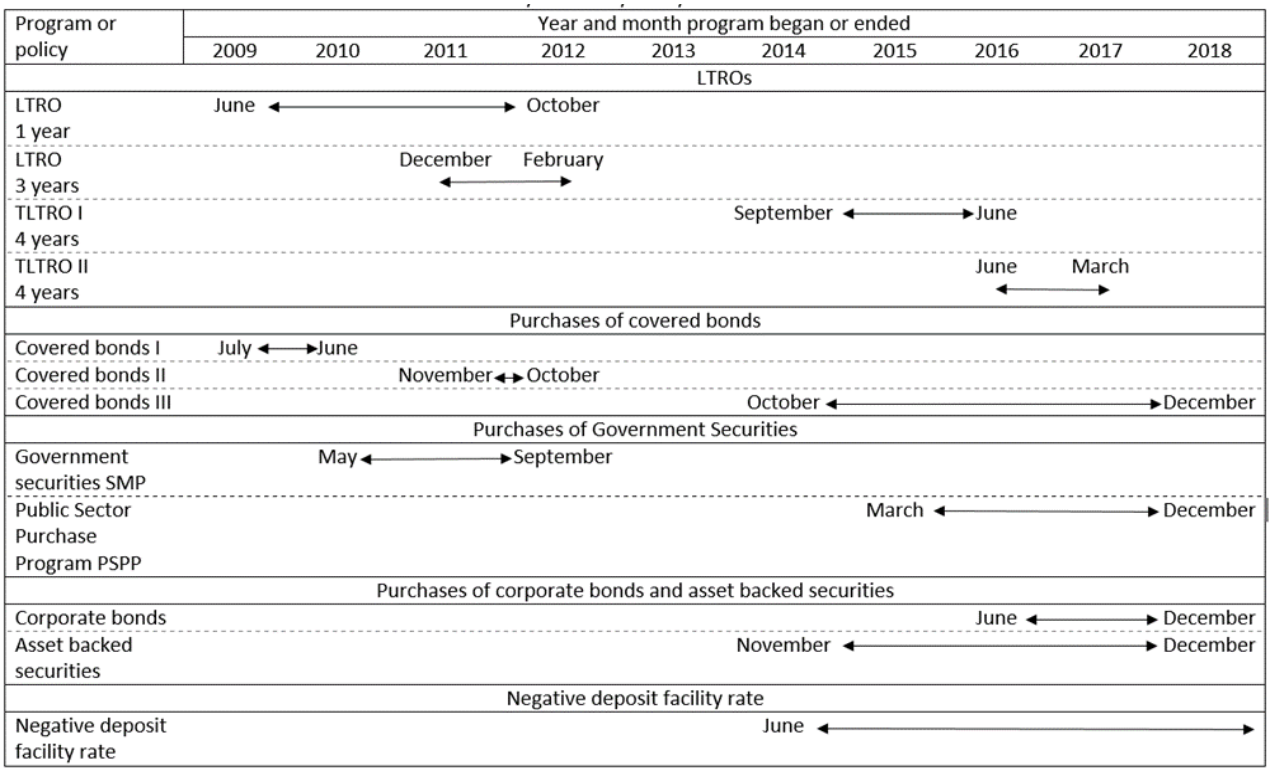
Wright, Jonathan. (2022). *New Empirical Evidence on the Transmission of Unconventional Monetary Policy.* 2022 International Association of Applied Econometrics Conference, London, 21-24 June.

Wu, Jing-Cynthia, and Fan-Dora Xia. (2016). "Measuring the macroeconomic impact of monetary policy at the zero lower bound". *Journal of Money, Credit and Banking,* 48(2-3), pp. 253-291. https://doi.org/10.1111/jmcb.12300

Zwan, Terri van der, Erik Kole and Michel van der Wel. (2022). "Heterogeneous Macro and Financial Effects of ECB Asset Purchase Programs". Tinbergen Institute Discussion Papers, 2021-109/III, Tinbergen Institute. https://dx.doi.org/10.2139/ssrn.4000702

Table 1

The ECB's Unconventional Monetary Policy Measures in period 2009 to 2018



NOTES: We use the first and last months and years at which loans were provided to banks and the dates when the ECB was buying assets for the asset purchase programs. We provide the maturity date or initial term to maturity of assets for each of the Long Term Refinancing Operations (LTROs) and Targeted Long Term Refinancing Operations (TLTROs). We provide no such date for assets purchased because none of the assets acquired has gone to zero. We use the date June 2016 for expiration of TLTRO I since banks were allowed to pay off those loans and switch to the lower cost loans from TLTRO II if they were eligible. We leave the Outright Monetary Transactions (OMT) out of the table since purchases were zero. We draw a line between the first and last months when the beginning and ending months are not in consecutive years.

Table 2

Sample coverage across countries

Non-crisis countries	Number of banks	Number of observations	Percent of total observations
Austria	9	734	7.48%
Belgium	8	789	8.04%
Estonia	2	170	1.73%
Finland	2	135	1.38%
France	9	947	9.66%
Germany	18	1,587	16.18%
Luxembourg	4	375	3.82%
Netherlands	6	661	6.74%
Slovakia	1	119	1.21%
Slovenia	3	303	3.09%
Group total	62		59.12%
Crisis countries			
Cyprus	3	239	2.44%
Greece	4	519	5.29%
Ireland	6	613	6.25%
Italy	12	936	9.54%
Malta	2	203	2.07%
Portugal	4	433	4.41%
Spain	12	1,067	10.88%
Group total	43		40.88%
Sample total	**105**		

Table 3

Description and summary of variables

Abbreviation	Description
Bank-level variables	Gross loans/Total assets
loans	Government securities/Total assets
govsec	Cash and balances in central banks/Total assets
depCB	Deposits from banks/Total assets
depbks	Tangible common equity/Tangible assets
taneg	= (Total equity - Intangible assets)/(Total assets - Intangible assets)
Macro variables	
gdp	Country GDP growth rate
cds	The government credit defau lt swap level for country *j* in year *t* relative to the median credit default swap level in year *t* for the eurozone countries in the sample
ECB policy variables	
ltro	The first round ECB Long Term Refinancing Operations, LTRO, that took place from 2011 - 2014
tltro	The second round ECB Long Term Refinancing Operations that took place from 2015 - 2018 - Targeted LTRO
app	ECB's asset purchase programs: total of private and public asset purchases that occurred over the period 2009 - 2018
ecb_intrate	ECB interest rate at its deposit facility

Table 4

Summary statistics - Bank variables

	All (105 Banks)					
	Obs	Mean	Median	St.Dev.	Min	Max
loans	1,093	0.57	0.61	0.21	1.14E-04	0.99
govsec	757	0.09	0.08	0.07	2.15E-05	0.36
depCB	1,095	0.05	0.02	0.06	3.79E-05	0.52
other assets	1,096	0.34	0.3	0.2	1.99E-02	0.99
depbks	1,088	0.16	0.12	0.14	3.84E-05	0.94
taneq	1,097	0.07	0.06	0.07	-0.05	0.88
total assets	1,097	2.24E+08	6.68E+07	3.82E+08	415,368.00	2.20E+09
	Non-crisis countries (62 Banks)					
	Obs	Mean	Median	St.Dev.	Min	Max
loans	649	0.52	0.55	0.21	2.76E-03	0.95
govsec	467	0.09	0.07	0.07	3.00E-05	0.36
depCB	648	0.05	0.02	0.07	3.79E-05	0.52
other assets	649	0.38	0.35	0.22	1.99E-02	0.99
depbks	642	0.16	0.11	0.15	3.84E-05	0.94
taneq	649	0.06	0.05	0.07	-0.004	0.88
total assets	649	2.68E+08	7.27E+07	4.42E+08	415,368.00	2.20E+09
	Crisis Countries (43 Banks)					
	Obs	Mean	Median	St.Dev.	Min	Max
loans	445	0.65	0.67	0.16	1.14E-04	0.99
govsec	290	0.1	0.09	0.06	2.15E-05	0.27
depCB	447	0.04	0.02	0.05	1.12E-04	0.34
other assets	447	0.3	0.27	0.15	6.58E-02	0.99
depbks	446	0.15	0.13	0.12	0.01	0.83
taneq	448	0.07	0.06	0.08	-0.05	0.76
total assets	448	1.60E+08	6.46E+07	2.59E+08	697,434.00	1.52E+09
	Banks that received government support (29 Banks)					
	Obs	Mean	Median	Std.Dev.	Min	Max
loans	316	0.59	0.63	0.19	0.11	0.93
govsec	211	0.08	0.07	0.06	6.35E-04	0.27
depCB	316	0.03	0.02	0.03	7.54E-04	0.15
other assets	316	0.36	0.32	0.18	0.08	0.88
depbks	316	0.14	0.12	0.1	8.35E-03	0.63
taneq	316	0.05	0.05	0.03	-0.05	0.15
total assets	316	3.83E+08	1.41E+08	4.87E+08	8.89E+06	2.20E+09

Table 5

Diff-in-means analysis of non - crisis countries vs. crisis countries

	Non-crisis countries			Crisis countries			t-test (crisis)	
Variables	Obs.	mean	sd	Obs	mean	sd	t-test	p - value
loans	649	0.52	0.21	445	0.65	0.15	-10.88	0
govsec	467	0.09	0.07	290	0.1	0.06	-2.36	0.02
depCB	648	0.05	0.07	447	0.04	0.05	4.26	0
other assets	649	0.38	0.22	447	0.3	0.15	6.58	0
depbks	642	0.16	0.15	446	0.15	0.12	0.69	0.49
taneq	649	0.06	0.07	448	0.07	0.08	-2.03	0.04
total assets	649	2.68E+08	4.42E+08	448	1.60E+08	2.59E+08	4.66	0

Table 6

Fisher panel unit root tests

Non-crisis countries				
Variable	ADF	p-value	Phillips-Perron	p-value
loans				
Level	-1.1032	0.135	-2.2582**	0.012
Difference	-9.5086***	0	-18.2985***	0
govsec				
Level	0.3069	0.6205	-3.9258***	0
Difference	-6.9720***	0	-14.5778***	0
depCB				
Level	2.9629	0.9985	2.4932	0.9937
Difference	-7.1285***	0	-16.4875***	0
depbks				
Level	-4.6900***	0	-5.8727***	0
Difference	-12.1961***	0	-20.2445***	0
taneq				
Level	2.3975	0.9917	-1.4922	0.0678
Difference	-4.7551***	0	-17.567***	0

Crisis countries				
Variable	ADF	p-value	Phillips-Perron	p-value
loans				
Level	0.4865	0.6867	-1.95	0.0256
Difference	-2.7922**	0.0026	-12.5963***	0
govsec				
Level	-2.465***	0.0069	-1.1532	0.1244
Difference	-2.9664***	0.0015	-9.7597***	0
depCB				
Level	3.4499	0.9997	0.3504	0.637
Difference	-5.0206***	0	-13.3301***	0
depbks				
Level	-6.8944***	0	-3.9359***	0
Difference	-9.8620***	0	-9.4619***	0
taneq				
Level	-0.5465	0.2924	-0.494	0.3106
Difference	-8.5392***	0	-13.1277***	0

NOTES: ADF is Fisher Augmented Dickey-Fuller test of unit roots. PP is Fisher Phillips-Perron test of unit roots. * Significance at 10%, ** Significance at 5% and *** Significance at 1%.

Table 7

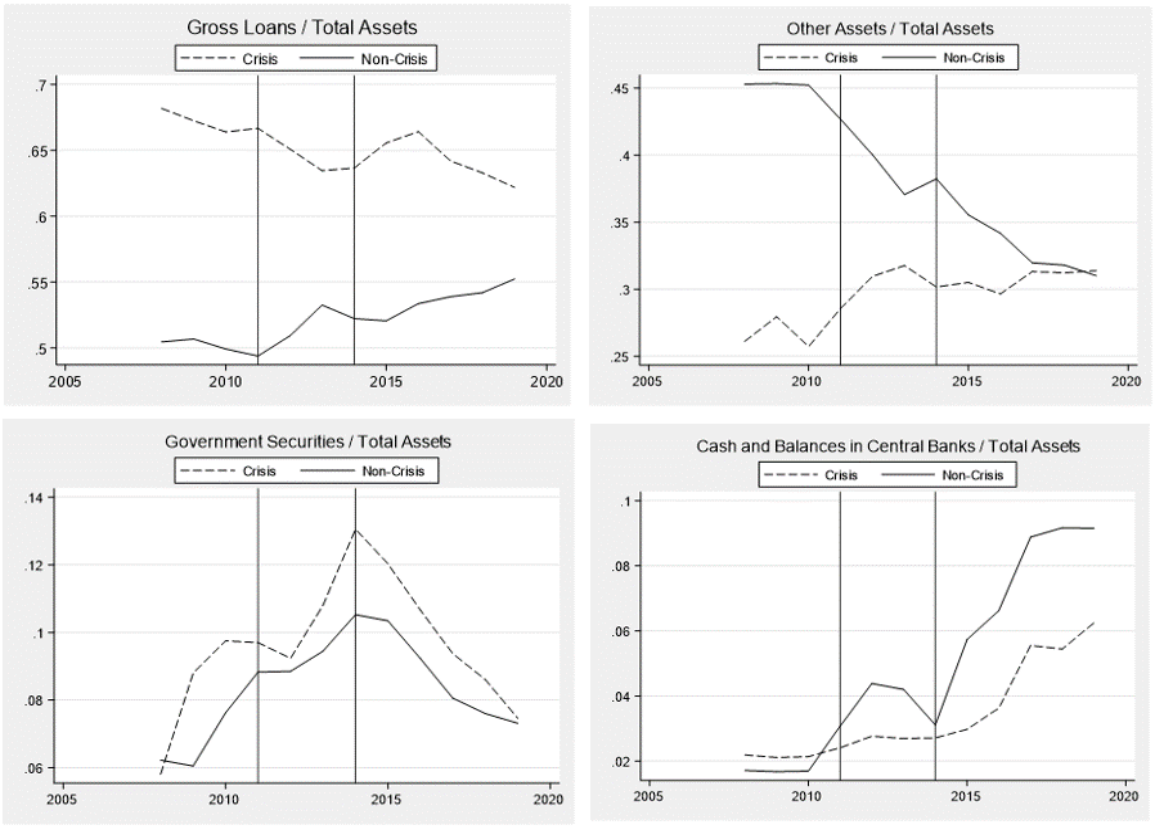
The quantified effects of one mean increase in the ECB's policy variables: *ltro, tltro, ecb_intrate and taneq*

			Non-crisis countries			
	IRFs: *ltro*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.11200	-0.14080		0.22%	-1.56%	
	IRFs: *tltro*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.23860	-0.33070	0.1309	0.46%	-3.67%	2.62%
			Crisis countries			
	IRFs: *ltro*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0		0.11330			1.13%	
	IRFs: *tltro*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.21300	-0.17260		0.33%	-1.73%	
	IRFs: *ecb_intrate*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.05310			0.08%		
	IRFs: *taneq*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.01336			0.02%		
			Banks that received government capitalization			
	IRFs: *ltro*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.11220			0.19%		
	IRFs: *tltro*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0	0.31180	-0.20640	0.09070	0.53%	-2.58%	3.02%
	IRFs: *ecb_intrate*			Quantification (%)		
Time	*loans*	*govsec*	*depCB*	*loans*	*govsec*	*depCB*
0			0.01280			0.43%

NOTES: Table 7 shows the quantified effects of one mean increase in the ECB's policies and factors for which we find statistically significant evidence in the PVARX regression analysis and those are ltro, tltro, ecb_intrate and bank's capital. In the left column, we show the estimated magnitudes of the IRFs of each of the ECB's policies and factors. The magnitudes given in this table correspond to the maximum impact, which is achieved in period zero for all exogenous variables examined in this table (the contemporaneous value of the impact). Additionally we show the magnitudes of all periods in appendices A.2 and A.3. In the right column, we show the change of the mean of each of the investment assets variables, loans, govsec and depCB (in %). Bank variables in the model are used in the first differences transformation; however, we quantify the effects on the untransformed bank variables for which the descriptive statistics is given in Table 4. We also quantify the effect of a one standard deviation shock in each of the policies and factors of interest on bank investment untransformed variables and we find the identical conclusion.

Figure 1

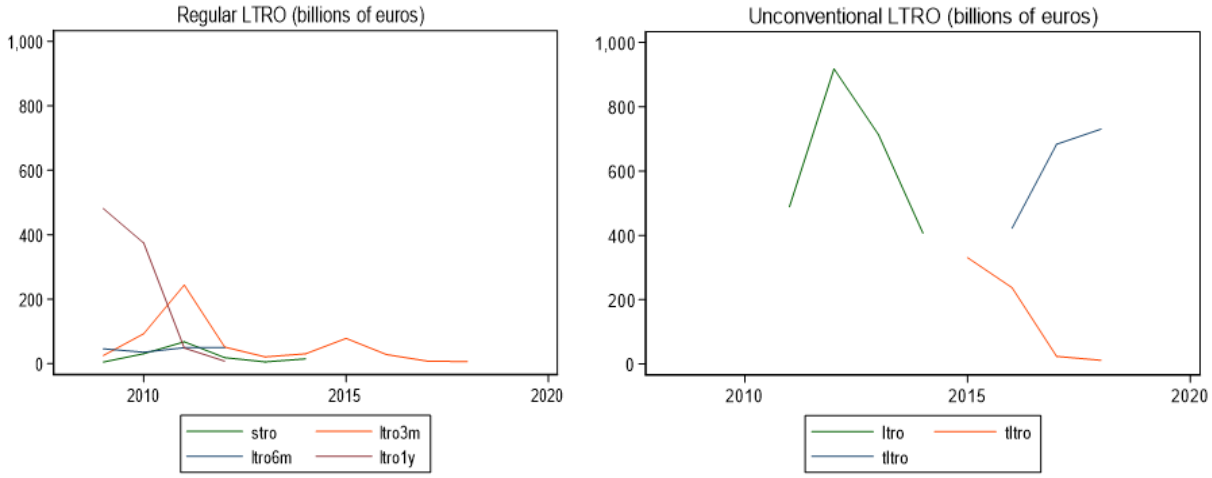
Time evolution of selected assets of our interest: loans, government securities and deposits in central banks



NOTES: Figure 1 shows the time evolution of loans, government securities, cash and balances in central banks and other assets as fractions of total assets over the sample period 2008 – 2019 for the two sets of countries separately: non-crisis and crisis countries. Gross loans corresponds to the Bankfocus term for loans and measures total loans on bank assets portfolios. Government securities corresponds to the Bankfocus term and measures total government securities on bank assets portfolios. Cash and balances in central banks corresponds to the Bankfocus term and refers to deposits in central banks. We put the rest of bank assets in the category "other assets" and we provide their evolution over time for a comparison.
The solid line shows the time evolution of banks' assets in the set of non-crisis countries and the dashed line shows the time evolution of banks' assets in the set of crisis countries. The crisis countries are Cyprus, Greece, Ireland, Italy, Malta, Portugal and Spain. The non-crisis countries are the other 10 members of the euro area in this period, listed in Table 2.

Figure 2

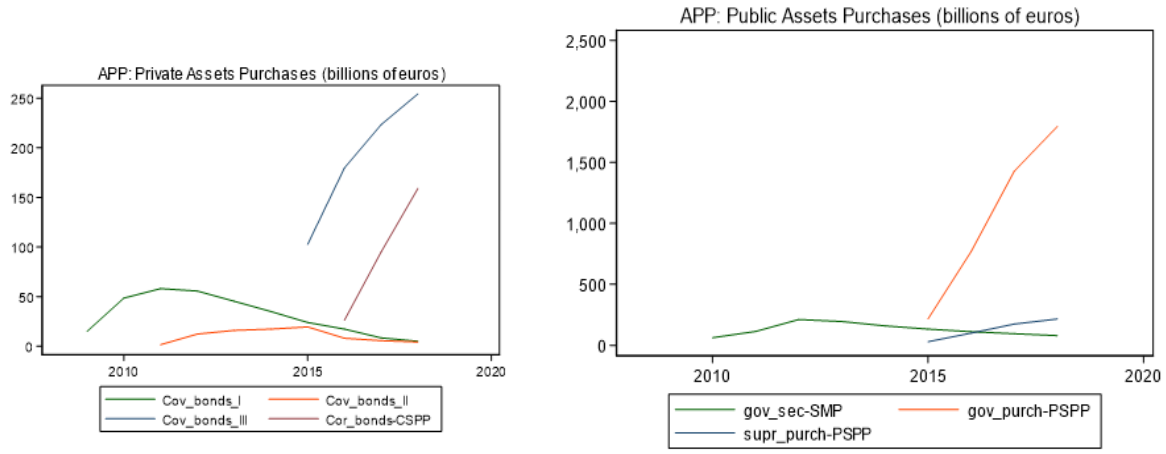
The ECB's LTRO from 2009 to 2018



NOTES: This figure shows the magnitudes and length of time of the regular LTRO and the unconventional LTRO. Left-hand graph shows the magnitudes of the regular LTRO with a maturity of less than 1 year. The right-hand graph shows the magnitudes of the unconventional LTRO implemented since 2011: the first round LTRO (ltro) and targeted LTRO (tltro). The unconventional LTRO differ from the regular LTRO by providing fixed rate full allotment policy (FRFA) and by having long-term maturities of 3 and 4 years.

Figure 3

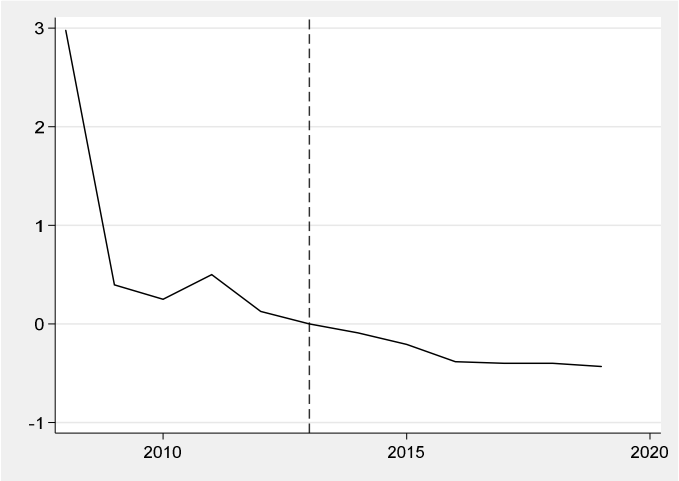
The ECB's Asset Purchase Programs from 2009 to 2018



NOTES: Figure 3 graphs the magnitudes and length of time of the ECB's asset purchase programs. The left-hand graphs shows the purchases of private bonds. "Cov-bons-I" is the first covered bond purchase program (CBPP I) performed from July 2, 2009 to June 30, 2010. "Cov-bonds-II" and "Cov-bons-III" are the second and third covered bond purchase programs performed from November 2011 to October 2012 and from October 2014 to December 2018, respectively. CSPP is the Corporate Sector Purchase Program in which ECB purchased corporate bonds from June 8, 2016 to December 19, 2018. The right-hand graph shows the purchases of government bonds. SMP stands for Securities Market Program. It is the first government securities purchase program performed from May 10, 2010 to September 6, 2012. PSPP stands for Public Securities Purchase Program. It is the second program lunched by ECB to purchase government securities and it was active from March 9, 2015 to December 19, 2018. "supr_purch-PSPP" corresponds to the part of the PSPP that included purchases of supranational bonds (bonds issued by recognized agencies, regional and local governments, international organizations and multilateral development banks located in the euro area). The vertical scales of the two graphs differ by a factor of ten.

Figure 4

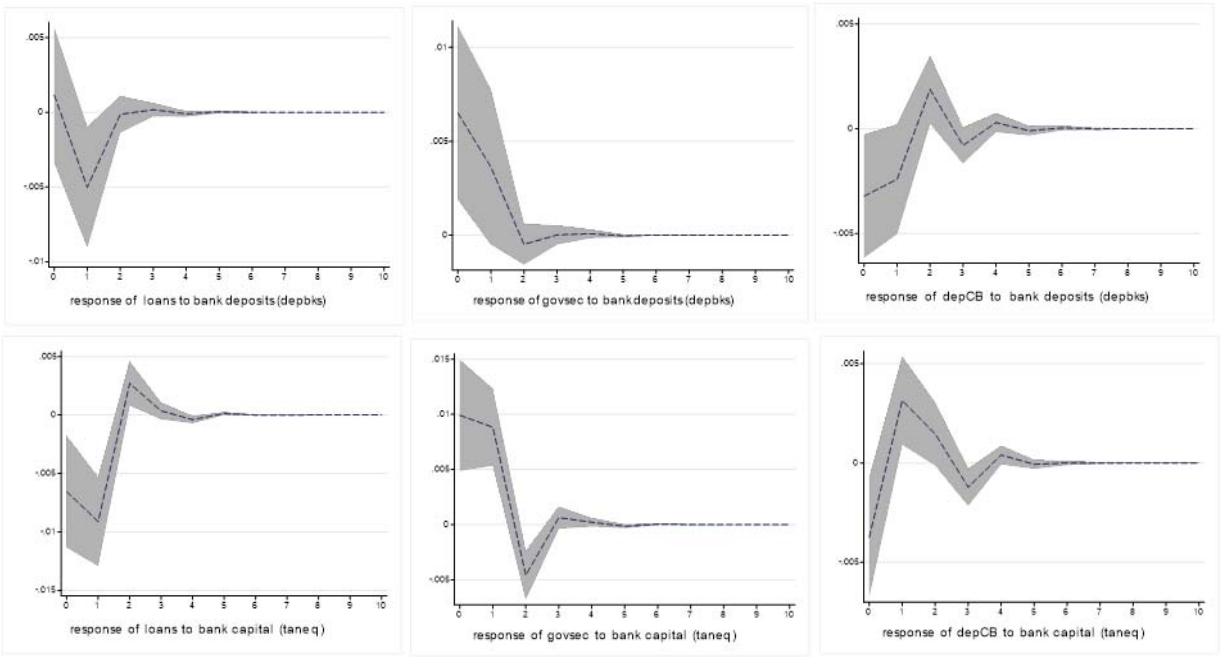
ECB's Interest rate at its deposit facility



NOTES: Figure 4 shows the time evolution of the ECB's interest rate at it deposit facility over 2009 – 2020 period. The ECB's interest rate at its deposit facility reached the zero lower bound over the year of 2013. In June, 2014 it became negative and continued to operate in the negative territory until the end of our sample period in 2019.

Figure 5

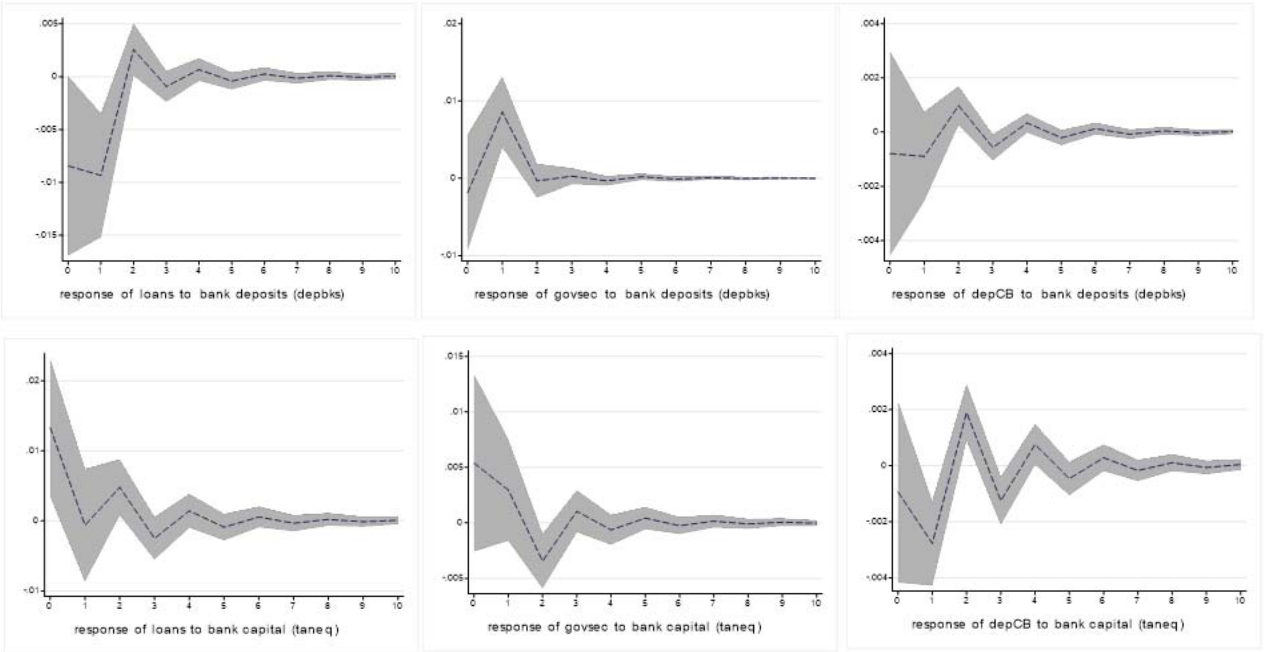
Orthogonalized IRFs to shocks in bank-financing factors: bank deposits and bank capital. Sample: Non-crisis countries



NOTES: This figure shows the IRFs for loans, government securities and deposits in central banks in response to shocks to bank deposits and bank capital in non-crisis countries. The shaded area indicates the 95 percent confidence interval.

Figure 6

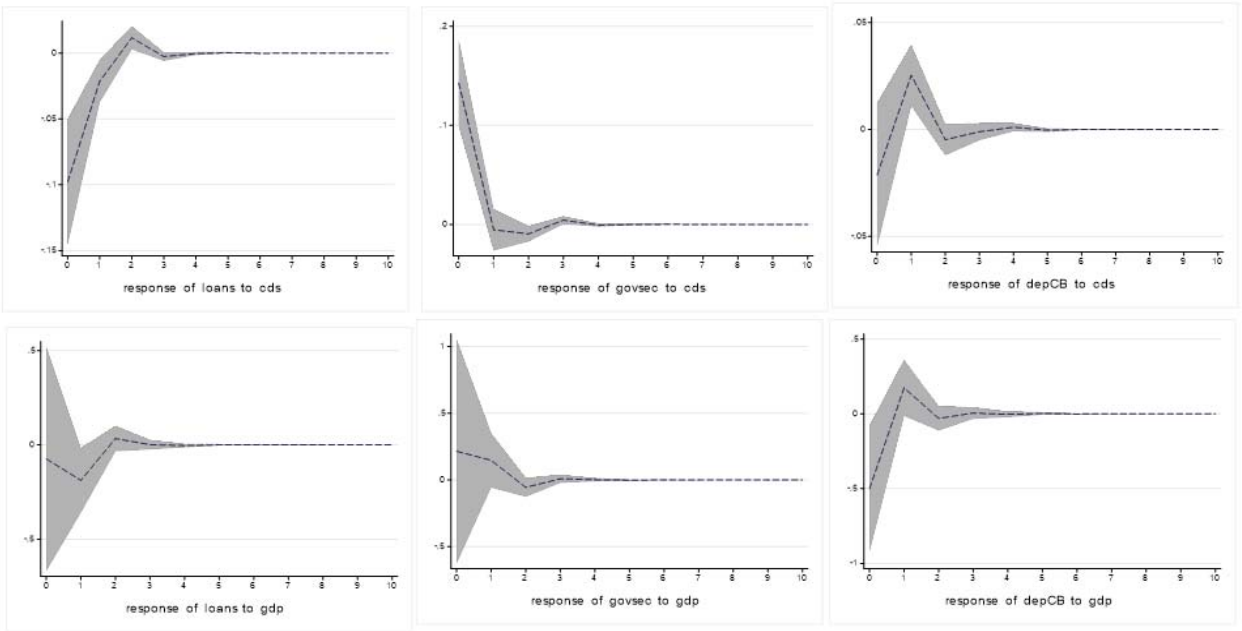
Orthogonalized IRFs to shocks in bank-financing factors: bank deposits and bank capital



NOTES: This figure shows the IRFs for loans, government securities and deposits in central banks in response to shocks to bank deposits and bank capital in crisis countries. The shaded area indicates the 95 percent confidence interval.

Figure 7

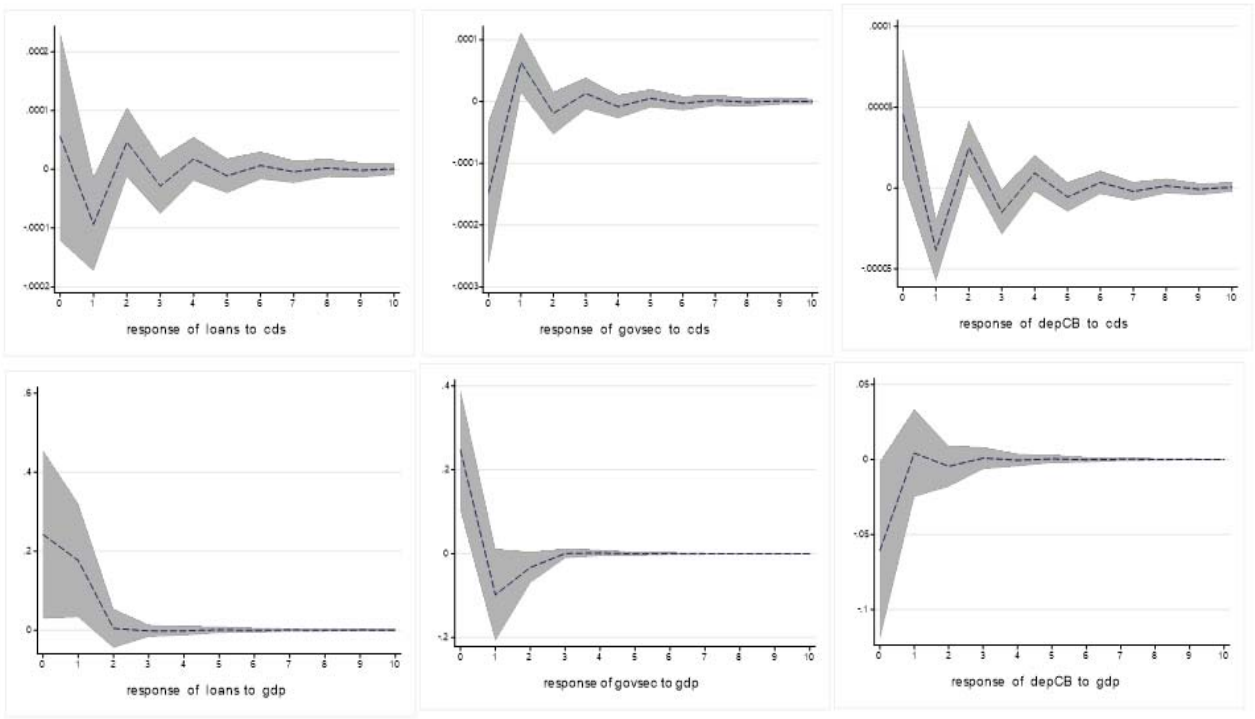
Dynamic Multipliers for Orthogonalized Shocks to Macroeconomic Factors: Credit Default Swap for Countries and GDP Growth. Sample: Non-crisis Countries



NOTES: This figure shows the impulse-response functions for loans, government securities (govsec) and deposits in central banks (depCB) in response to shocks to macroeconomic factors in non-crisis countries. cds stands for credit default swap for countries and gdp stands for GDP growth. The shaded area indicates the 95 percent confidence interval.

Figure 8

Dynamic Multipliers for Orthogonalized Shocks to Macroeconomic Factors: Credit Default Swap for Countries and GDP Growth. Sample: Crisis Countries

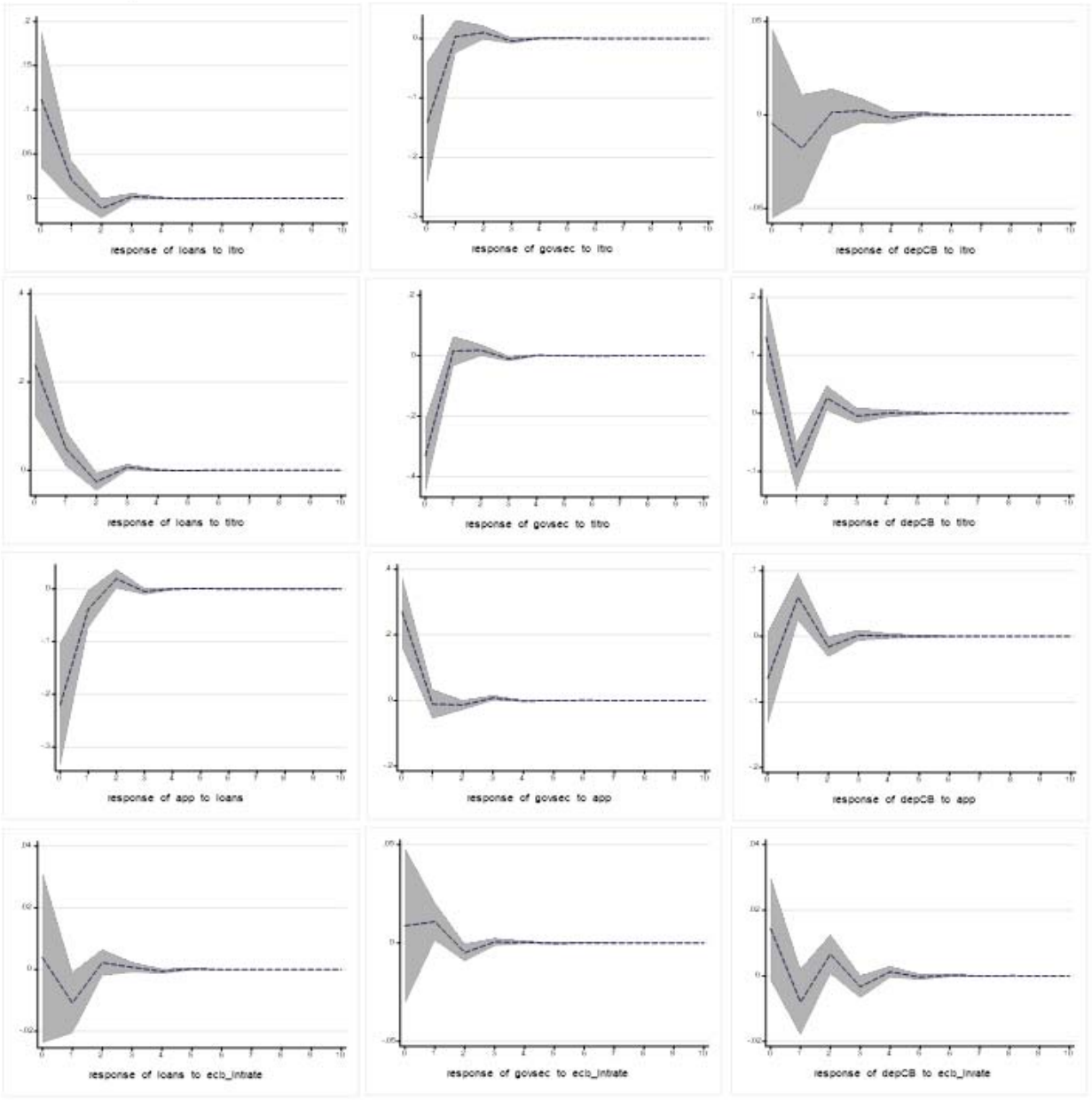


NOTES: This figure shows the impulse-response functions for loans, government securities (govsec) and deposits in central banks (depCB) in response to shocks to macroeconomic factors in crisis countries.. cds stands for credit default swap for countries and gdp stands for GDP growth. The shaded area indicates the 95 percent confidence interval.

.

Figure 9

Dynamic Multipliers for Orthogonalized Shocks to Unconventional Policies. Sample: Non-crisis countries

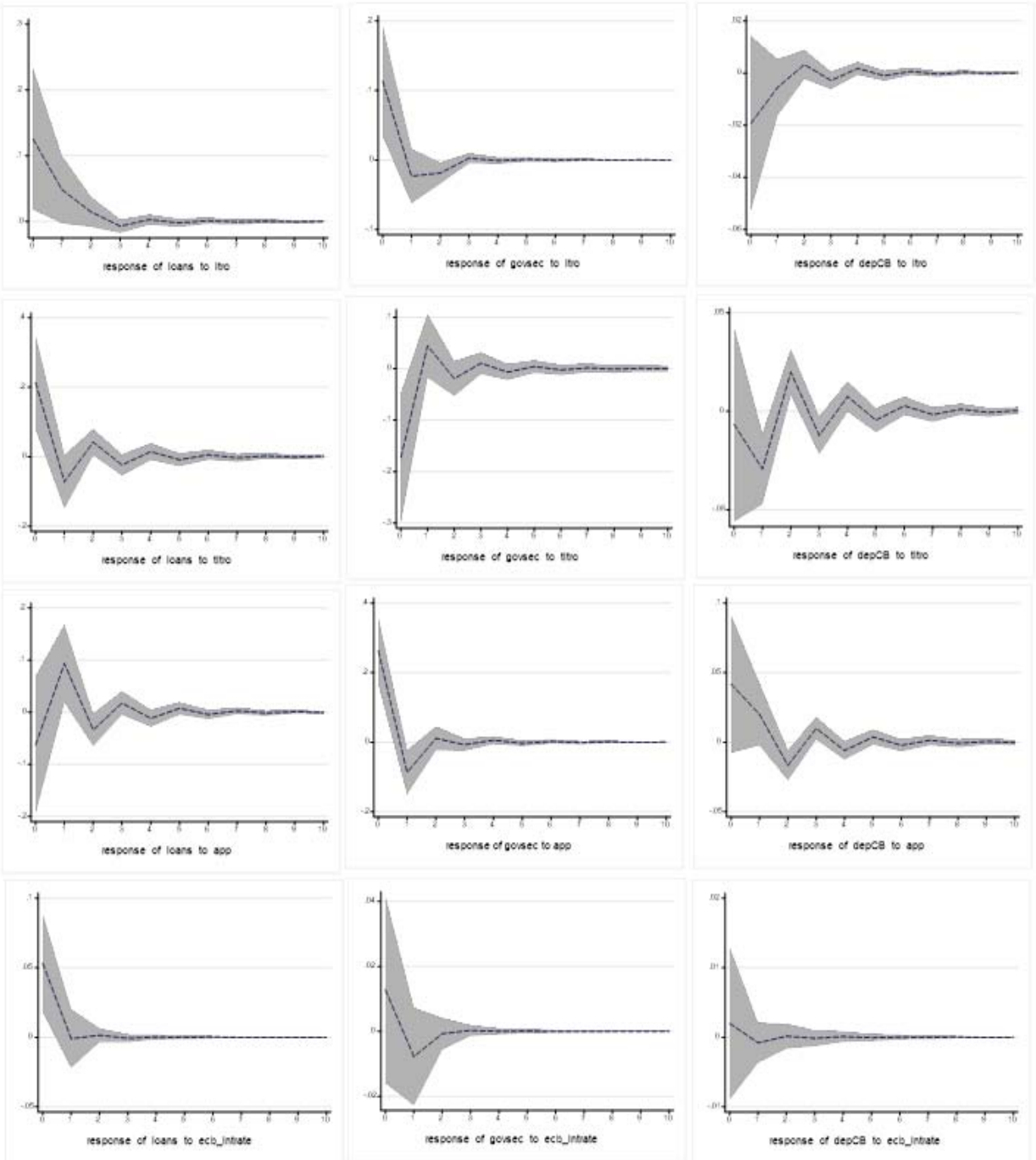


NOTES: This figure shows the impulse-response functions of loans, government securities (govsec) and deposits in central banks (depCB) in response to shocks in unconventional policies in non-crisis countries. ltro notes the first round unconventional ltro, tltro notes the targeted ltro, app stands for the asset purchase programs and ecb-intrate corresponds to the ecb's interest rate at its deposit facility. The shaded area indicates the 95 percent confidence interval.

.

Figure 10

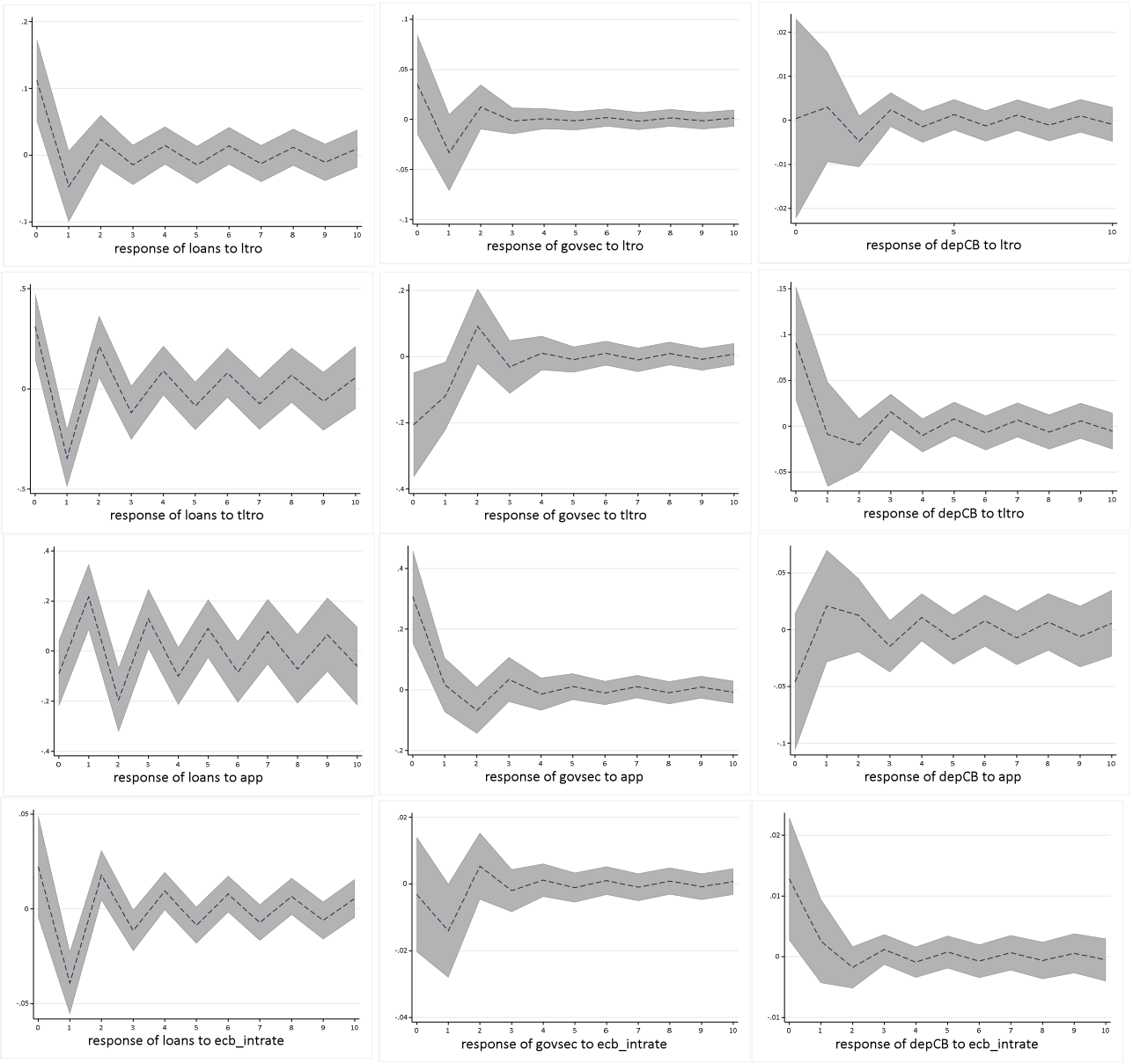
Dynamic Multipliers for Orthogonalized Shocks to Unconventional Policies: Crisis countries



NOTES: This figure shows the impulse-response functions of loans, government securities (govsec) and deposits in central banks (depCB) in response to shocks in unconventional policies in crisis countries. ltro notes the first round unconventional ltro, tltro notes the targeted ltro, app stands for the asset purchase programs and ecb-intrate corresponds to the ecb's interest rate at its deposit facility. The shaded area indicates the 95 percent confidence interval.

Figure 11

Dynamic multipliers for orthogonalized shocks to ECB unconventional monetary policies: Set of banks that received government capitalization



NOTE: TThis figure shows the impulse-response functions of loans, government securities (govsec) and deposits in central banks (depCB) in response to shocks in unconventional policies in the set of banks that received government support. ltro notes the first round unconventional ltro, tltro notes the targeted ltro, app stands for the asset purchase programs and ecb-intrate corresponds to the ecb's interest rate at its deposit facility. The shaded area indicates the 95 percent confidence interval.

Appendix A.1 Descriptive statistics of the macroeconomic variables and list of banks

Table A.1.1

Summary statistics of the macroeconomic variables over time

		GDP growth rate					*Government's Credit Default Swap*				
Year	Obs.	Mean	Median	St.Dev	Min	Max	Mean	Median	St.Dev	Min	Max
2008	17	0.01	0.01	0.03	-0.05	0.06	1.09	1.00	1.09	0.00	5.02
2009	17	-0.05	-0.04	0.03	-0.14	-0.02	1.03	1.00	0.76	0.00	3.34
2010	17	0.02	0.02	0.02	-0.05	0.06	1.41	1.00	1.38	0.00	5.93
2011	17	0.01	0.02	0.03	-0.09	0.07	2.06	1.00	3.12	0.00	13.37
2012	17	-0.01	-0.004	0.03	-0.07	0.03	7.82	1.00	26.68	0.00	111.24
2013	17	-0.002	0.0003	0.03	-0.07	0.05	14.04	1.00	51.67	0.00	214.47
2014	17	0.02	0.01	0.03	-0.02	0.09	16.42	1.00	62.41	0.00	258.55
2015	17	0.04	0.02	0.06	-0.004	0.25	2.33	1.00	4.27	0.00	18.41
2016	17	0.03	0.02	0.02	-0.002	0.07	1.84	1.00	2.37	0.00	10.18
2017	17	0.03	0.03	0.02	0.02	0.08	1.59	1.00	1.81	0.00	7.69
2018	17	0.03	0.03	0.02	0.01	0.08	1.32	1.00	1.39	0.00	5.60
2019	17	0.02	0.02	0.02	0.003	0.06	1.30	1.00	1.31	0.00	4.95

NOTE: The Credit Default Swap of Luxembourg is 0 over the entire sample period 2008 – 2019.

Table A.1.2

Pairwise correlation between GDP and Credit Default Swap across time

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
-0,50	-0,62	-0,84	-0,88	-0,63	-0,33	-0,14	-0,17	-0,25	-0,06	0,11	0,17

Table A.1.3

List of Banks

	Bank	Bank's Headquarter	Country
1	Investar (Holding of Argenta Bank- en Verzekeringsgroep)	ANTWERPEN	BELGIUM
2	OP Financial Group	HELSINKI	FINLAND
3	BNP Paribas S.A.	PARIS	FRANCE
4	Societe Generale S.A.	PARIS	FRANCE
5	ABN AMRO Bank N.V.	AMSTERDAM	NETHERLANDS
6	Groupe Credit Agricole	MONTROUGE	FRANCE
7	CaixaBank, S.A.	VALENCIA	SPAIN
8	BFA, Tenedora de Acciones, S.A.U.	MADRID- CASTILLE-LA MANCHE	SPAIN
9	THE BANK OF NEW YORK MELLON S.A./N.V.	BRUSSELS	BELGIUM
10	Liberbank S.A.	MADRID	SPAIN
11	RCI Banque	NOISY LE GRAND CEDEX	FRANCE
12	BPI France (Banque Publique d'Investissement)	MAISONS ALFORT	FRANCE
13	Deutsche Pfandbriefbank AG	Unterschleißheim	GERMANY
14	Bayerische Landesbank	MÜNCHEN	GERMANY
15	Commerzbank AG	FRANKFURT AM MAIN 1	GERMANY
16	Deutsche Bank AG	FRANKFURT AM MAIN	GERMANY
17	Aareal Bank AG	WIESBADEN	GERMANY
18	DekaBank Deutsche Girozentrale	Frankfurt am Main	GERMANY
19	HASPA Finanzholding	HAMBURG 11	GERMANY
20	Landesbank Hessen-Thueringen Girozentrale	Frankfurt am Main	GERMANY
21	Norddeutsche Landesbank Girozentrale	HANNOVER	GERMANY
22	Caja de Ahorros y M.P. de Zaragoza	ZARAGOZA	SPAIN
23	ABANCA Corporacion Bancaria, S.A.	LA CORUNA (A CORUNA)	SPAIN
24	Volkswagen Bank GmbH	BRAUNSCHWEIG	GERMANY
25	Landesbank Berlin Holding AG	Berlin	GERMANY
26	Kutxabank, S.A.	BILBAO	SPAIN
27	Volkswagen Financial Services AG	BRAUNSCHWEIG	GERMANY
28	Unione di Banche Italiane S.p.A.	BERGAMO	ITALY
29	Hypo Real Estate Holding GmbH	MUENCHEN	GERMANY
30	DZ Bank AG Deutsche Zentral-Genossenschaftsbank	FRANKFURT AM MAIN	GERMANY
31	Municipality Finance PLC	HELSINKI	FINLAND
32	OESTERREICHISCHE VOLKSBANK AG (Volksbank Gruppe)	VIENNA	AUSTRIA
33	DEPFA BANK plc	DUBLIN 1	IRELAND
34	HSH Nordbank AG	HAMBURG	GERMANY
35	Allied Irish Banks, plc	DUBLIN 2	IRELAND
36	Bank of Ireland	DUBLIN 4	IRELAND
37	Credit Institution Ulster Bank Ireland Designated Activity Company	DUBLIN 2	IRELAND
38	Credit Institution Iccrea Banca S.p.A. - Istituto Centrale del Credito Cooperativo	ROME	ITALY
39	Banca Monte dei Paschi di Siena SpA	SIENA	ITALY
40	Banca Carige S.p.A. - Cassa di Risparmio di Genova e Imperia	GENOVA	ITALY
41	Credit Institution Banque Internationale à Luxembourg S.A.	LUXEMBOURG	LUXEMBOURG
42	Banque et Caisse d'Epargne de l'Etat	LUXEMBOURG	LUXEMBOURG
43	BNG Bank N.V.	THE HAGUE	NETHERLANDS
44	ING Groep N.V.	AMSTERDAM	NETHERLANDS
45	Cooperatieve Rabobank U.A.	UTRECHT	NETHERLANDS

Table A.1.3

List of Banks (cont'd)

	Bank	Bank's Headquarter	Country
46	Credit Institution de Volksbank N.V.	'S-HERTOGENBOSCH	NETHERLANDS
47	ING Bank N.V.	AMSTERDAM	NETHERLANDS
48	Caixa Geral de Depositos, S.A.	LISBON CODEX	PORTUGAL
49	Banco Comercial Portugues, S.A.	PORTO	PORTUGAL
50	Banco Bilbao Vizcaya Argentaria, S.A.	BILBAO	SPAIN
51	Bankinter	MADRID -CASTILE-LA MANCHA	SPAIN
52	Banco de Sabadell S.A.	ALICANTE	SPAIN
53	Groupe BPCE	PARIS	FRANCE
54	Bank of Valletta plc	VALLETTA	MALTA
55	La Banque Postale	PARIS CEDEX 06	FRANCE
56	RBC Investor Services Bank S.A.	ESCH-SUR-ALZETTE	LUXEMBOURG
57	Sberbank Europe AG	VIENNA	AUSTRIA
58	Bank of Cyprus Public Company Ltd	NICOSIA	CYPRUS
59	Nova Kreditna Banka Maribor d.d.	MARIBOR	SLOVENIA
60	Nova Ljubljanska banka d. d.	LJUBLJANA	SLOVENIA
61	Cyprus Popular Bank Public Co Ltd	NICOSIA	CYPRUS
62	Hellenic Bank Public Company Ltd	NICOSIA	CYPRUS
63	Raiffeisenlandesbank Oberosterreich AG	LINZ	AUSTRIA
64	Credit Institution Tatra banka, a.s	BRATISLAVA	SLOVAKIA
65	Raiffeisen Bank International AG	VIENNA	AUSTRIA
66	Alpha Bank AE	ATHENS	GREECE
67	Banca Piccolo Credito Valtellinese	SONDRIO	ITALY
68	AXA Bank Belgium	BRUSSELS	BELGIUM
69	BPER Banca S.p.A.	MODENA	ITALY
70	National Bank of Greece S.A.	ATHENS	GREECE
71	Credit Institution Banque Degroof Petercam SA	BRUSSELS	BELGIUM
72	BAWAG P.S.K.	VIENNA	AUSTRIA
73	Landwirtschaftliche Rentenbank	FRANKFURT	GERMANY
74	Raiffeisenlandesbank Niederoesterreich-Wien AG	VIENNA	AUSTRIA
75	Piraeus Bank S.A.	ATHENS	GREECE
76	Investeringsmaatschappij Argenta (Argenta Bank)	ANTWERPEN	BELGIUM
77	Banque PSA Finance	PARIS	FRANCE
78	Credit Institution Swedbank AS	TALLINN	ESTONIA
79	Mediobanca Spa	MILAN	ITALY
80	Dexia NV*	BRUSSELS	BELGIUM
81	Banco BPI S.A.	PORTO	PORTUGAL
82	Credito Emiliano S.p.A.	REGGIO-EMILIA	ITALY
83	Banca Popolare di Sondrio	SONDRIO	ITALY
84	Erste Group Bank AG	VIENNA	AUSTRIA
85	Intesa Sanpaolo S.p.A.	TORINO	ITALY
86	UniCredit S.p.A.	MILANO	ITALY
87	Banco Santander S.A.	SANTANDER-CANTABRIA	SPAIN
88	Landesbank Baden-Wuerttemberg	STUTTGART	GERMANY
89	SID Bank Inc Ljubljana	LJUBLJANA	SLOVENIA
90	KBC Group NV	BRUSSELS	BELGIUM
91	Belfius Bank SA/NV	BRUSSELS	BELGIUM

Table A.1.3

List of Banks (cont'd)

	Bank	Bank's Headquarter	Country
92	Eurobank Ergasias S.A.	ATHENS	GREECE
93	Criteria Caixa, S.A.U.	PALMA DE MALLORCA	SPAIN
94	Unicaja Banco S.A.	MALAGA-MURCIA	SPAIN
95	Societe de Financement Local (SFIL)	ISSY LES MOULINEAUX	FRANCE
96	Novo Banco, S.A.	LISBOA	PORTUGAL
97	AS LHV Group	TALLINN	ESTONIA
98	Financial Holding Raiffeisenbankengruppe OÖ Verbund eGen	LINZ	AUSTRIA
99	Permanent TSB Group Holdings P.L.C	DUBLIN 2	IRELAND
100	Erwerbsgesellschaft der S-Finanzgruppe mbH & Co KG	NEUHARDENBERG	GERMANY
101	Precision Capital S.A.	LUXEMBOURG	LUXEMBOURG
102	MeDirect Group Limited (MBD Group)	VALLETTA	MALTA
103	Credit Institution Banco BPM S.p.A	MILANO	ITALY
104	BAWAG Group AG	WIEN	AUSTRIA
105	Bank of Ireland Group Public Limited Company	DUBLIN	IRELAND

Appendix A.2 All relevant estimates of the reduced-form of the PVARX model in Eq. (2)

Table A.2.1
Coefficients estimates of the reduced-form of non-crisis countries:

VARIABLES	*taneq*	*depbks*	*loans*	*govsec*	*depCB*
L.taneq	-0.139**	-0.686***	-0.700***	0.843***	-0.0520
	(0.0647)	(0.132)	(0.142)	(0.126)	(0.0576)
L.depbks	-0.00137	0.0408	-0.116**	0.130**	-0.0925***
	(0.0125)	(0.0488)	(0.0532)	(0.0561)	(0.0285)
L.loans	-0.0293**	-0.00422	-0.0206	-0.0678**	-0.214***
	(0.0135)	(0.0303)	(0.0477)	(0.0325)	(0.0455)
L.govsec	-0.0876***	0.0242	-0.0741*	-0.185***	-0.0217
	(0.0201)	(0.0270)	(0.0411)	(0.0466)	(0.0347)
L.depCB	-0.00375	-0.0447	0.0889	-0.0634	-0.415***
	(0.0172)	(0.0372)	(0.0544)	(0.0618)	(0.0670)
gdp	0.112	0.436*	-0.0741	0.216	-0.501**
	(0.0780)	(0.244)	(0.310)	(0.401)	(0.228)
cds	0.0143*	0.00718	-0.0978***	0.143***	-0.0212
	(0.00745)	(0.0184)	(0.0240)	(0.0225)	(0.0174)
ltro	-0.0178	-0.00459	0.112***	-0.141***	-0.00441
	(0.0121)	(0.0329)	(0.0401)	(0.0508)	(0.0292)
tltro	-0.0150	-0.0652	0.239***	-0.331***	0.131***
	(0.0154)	(0.0449)	(0.0600)	(0.0596)	(0.0414)
app	0.0110	0.0815**	-0.220***	0.270***	-0.0644*
	(0.0139)	(0.0405)	(0.0571)	(0.0560)	(0.0388)
ecb_intrate	0.0159***	0.00193	0.00389	0.00869	0.0144*
	(0.00525)	(0.0143)	(0.0144)	(0.0185)	(0.00807)
Observations	295	295	295	295	295
Instruments	01-abr	01-abr	01-abr	01-abr	01-abr
FE elim	fod	fod	fod	fod	fod
CD	0.80	0.80	0.80	0.80	0.80
J	67.99	67.99	67.99	67.99	67.99
pval	0.7	0.7	0.7	0.7	0.7
Model	FD	FD	FD	FD	FD
Panels	49	49	49	49	49

NOTES: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.2.2

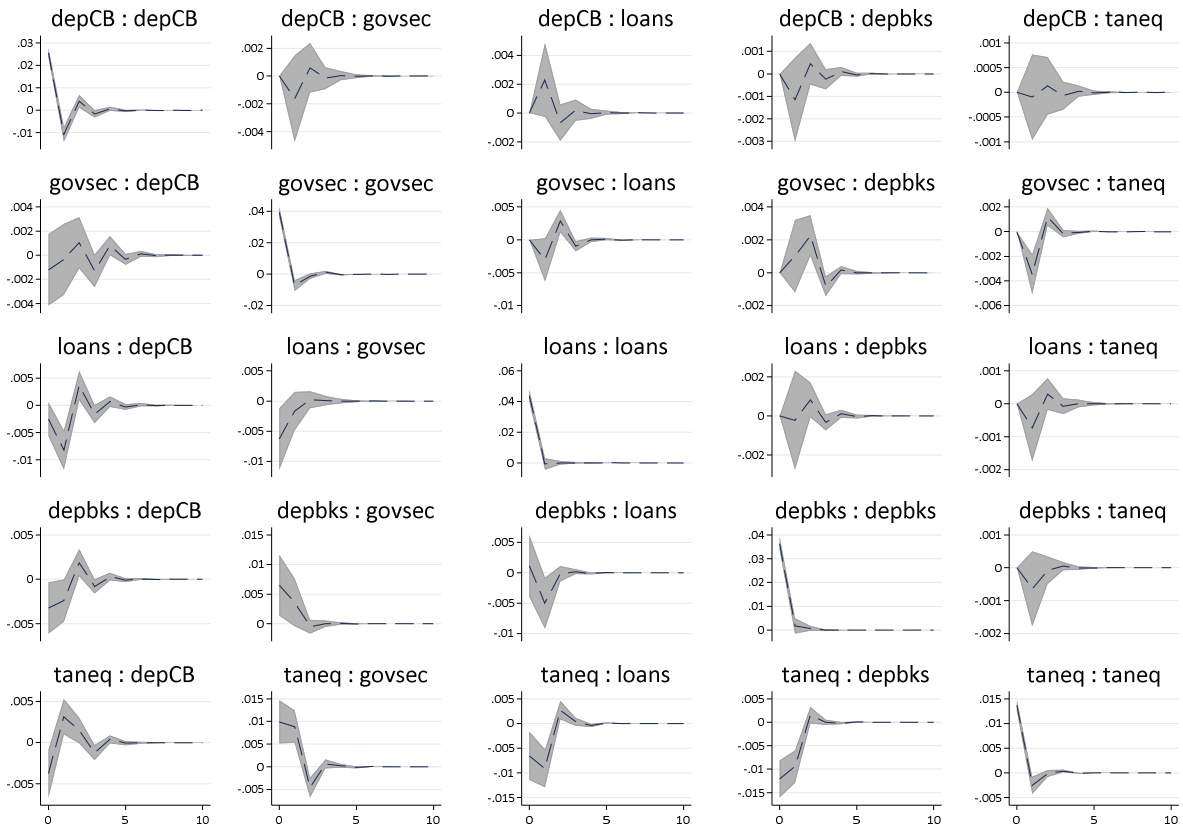
Dynamic multipliers for orthogonalized shocks to macroeconomic factors and ECB unconventional monetary policies: non-crisis countries

VARIABLES	*taneq*	*depbks*	*loans*	*govsec*	*depCB*
L.taneq	-0.526***	0.136	-0.311*	0.378***	-0.138***
	(0.0927)	(0.157)	(0.168)	(0.0872)	(0.0264)
L.depbks	-0.0371	-0.133**	-0.116***	0.0891***	-0.0150
	(0.0229)	(0.0531)	(0.0442)	(0.0292)	(0.00958)
L.loans	-0.0517**	-0.0769	0.119	-0.209***	-0.0184
	(0.0209)	(0.0560)	(0.0786)	(0.0372)	(0.0153)
L.govsec	0.113***	-0.403***	0.182***	-0.1000	0.0301
	(0.0220)	(0.0825)	(0.0666)	(0.0711)	(0.0229)
L.depCB	-0.169**	0.407**	-0.467**	-0.218**	-0.112**
	(0.0728)	(0.185)	(0.203)	(0.0933)	(0.0498)
gdp	0.156***	-1.060***	0.242**	0.247***	-0.0607**
	(0.0428)	(0.261)	(0.110)	(0.0744)	(0.0300)
cds	0.000216***	-0.000130	5.62e-05	-0.000147***	4.52e-05**
	(3.47e-05)	(8.34e-05)	(9.12e-05)	(5.31e-05)	(2.06e-05)
ltro	0.0946***	-0.287***	0.125**	0.113***	-0.0192
	(0.0159)	(0.0707)	(0.0534)	(0.0396)	(0.0174)
tltro	0.122***	0.271***	0.213***	-0.173***	-0.00662
	(0.0306)	(0.0982)	(0.0698)	(0.0589)	(0.0280)
app	-0.0641**	-0.451***	-0.0628	0.263***	0.0417*
	(0.0263)	(0.0940)	(0.0611)	(0.0534)	(0.0239)
ecb_intrate	-0.0116	0.106***	0.0531***	0.0127	0.00198
	(0.00779)	(0.0330)	(0.0197)	(0.0135)	(0.00603)
Observations	152	152	152	152	152
Instruments	01-abr	01-abr	01-abr	01-abr	01-abr
FE elim	fod	fod	fod	fod	fod
CD	0.56	0.56	0.56	0.56	0.56
J	95.44	95.44	95.44	95.44	95.44
pval	0.06	0.06	0.06	0.06	0.06
Model	FD	FD	FD	FD	FD
Panels	26	26	26	26	26

NOTES: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure A.2.1

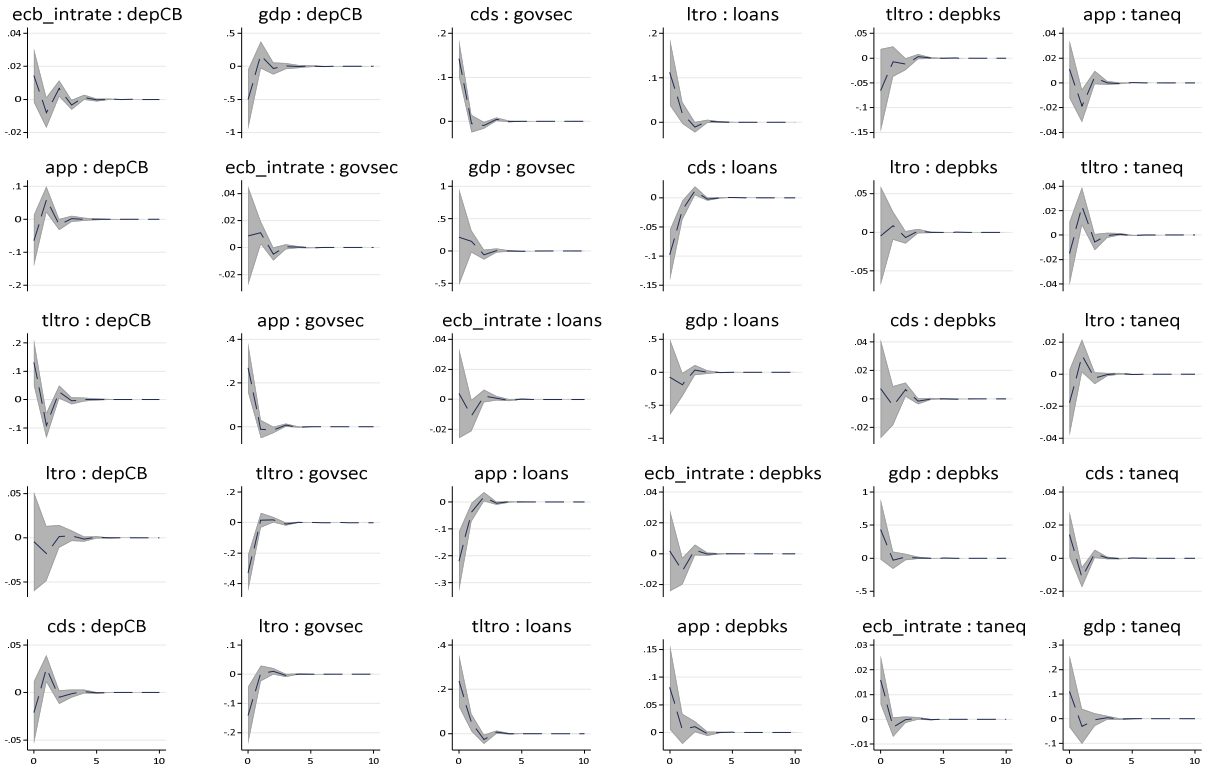
Orthogonalized impulse-response functions to shocks in bank financing factors: Bank capital and bank deposits – non-crisis countries



NOTES: This figure shows the impulse-response functions for loans, government securities and deposits in central banks in response to shocks to bank deposits and bank capital in crisis countries. The shaded area indicates the 95 percent confidence interval.

Figure A.2.2

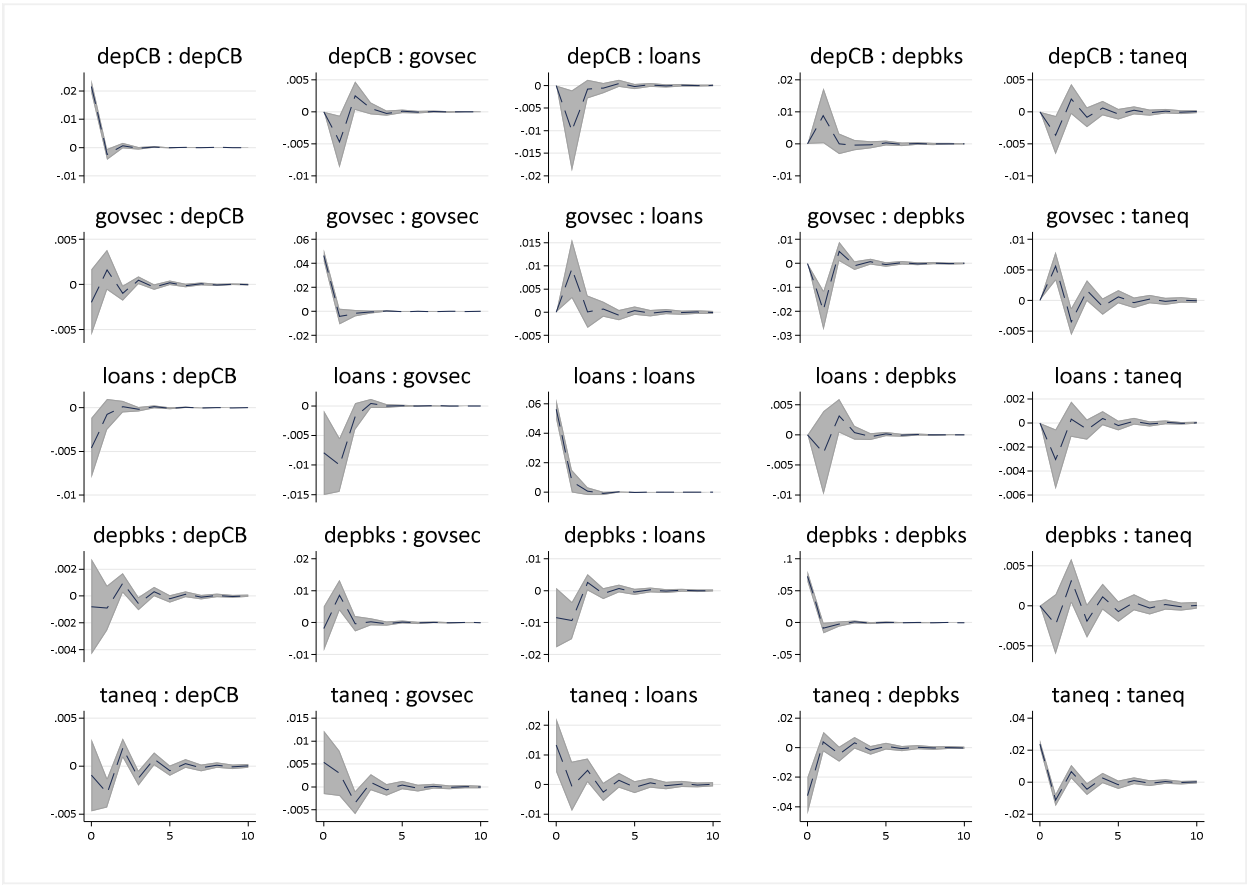
Dynamic multipliers for orthogonalized shocks to macroeconomic factors and ECB unconventional monetary policies: non-crisis countries



NOTES: This figure shows the impulse-response functions for loans, government securities (*govsec*) and deposits in central banks (*depCB*) in response to shocks to macroeconomic factors and ECB unconventional monetary policies in non- crisis countries. *cds* stands for credit default swap for countries, *gdp* stands for GDP growth, *ltro* notes the first round unconventional ltro, *tltro* notes the targeted ltro, *app* stands for the asset purchase programs and *ecb_intrate* corresponds to the ecb's interest rate at its deposit facility. The shaded area indicates the 95 percent confidence interval

Figure A.2.3

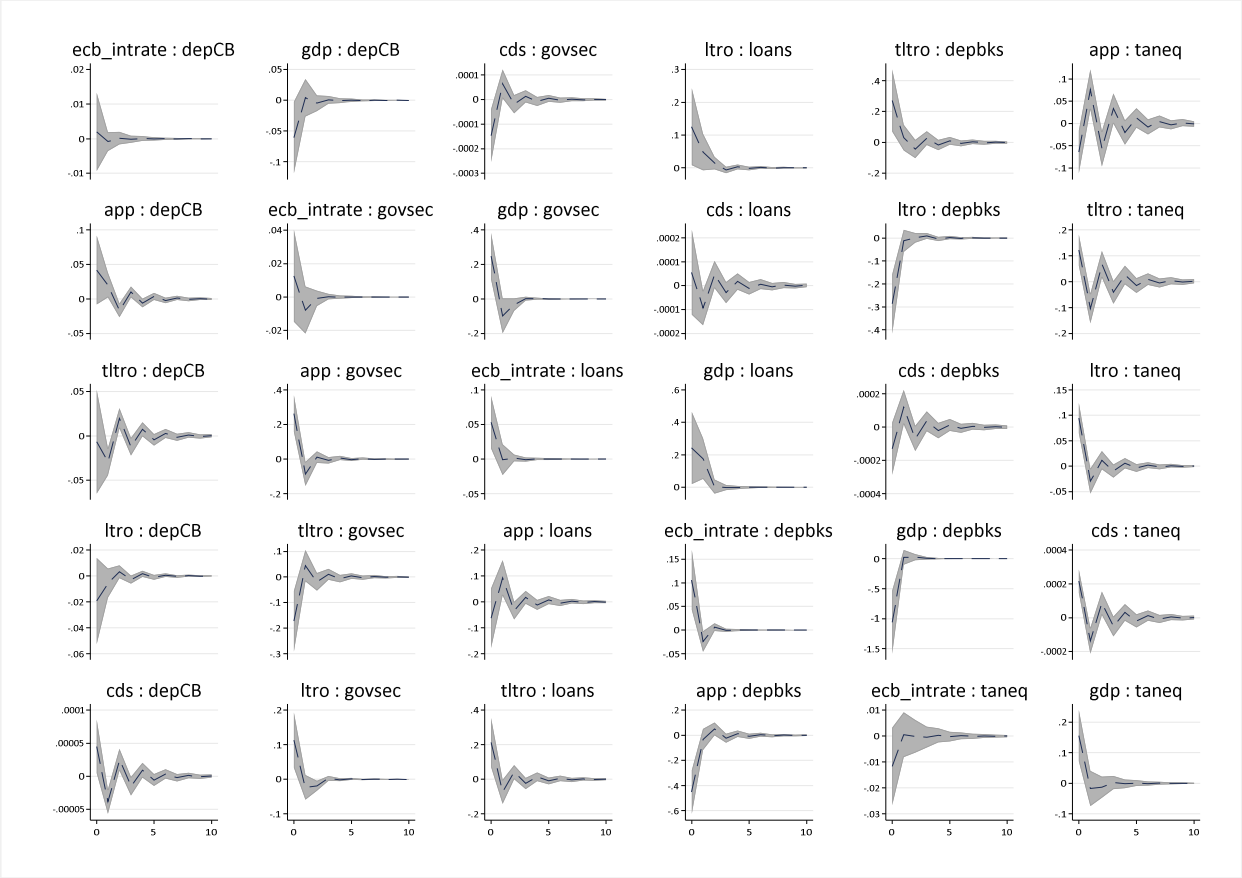
Orthogonalized impulse-response functions to shocks in bank financing factors: Bank capital and bank deposits – crisis countries



NOTES: This figure shows the impulse-response functions for loans, government securities and deposits in central banks in response to shocks to bank deposits and bank capital in crisis countries. The shaded area indicates the 95 percent confidence interval.

Figure A.2.4

Dynamic multipliers for orthogonalized shocks to macroeconomic factors And ECB unconventional monetary policies – crisis countries



NOTE: This figure shows the impulse-response functions for loans, government securities *(govsec)* and deposits in central banks *(depCB)* in response to shocks to macroeconomic factors and ECB unconventional monetary policies in crisis countries. *cds* stands for credit default swap for countries, *gdp* stands for GDP growth, *ltro* notes the first round unconventional ltro, *tltro* notes the targeted ltro, *app* stands for the asset purchase programs and *ecb_intrate* corresponds to the ecb's interest rate at its deposit facility. The shaded area indicates the 95 percent confidence interval

Table A.2.3

Magnitudes of the orthogonalized impulse response functions: Non-crisis countries

	Time	*depCB*	*depCB (se)*	*govsec*	*govsec (se)*	*loans*	*loans (se)*
gdp	0	-0.5009	0.2386	0.2156	0.4194	-0.0741	0.2961
gdp	1	0.1732	0.1107	0.1475	0.0965	-0.1877	0.0880
gdp	2	-0.0304	0.0470	-0.0555	0.0336	0.0336	0.0401
gdp	3	0.0053	0.0215	0.0089	0.0149	0.0014	0.0143
gdp	4	-0.0032	0.0105	0.0021	0.0051	-0.0037	0.0044
gdp	5	0.0024	0.0049	-0.0016	0.0019	0.0010	0.0019
gdp	6	-0.0013	0.0023	0.0003	0.0008	0.0001	0.0007
gdp	7	0.0005	0.0011	0.0001	0.0003	-0.0002	0.0003
gdp	8	-0.0002	0.0005	-0.0001	0.0001	0.0001	0.0001
gdp	9	0.0001	0.0003	0.0000	0.0001	0.0000	0.0001
gdp	10	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
cds	0	-0.0212	0.0173	0.1429	0.0220	-0.0978	0.0226
cds	1	0.0253	0.0079	-0.0054	0.0101	-0.0213	0.0090
cds	2	-0.0048	0.0041	-0.0095	0.0042	0.0117	0.0041
cds	3	-0.0011	0.0023	0.0043	0.0020	-0.0026	0.0015
cds	4	0.0010	0.0011	-0.0007	0.0007	-0.0003	0.0006
cds	5	-0.0003	0.0004	-0.0002	0.0003	0.0004	0.0003
cds	6	0.0000	0.0002	0.0001	0.0001	-0.0001	0.0001
cds	7	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
cds	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ltro	0	-0.0044	0.0278	-0.1408	0.0531	0.1120	0.0427
ltro	1	-0.0178	0.0152	0.0031	0.0152	0.0207	0.0133
ltro	2	0.0015	0.0068	0.0100	0.0060	-0.0113	0.0058
ltro	3	0.0023	0.0034	-0.0041	0.0027	0.0021	0.0020
ltro	4	-0.0015	0.0016	0.0005	0.0010	0.0004	0.0008
ltro	5	0.0005	0.0007	0.0002	0.0004	-0.0004	0.0003
ltro	6	-0.0001	0.0003	-0.0001	0.0002	0.0001	0.0001
ltro	7	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001
ltro	8	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
ltro	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ltro	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
tltro	0	0.1309	0.0396	-0.3307	0.0618	0.2386	0.0627
tltro	1	-0.0915	0.0207	0.0155	0.0257	0.0493	0.0238
tltro	2	0.0265	0.0109	0.0186	0.0108	-0.0260	0.0107
tltro	3	-0.0044	0.0064	-0.0098	0.0049	0.0070	0.0037
tltro	4	0.0003	0.0032	0.0018	0.0017	0.0000	0.0014
tltro	5	-0.0002	0.0014	0.0002	0.0007	-0.0006	0.0006
tltro	6	0.0003	0.0006	-0.0003	0.0003	0.0002	0.0002
tltro	7	-0.0002	0.0003	0.0001	0.0001	0.0000	0.0001
tltro	8	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000
tltro	9	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
tltro	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table A.2.3

Magnitudes of the orthogonalized impulse response functions: Non-crisis countries (cont'd)

	Time	*depCB*	*depCB (se)*	*govsec*	*govsec (se)*	*loans*	*loans (se)*
app	0	-0.0644	0.0390	0.2699	0.0586	-0.2201	0.0581
app	1	0.0600	0.0189	-0.0110	0.0226	-0.0384	0.0208
app	2	-0.0160	0.0082	-0.0141	0.0084	0.0192	0.0086
app	3	0.0017	0.0046	0.0074	0.0038	-0.0051	0.0030
app	4	0.0004	0.0023	-0.0013	0.0013	-0.0001	0.0010
app	5	-0.0001	0.0010	-0.0002	0.0005	0.0005	0.0005
app	6	-0.0001	0.0004	0.0002	0.0002	-0.0002	0.0002
app	7	0.0001	0.0002	-0.0001	0.0001	0.0000	0.0001
app	8	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
app	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
app	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ecb_intrate	0	0.0144	0.0075	0.0087	0.0186	0.0039	0.0157
ecb_intrate	1	-0.0080	0.0045	0.0109	0.0050	-0.0108	0.0055
ecb_intrate	2	0.0066	0.0028	-0.0049	0.0024	0.0022	0.0023
ecb_intrate	3	-0.0033	0.0016	0.0005	0.0010	0.0007	0.0009
ecb_intrate	4	0.0012	0.0008	0.0003	0.0004	-0.0006	0.0004
ecb_intrate	5	-0.0004	0.0004	-0.0002	0.0002	0.0002	0.0002
ecb_intrate	6	0.0001	0.0002	0.0000	0.0001	0.0000	0.0001
ecb_intrate	7	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
ecb_intrate	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ecb_intrate	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ecb_intrate	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table A.2.4

Magnitudes of the orthogonalized impulse response functions: Crisis countries

	Time	*depCB*	*depCB (se)*	*govsec*	*govsec (se)*	*loans*	*loans (se)*
gdp	0	-0.0607	0.0315	0.2471	0.0715	0.2420	0.1112
gdp	1	0.0042	0.0146	-0.0978	0.0544	0.1763	0.0708
gdp	2	-0.0046	0.0071	-0.0327	0.0202	0.0043	0.0248
gdp	3	0.0009	0.0036	0.0006	0.0062	-0.0020	0.0079
gdp	4	-0.0005	0.0021	0.0017	0.0031	-0.0021	0.0055
gdp	5	0.0004	0.0014	-0.0003	0.0017	0.0008	0.0036
gdp	6	-0.0002	0.0009	0.0002	0.0012	-0.0004	0.0025
gdp	7	0.0001	0.0007	-0.0001	0.0008	0.0003	0.0018
gdp	8	-0.0001	0.0005	0.0001	0.0006	-0.0002	0.0013
gdp	9	0.0001	0.0003	0.0000	0.0005	0.0001	0.0010
gdp	10	0.0000	0.0003	0.0000	0.0003	-0.0001	0.0007
cds	0	0.0000	0.0000	-0.0001	0.0001	0.0001	0.0001
cds	1	0.0000	0.0000	0.0001	0.0000	-0.0001	0.0000
cds	2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
cds	10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ltro	0	-0.0192	0.0175	0.1133	0.0402	0.1252	0.0555
ltro	1	-0.0055	0.0057	-0.0232	0.0206	0.0482	0.0280
ltro	2	0.0033	0.0028	-0.0188	0.0079	0.0147	0.0100
ltro	3	-0.0029	0.0017	0.0026	0.0035	-0.0070	0.0049
ltro	4	0.0017	0.0012	-0.0010	0.0023	0.0029	0.0036
ltro	5	-0.0010	0.0009	0.0010	0.0016	-0.0020	0.0027
ltro	6	0.0006	0.0007	-0.0006	0.0012	0.0013	0.0020
ltro	7	-0.0004	0.0005	0.0003	0.0009	-0.0008	0.0015
ltro	8	0.0002	0.0004	-0.0002	0.0007	0.0005	0.0012
ltro	9	-0.0001	0.0003	0.0001	0.0006	-0.0003	0.0009
ltro	10	0.0001	0.0002	-0.0001	0.0004	0.0002	0.0007
tltro	0	-0.0066	0.0281	-0.1726	0.0570	0.2130	0.0687
tltro	1	-0.0292	0.0090	0.0442	0.0300	-0.0722	0.0352
tltro	2	0.0198	0.0052	-0.0193	0.0177	0.0417	0.0206
tltro	3	-0.0122	0.0044	0.0104	0.0104	-0.0237	0.0158
tltro	4	0.0074	0.0037	-0.0066	0.0074	0.0145	0.0122
tltro	5	-0.0045	0.0030	0.0041	0.0055	-0.0089	0.0094
tltro	6	0.0028	0.0024	-0.0025	0.0042	0.0054	0.0072
tltro	7	-0.0017	0.0019	0.0015	0.0032	-0.0033	0.0056
tltro	8	0.0010	0.0015	-0.0009	0.0025	0.0020	0.0043
tltro	9	-0.0006	0.0012	0.0006	0.0019	-0.0012	0.0034
tltro	10	0.0004	0.0009	-0.0003	0.0015	0.0008	0.0026

Table A.2.4

Magnitudes of the orthogonalized impulse response functions: Crisis countries (cont'd)

	Time	*depCB*	*depCB (se)*	*govsec*	*govsec (se)*	*loans*	*loans (se)*
app	0	0.0417	0.0238	0.2630	0.0501	-0.0628	0.0610
app	1	0.0200	0.0110	-0.0867	0.0343	0.0931	0.0352
app	2	-0.0166	0.0049	0.0108	0.0171	-0.0340	0.0183
app	3	0.0099	0.0035	-0.0074	0.0090	0.0176	0.0125
app	4	-0.0060	0.0028	0.0057	0.0059	-0.0118	0.0096
app	5	0.0037	0.0023	-0.0033	0.0043	0.0072	0.0072
app	6	-0.0023	0.0018	0.0020	0.0033	-0.0044	0.0056
app	7	0.0014	0.0014	-0.0012	0.0025	0.0027	0.0043
app	8	-0.0008	0.0011	0.0008	0.0019	-0.0016	0.0033
app	9	0.0005	0.0009	-0.0005	0.0015	0.0010	0.0026
app	10	-0.0003	0.0007	0.0003	0.0011	-0.0006	0.0020
ecb_intrate	0	0.0020	0.0061	0.0127	0.0128	0.0531	0.0185
ecb_intrate	1	-0.0008	0.0017	-0.0078	0.0069	-0.0010	0.0108
ecb_intrate	2	0.0002	0.0010	-0.0008	0.0022	0.0015	0.0026
ecb_intrate	3	-0.0001	0.0006	0.0002	0.0009	-0.0007	0.0015
ecb_intrate	4	0.0001	0.0004	0.0000	0.0004	0.0002	0.0009
ecb_intrate	5	-0.0001	0.0002	0.0000	0.0003	-0.0001	0.0006
ecb_intrate	6	0.0000	0.0002	0.0000	0.0002	0.0001	0.0004
ecb_intrate	7	0.0000	0.0001	0.0000	0.0001	0.0000	0.0003
ecb_intrate	8	0.0000	0.0001	0.0000	0.0001	0.0000	0.0002
ecb_intrate	9	0.0000	0.0001	0.0000	0.0001	0.0000	0.0002
ecb_intrate	10	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001

Appendix A.3 All relevant results for the set of banks that received government capitalization

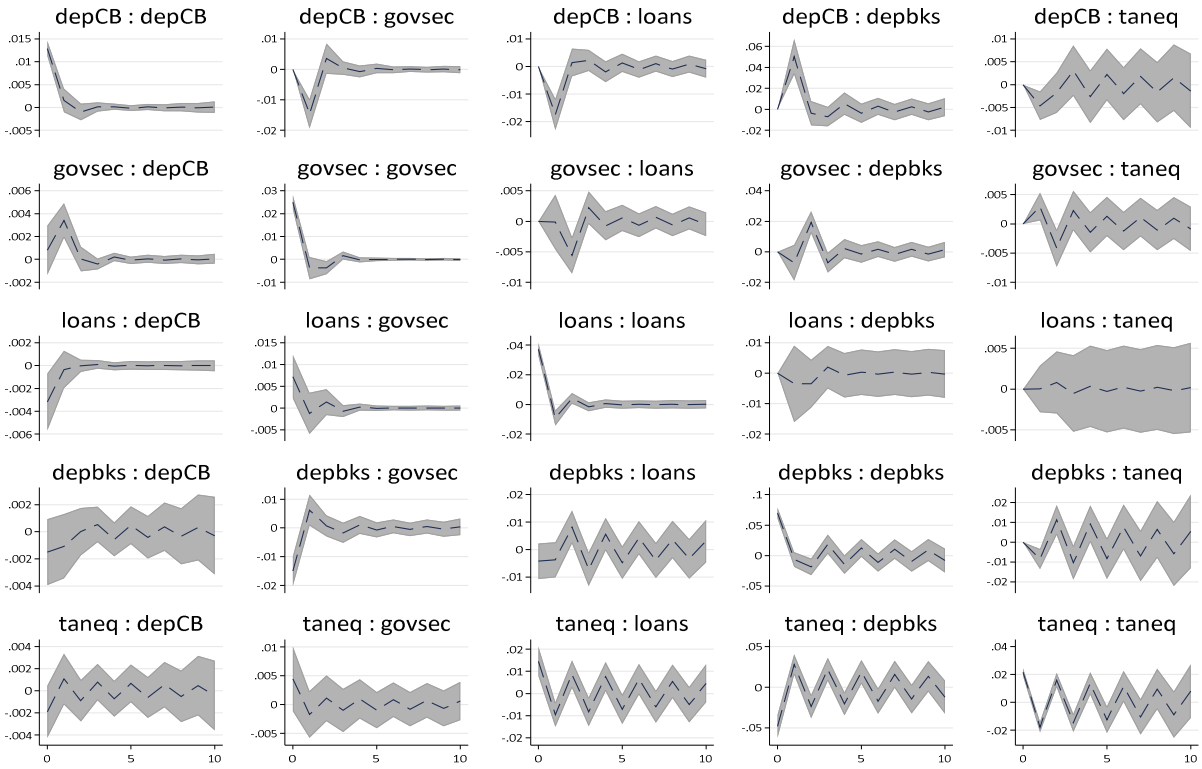
Table A.3.1
Coefficients estimates of the reduced-form of the crisis countries

VARIABLES	*taneq*	*depbks*	*loans*	*govsec*	*depCB*
L.taneq	-1.073***	1.327***	-0.533***	-0.0101	0.0811
	(0.108)	(0.238)	(0.142)	(0.105)	(0.0899)
L.depbks	-0.104***	-0.0793	-0.0960**	0.0330	0.0143
	(0.0328)	(0.0765)	(0.0404)	(0.0363)	(0.0188)
L.loans	-0.0553	0.319***	-0.368***	-0.106*	-0.0246
	(0.0347)	(0.0957)	(0.0474)	(0.0565)	(0.0199)
L.govsec	0.131***	-0.414**	0.0380	-0.119	0.133***
	(0.0502)	(0.191)	(0.0816)	(0.0845)	(0.0276)
L.depCB	-0.357***	3.887***	-1.348***	-1.132***	0.120
	(0.118)	(0.600)	(0.200)	(0.183)	(0.109)
gdp	0.330***	-2.338***	0.166***	0.206***	0.0648*
	(0.0719)	(0.376)	(0.0614)	(0.0528)	(0.0374)
cds	0.000350***	-0.000541***	0.000281***	-2.01e-05	-1.76e-06
	(3.32e-05)	(9.06e-05)	(6.12e-05)	(4.03e-05)	(1.97e-05)
ltro	0.0971***	-0.474***	0.112***	0.0349	0.000397
	(0.0180)	(0.0812)	(0.0340)	(0.0264)	(0.0116)
tltro	0.219***	-0.164	0.312***	-0.206***	0.0907***
	(0.0409)	(0.131)	(0.0871)	(0.0778)	(0.0342)
app	-0.153***	-0.299**	-0.0899	0.307***	-0.0460
	(0.0323)	(0.125)	(0.0719)	(0.0743)	(0.0314)
ecb_intrate	0.0108*	0.0791***	0.0223	-0.00310	0.0128**
	(0.00621)	(0.0294)	(0.0138)	(0.00853)	(0.00550)
Observations	123	123	123	123	123
Instruments	01-abr	01-abr	01-abr	01-abr	01-abr
FE elim	fod	fod	fod	fod	fod
CD	0.46	0.46	0.46	0.46	0.46
J	77.05	77.05	77.05	77.05	77.05
pval	0.21	0.21	0.21	0.21	0.21
Model	FD	FD	FD	FD	FD
Panels	19	19	19	19	19

NOTES: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure A.3.1

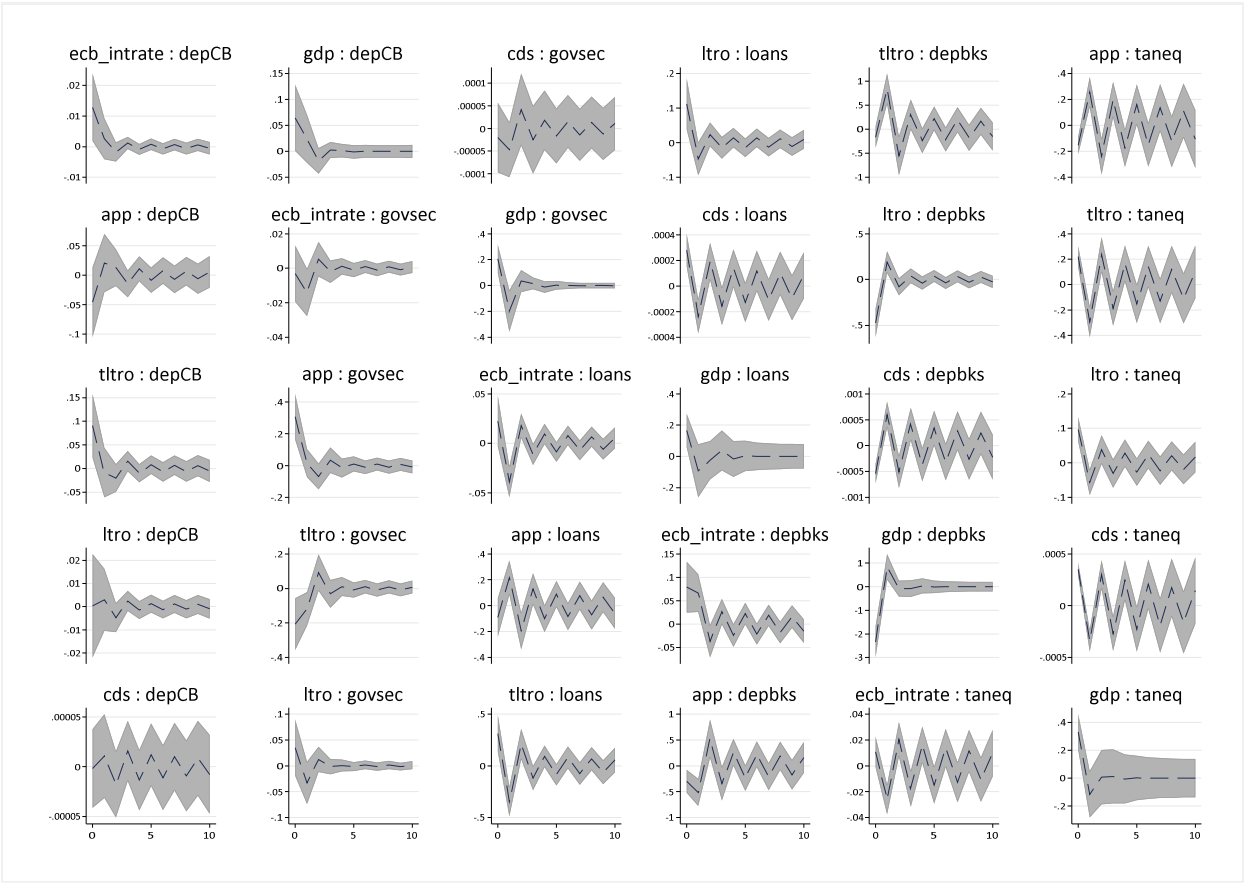
Orthogonalized impulse-response functions to shocks in bank factors: bank capital and bank deposits: Set of banks that received government capitalization



NOTES: This figure shows the impulse-response functions for loans, government securities and deposits in central banks in response to shocks to bank deposits and bank capital in the set of banks that received government support. The shaded area indicates the 95 percent confidence interval.

Figure A.3.2

Dynamic multipliers for orthogonalized shocks to macroeconomic factors and ECB unconventional monetary policies: Set of banks that received government capitalization



NOTE: This figure shows the impulse-response functions for loans, government securities *(govsec)* and deposits in central banks *(depCB)* in response to shocks to macroeconomic factors and ECB unconventional monetary policies in the set of banks that received government support. *cds* stands for credit default swap for countries, *gdp* stands for GDP growth, *ltro* notes the first round unconventional ltro, *tltro* notes the targeted ltro, *app* stands for the asset purchase programs and *ecb_intrate* corresponds to the ecb's interest rate at its deposit facility. The shaded area indicates the 95 percent confidence interval

Table A.3.2

Magnitudes of the orthogonalized impulse response functions Sample: Banks that received government capitalization

	Time	*depCB*	*depCB (se)*	*govsec*	*govsec (se)*	*loans*	*loans (se)*
gdp	0	0.0648	0.0359	0.2058	0.0514	0.1662	0.0631
gdp	1	0.0243	0.0234	-0.1960	0.0775	-0.0924	0.0965
gdp	2	-0.0181	0.0121	0.0348	0.0437	-0.0253	0.0690
gdp	3	0.0026	0.0081	0.0165	0.0215	0.0384	0.0598
gdp	4	0.0015	0.0068	-0.0116	0.0171	-0.0162	0.0537
gdp	5	-0.0009	0.0063	0.0028	0.0134	0.0032	0.0484
gdp	6	0.0002	0.0061	0.0002	0.0112	-0.0001	0.0445
gdp	7	0.0000	0.0061	-0.0003	0.0103	0.0001	0.0420
gdp	8	0.0000	0.0062	0.0000	0.0100	-0.0004	0.0403
gdp	9	0.0000	0.0065	0.0001	0.0100	0.0004	0.0390
gdp	10	0.0000	0.0069	-0.0001	0.0103	-0.0004	0.0381
cds	0	0.0000	0.0000	0.0000	0.0000	0.0003	0.0001
cds	1	0.0000	0.0000	0.0000	0.0000	-0.0002	0.0001
cds	2	0.0000	0.0000	0.0000	0.0000	0.0002	0.0001
cds	3	0.0000	0.0000	0.0000	0.0000	-0.0002	0.0001
cds	4	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
cds	5	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0001
cds	6	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
cds	7	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0001
cds	8	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
cds	9	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0001
cds	10	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
ltro	0	0.0004	0.0109	0.0349	0.0261	0.1122	0.0320
ltro	1	0.0030	0.0065	-0.0332	0.0183	-0.0467	0.0268
ltro	2	-0.0048	0.0029	0.0123	0.0108	0.0238	0.0177
ltro	3	0.0024	0.0020	-0.0016	0.0061	-0.0145	0.0151
ltro	4	-0.0015	0.0019	0.0006	0.0044	0.0143	0.0141
ltro	5	0.0013	0.0018	-0.0015	0.0038	-0.0146	0.0140
ltro	6	-0.0013	0.0018	0.0018	0.0036	0.0139	0.0141
ltro	7	0.0012	0.0018	-0.0017	0.0035	-0.0128	0.0143
ltro	8	-0.0011	0.0019	0.0016	0.0034	0.0117	0.0146
ltro	9	0.0010	0.0020	-0.0014	0.0034	-0.0107	0.0150
ltro	10	-0.0009	0.0021	0.0013	0.0034	0.0098	0.0155
tltro	0	0.0907	0.0327	-0.2064	0.0746	0.3118	0.0814
tltro	1	-0.0088	0.0255	-0.1187	0.0459	-0.3457	0.0757
tltro	2	-0.0201	0.0139	0.0916	0.0479	0.2108	0.0740
tltro	3	0.0157	0.0107	-0.0312	0.0345	-0.1191	0.0589
tltro	4	-0.0101	0.0109	0.0107	0.0244	0.0916	0.0536
tltro	5	0.0080	0.0114	-0.0091	0.0214	-0.0852	0.0537
tltro	6	-0.0073	0.0120	0.0100	0.0213	0.0802	0.0562
tltro	7	0.0069	0.0130	-0.0099	0.0219	-0.0741	0.0588
tltro	8	-0.0064	0.0143	0.0091	0.0228	0.0679	0.0618
tltro	9	0.0058	0.0161	-0.0083	0.0243	-0.0622	0.0652
tltro	10	-0.0053	0.0185	0.0076	0.0266	0.0570	0.0694

Table A.3.2

Magnitudes of the orthogonalized impulse response functions Sample: Banks that received government capitalization (cont'd)

	Time	*depCB*	*depCB (se)*	*govsec*	*govsec (se)*	*loans*	*loans (se)*
app	0	-0.0460	0.0302	0.3073	0.0702	-0.0899	0.0656
app	1	0.0208	0.0253	0.0166	0.0413	0.2171	0.0683
app	2	0.0128	0.0150	-0.0681	0.0396	-0.1950	0.0682
app	3	-0.0146	0.0116	0.0341	0.0362	0.1291	0.0578
app	4	0.0108	0.0120	-0.0146	0.0277	-0.0999	0.0517
app	5	-0.0087	0.0129	0.0105	0.0241	0.0900	0.0517
app	6	0.0078	0.0141	-0.0105	0.0240	-0.0839	0.0546
app	7	-0.0072	0.0155	0.0102	0.0252	0.0776	0.0581
app	8	0.0067	0.0176	-0.0095	0.0270	-0.0713	0.0619
app	9	-0.0061	0.0202	0.0087	0.0296	0.0653	0.0663
app	10	0.0056	0.0237	-0.0079	0.0333	-0.0599	0.0717
ecb_intrate	0	0.0128	0.0057	-0.0031	0.0086	0.0223	0.0140
ecb_intrate	1	0.0026	0.0037	-0.0140	0.0075	-0.0390	0.0099
ecb_intrate	2	-0.0018	0.0016	0.0053	0.0054	0.0178	0.0070
ecb_intrate	3	0.0012	0.0013	-0.0020	0.0029	-0.0114	0.0057
ecb_intrate	4	-0.0009	0.0011	0.0012	0.0023	0.0094	0.0053
ecb_intrate	5	0.0008	0.0012	-0.0011	0.0021	-0.0086	0.0052
ecb_intrate	6	-0.0007	0.0012	0.0010	0.0020	0.0079	0.0052
ecb_intrate	7	0.0007	0.0012	-0.0010	0.0020	-0.0072	0.0052
ecb_intrate	8	-0.0006	0.0013	0.0009	0.0020	0.0066	0.0053
ecb_intrate	9	0.0006	0.0014	-0.0008	0.0020	-0.0061	0.0055
ecb_intrate	10	-0.0005	0.0015	0.0007	0.0021	0.0056	0.0057

BANCO DE ESPAÑA PUBLICATIONS

WORKING PAPERS

2241 JULIO GÁLVEZ and GONZALO PAZ-PARDO: Richer earnings dynamics, consumption and portfolio choice over the life cycle.
2242 MARINA DIAKONOVA, CORINNA GHIRELLI, LUIS MOLINA and JAVIER J. PÉREZ: The economic impact of conflict-related and policy uncertainty shocks: the case of Russia.
2243 CARMEN BROTO, LUIS FERNÁNDEZ LAFUERZA and MARIYA MELNYCHUK: Do buffer requirements for European systemically important banks make them less systemic?
2244 GERGELY GANICS and MARÍA RODRÍGUEZ-MORENO: A house price-at-risk model to monitor the downside risk for the Spanish housing market.
2245 JOSÉ E. GUTIÉRREZ and LUIS FERNÁNDEZ LAFUERZA: Credit line runs and bank risk management: evidence from the disclosure of stress test results.
2301 MARÍA BRU MUÑOZ: The forgotten lender: the role of multilateral lenders in sovereign debt and default.
2302 SILVIA ALBRIZIO, BEATRIZ GONZÁLEZ and DMITRY KHAMETSHIN: A tale of two margins: monetary policy and capital misallocation.
2303 JUAN EQUIZA, RICARDO GIMENO, ANTONIO MORENO and CARLOS THOMAS: Evaluating central bank asset purchases in a term structure model with a forward-looking supply factor.
2304 PABLO BURRIEL, IVÁN KATARYNIUK, CARLOS MORENO PÉREZ and FRANCESCA VIANI: New supply bottlenecks index based on newspaper data.
2305 ALEJANDRO FERNÁNDEZ-CEREZO, ENRIQUE MORAL-BENITO and JAVIER QUINTANA: A production network model for the Spanish economy with an application to the impact of NGEU funds.
2306 MONICA MARTINEZ-BRAVO and CARLOS SANZ: Trust and accountability in times of pandemic.
2307 NATALIA FABRA, EDUARDO GUTIÉRREZ, AITOR LACUESTA and ROBERTO RAMOS: Do renewable energies create local jobs?
2308 ISABEL ARGIMÓN and IRENE ROIBÁS: Debt overhang, credit demand and financial conditions.
2309 JOSÉ-ELÍAS GALLEGOS: Inflation persistence, noisy information and the Phillips curve.
2310 ANDRÉS ALONSO-ROBISCO, JOSÉ MANUEL CARBÓ and JOSÉ MANUEL MARQUÉS: Machine Learning methods in climate finance: a systematic review.
2311 ALESSANDRO PERI, OMAR RACHEDI and IACOPO VAROTTO: The public investment multiplier in a production network.
2312 JUAN S. MORA-SANGUINETTI, JAVIER QUINTANA, ISABEL SOLER and ROK SPRUK: Sector-level economic effects of regulatory complexity: evidence from Spain.
2313 CORINNA GHIRELLI, ENKELEJDA HAVARI, ELENA MERONI and STEFANO VERZILLO: The long-term causal effects of winning an ERC grant.
2314 ALFREDO GARCÍA-HIERNAUX, MARÍA T. GONZÁLEZ-PÉREZ and DAVID E. GUERRERO: How to measure inflation volatility. A note.
2315 NICOLÁS ABBATE, INÉS BERNIELL, JOAQUÍN COLEFF, LUIS LAGUINGE, MARGARITA MACHELETT, MARIANA MARCHIONNI, JULIÁN PEDRAZZI and MARÍA FLORENCIA PINTO: Discrimination against gay and transgender people in Latin America: a correspondence study in the rental housing market.
2316 SALOMÓN GARCÍA: The amplification effects of adverse selection in mortgage credit suply.
2317 METTE EJRNÆS, ESTEBAN GARCÍA-MIRALLES, METTE GØRTZ and PETTER LUNDBORG: When death was postponed: the effect of HIV medication on work, savings and marriage.
2318 GABRIEL JIMÉNEZ, LUC LAEVEN, DAVID MARTÍNEZ-MIERA and JOSÉ-LUIS PEYDRÓ: Public guarantees and private banks' incentives: evidence from the COVID-19 crisis.
2319 HERVÉ LE BIHAN, DANILO LEIVA-LEÓN and MATÍAS PACCE: Underlying inflation and asymmetric risks.
2320 JUAN S. MORA-SANGUINETTI, LAURA HOSPIDO and ANDRÉS ATIENZA-MAESO: The numbers of equality regulation. Quantifying regulatory activity on non-discrimination and its relationship with gender gaps in the labour market.
2321 ANDRES ALONSO-ROBISCO and JOSÉ MANUEL CARBÓ: Analysis of CBDC Narrative of Central Banks using Large Language Models.
2322 STEFANIA ALBANESI, ANTÓNIO DIAS DA SILVA, JUAN F. JIMENO, ANA LAMO and ALENA WABITSCH: New technologies and jobs in Europe.
2323 JOSÉ E. GUTIÉRREZ: Optimal regulation of credit lines.
2324 MERCEDES DE LUIS, EMILIO RODRÍGUEZ and DIEGO TORRES: Machine learning applied to active fixed-income portfolio management: a Lasso logit approach.

2325 SELVA BAHAR BAZIKI, MARÍA J. NIETO and RIMA TURK-ARISS: Sovereign portfolio composition and bank risk: the case of European banks.

2326 ANGEL-IVAN MORENO and TERESA CAMINERO: Assessing the data challenges of climate-related disclosures in european banks. A text mining study.

2327 JULIO GÁLVEZ: Household portfolio choices under (non-)linear income risk: an empirical framework.

2328 NATASCHA HINTERLANG: Effects of Carbon Pricing in Germany and Spain: An Assessment with EMuSe.

2329 RODOLFO CAMPOS, SAMUEL PIENKNAGURA and JACOPO TIMINI: How far has globalization gone? A tale of two regions.

2330 NICOLÁS FORTEZA and SANDRA GARCÍA-URIBE: A Score Function to Prioritize Editing in Household Survey Data: A Machine Learning Approach.

2331 PATRICK MACNAMARA, MYROSLAV PIDKUYKO and RAFFAELE ROSSI: Taxing consumption in unequal economies.

2332 ESTHER CÁCERES and MATÍAS LAMAS: Dividend Restrictions and Search for Income.

2333 MARGARITA MACHELETT: Gender price gaps and competition: Evidence from a correspondence study.

2334 ANTON NAKOV and CARLOS THOMAS: Climate-conscious monetary policy.

2335 RICARDO BARAHONA, STEFANO CASSELLA and KRISTY A. E. JANSEN: Do teams alleviate or exacerbate the extrapolation bias in the stock market?

2336 JUAN S. MORA-SANGUINETTI and ANDRÉS ATIENZA-MAESO: "Green regulation": A quantification of regulations related to renewable energy, sustainable transport, pollution and energy efficiency between 2000 and 2022.

2401 LAURA HOSPIDO, NAGORE IRIBERRI and MARGARITA MACHELETT: Gender gaps in financial literacy: a multi-arm RCT to break the response bias in surveys.

2402 RUBÉN DOMÍNGUEZ-DÍAZ, SAMUEL HURTADO and CAROLINA MENÉNDEZ: The medium-term effects of investment stimulus.

2403 CLODOMIRO FERREIRA, JOSÉ MIGUEL LEIVA, GALO NUÑO, ÁLVARO ORTIZ, TOMASA RODRIGO and SIRENIA VAZQUEZ: The heterogeneous impact of inflation on households' balance sheets.

2404 JORGE ABAD, GALO NUÑO and CARLOS THOMAS: CBDC and the operational framework of monetary policy.

2405 STÉPHANE BONHOMME and ANGELA DENIS: Estimating individual responses when tomorrow matters.

2406 LAURA ÁLVAREZ-ROMÁN, SERGIO MAYORDOMO, CARLES VERGARA-ALERT and XAVIER VIVES: Climate risk, soft information and credit supply.

2407 JESÚS FERNÁNDEZ-VILLAVERDE, JOËL MARBET, GALO NUÑO and OMAR RACHEDI: Inequality and the zero lower bound.

2408 PABLO BURRIEL, MAR DELGADO-TÉLLEZ, CAMILA FIGUEROA, IVÁN KATARYNIUK and JAVIER J. PÉREZ: Estimating the contribution of macroeconomic factors to sovereign bond spreads in the euro area.

2409 LUIS E. ROJAS and DOMINIK THALER: The bright side of the doom loop: banks' sovereign exposure and default incentives.

2410 SALOMÓN GARCÍA-VILLEGAS and ENRIC MARTORELL: Climate transition risk and the role of bank capital requirements.

2411 MIKEL BEDAYO and JORGE E. GALÁN: The impact of the Countercyclical Capital Buffer on credit: Evidence from its accumulation and release before and during COVID-19.

2412 EFFROSYNI ADAMOPOULOU, LUIS DÍEZ-CATALÁN and ERNESTO VILLANUEVA: Staggered contracts and unemployment during recessions.

2413 LUIS FÉRNANDEZ LAFUERZA and JORGE E. GALÁN: Should macroprudential policy target corporate lending? Evidence from credit standards and defaults.

2414 STÉPHANE BONHOMME and ANGELA DENIS: Estimating heterogeneous effects: applications to labor economics.

2415 LUIS GUIROLA, LAURA HOSPIDO and ANDREA WEBER: Family and career: An analysis across Europe and North America.

2416 GERALD P. DWYER, BILJANA GILEVSKA, MARÍA J. NIETO and MARGARITA SAMARTÍN: The effects of the ECB's unconventional monetary policies from 2011 to 2018 on banking assets