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www.eurobank.gr/research
research@eurobank.gr

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Platon Monokroussos,PhD
Assistant General Manager
Head of Financial Markets Research
pmonokrousos@eurobank.gr

Dimitris Thomakos
Professor
Dept. of Economics
University of Peloponnese
Quantitative Advisor
Global Advisory Division
Eurobank Ergasias S.A.

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Monetary Policy Transmission Mechanism and Bank Lending Channel in the Euro area

Greece Case Study

This paper employs two discrete empirical methodologies to examine the existence of a banking lending channel in the euro area and to assess the functionality of the monetary policy transmission mechanism in Greece in the period before and after outbreak of the global financial crisis. In line with a number of earlier empirical studies, our results provide strong evidence supporting the existence of a banking lending channel in the euro area. Specifically, country-specific money demand shocks have a significant effect on the growth of loans, which effectively implies that the level of bank deposits is indeed a key determinant of loan supply. Furthermore, the supply of bank loans has a significant effect on GDP and other real economic variables. In the case of Greece, our SVAR model estimates imply that a decline (increase) in the average Greek bank loan interest rate by 1ppt can lead to a cumulative boost (contraction) in real GDP growth by around 0.3ppts over a 4-quarter period. By and far, our results reinforce the need for a close monitoring of credit developments in the context of monetary authorities' ongoing efforts to restore the proper function of the monetary policy transmission mechanism. They also demonstrate the crucial role bank credit can play in the recovery of the Greek economy, following a prolonged domestic recession, which culminated in steep output losses over the last 5-year period.

1. Introduction

The 2007/2008 global financial crisis caused heavy impairments in euro area banks' capital positions and their access to wholesale funding. In an effort to contain the ensuing economic recession and alleviate heightened pressures in credit markets, most euro area governments provided in late 2008 significant support packages to their national banking systems, with their respective size (as percent of GDP) ranging from 18.5% in France and 52% in Holland to 80% in Belgium and 265% in Ireland. In addition to these support packages, the ECB took powerful initiatives to restore the proper functioning of the monetary policy transmission mechanism and to alleviate credit supply pressures ensuing from acute balance-sheet constraints faced by banks.

Among others, these initiatives included aggressive cuts in the European Central Bank's key policy rate, the provision of unlimited liquidity to the banking system, a relaxation of collateral requirements for crisis-hit countries (*e.g.* Greece) and, more recently, the announcement of the Outright Monetary Transactions (OMTs) programme for outright purchases in secondary sovereign bond markets, under certain conditions.

Credit growth to households and non-financial corporations in the euro area began to abate towards the end of 2008, reflecting both a decline in the demand from loans due to the ensuing economic downturn and rising credit supply constrains arising from banks' eroding capital positions and reduced access to wholesale funding.[1] Owing to the *broadly undisputable* relationship between credit growth and the real economy[2], and in view of the predominant role of banks in the euro area financial system, it is not a surprise that the ECB and other central banks have made serious efforts to alleviate supply-side constrains in credit availability and to restore the proper functioning of the monetary transmission mechanism in the period following the outbreak of the crisis.

In analyzing the impact of credit on macroeconomic variables such as real GDP and inflation, there are a number of contentious and highly controversial issues that need to be addressed. One such issue concerns the potential endogeneity or reverse causality problem in the relationship between loan supply and output. Namely, is credit availability a determinant of output growth or the former reflects the evolution of the demand for loans and other bank services along the different facets of the business cycle as well as expectations about future economic conditions?

Along with an empirical analysis using a structural vector autoregressive model (SVAR) to examine the functionality of the bank lending channel in Greece, this paper presents a cross sectional study on the relation between bank credit and output in the Eurozone, tackling the endogeneity issue in a framework originally proposed by Driscoll (2004) and later applied by L. Cappiello (2010) to the euro area economy.

More specifically, to empirically estimate the relationship between bank credit and output we apply the Driscoll (2004) model to a panel of 12 euro area economies, including: Austria (AT), Belgium (BE), Cyprus (CY), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PO) and Spain (ES).

In line with a number of earlier empirical studies, our results provide strong evidence supporting the existence of a banking lending channel in the euro area. Specifically, country-specific money demand shocks have a significant effect on the growth of loans, which effectively implies that the level of bank deposits is indeed a key determinant of loan supply. Furthermore, the supply of bank loans has a significant effect on GDP and other real economic variables. By and far, these finding reinforce the need for a close monitoring of credit developments in the context of monetary authorities' ongoing efforts to restore the proper function of the monetary policy transmission mechanism.

In the case of Greece, a panel analysis of a group of five euro area countries that have been particularly hit by the sovereign debt crisis (Greece, Portugal, Ireland, Spain and Cyprus) shows that, a 1 percentage point decrease (increase) in domestic bank loan growth relative to the cross-section average causes, after a quarter, a decline (rise) of between 0.2ppts and 0.47ppts in Greece's real GDP growth below (above) the respective cross-sectional average.

Separately, our SVAR model estimates imply that a decline (increase) in the average Greek bank loan interest rate by 1ppt can lead to a cumulative boost (contraction) in real GDP growth by around 0.3ppts over a 4-quarter period. If the decline (increase) in the average loan rate is, instead, 2ppts, then the cumulative boost (contraction) in real GDP growth can reach around 0.6ppts over a 4-quarter period. In our view, the latter results demonstrate the crucial role bank credit can play in the recovery of the Greek economy, following a prolonged domestic recession, which is expected to culminate in cumulative real output losses of around 25ppts over the period Q3 2008-Q4 2013.

Looking forward, the completion of the Greek bank recapitalization programme and the stabilization of deposits since mid-2012 are expected to facilitate a gradual improvement in domestic credit conditions. Yet, the need to continue reducing dependence on Eurosystem liquidity support (currently at ca €90bn vs. highs around €135bn in late 2012) is one of the factors arguing against a swift return to strong positive credit dynamics post-recapitalization. These considerations render even more pervasive the need to address domestic banks' funding costs.

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[1] See e.g. L. Cappiello et al. (2010), Hompell and Kok Sarensen (2009) as well as the ECB's Bank Lending Survey.
[2] Some theoretical papers and empirical studies have actually disputed that a positive long-term relationship exists between bank credit (and, more generally, financial development) and economic growth; see e.g. Lukas (1988) and Ahmed (2008)

One significant determinant of domestic banking sector funding costs is the still high domestic deposit rates. These remained at exceptionally high levels in recent months and quarters, reflecting intense competition by domestic banks (especially a number of smaller aggressive players) to attract depositors. However, the aggressive consolidation of the Greek banking system in the context of the ongoing bank recapitalization and resolution programme establishes the base for a gradual normalization of domestic bank deposit rates in the period ahead. This process could have beneficial effects on domestic GDP, to the extent that it could also help to compress bank loan interest rates.

As to the functionality of the monetary policy transmission mechanism, our empirical results show that around 44% of a given exogenous shock in the EONIA rate is transmitted within a year to the average interest rate on domestic MFI loans to Greek households and businesses. Over a 16-quarter period (i.e., 4 years) the cumulative pass-through reaches around 64.7%.

The rest of this paper is structured as follows: Chapter 2 provides a brief overview of the literature on monetary policy transmission channels; Chapter 3 discusses the Greek sovereign debt crisis, developments in the domestic banking system and the evolution of deposits and bank credit in the period before and after the sovereign debt crisis; Chapter 4 discusses the empirical methodology; Chapter 5 presents and analyses the empirical results of our study; and Chapter 6 concludes.

2. Related literature

2.1 Channels of monetary policy transmission

From a policy perspective, monetary policy innovations affect real economic variables via a number of channels. Mishkin (1996) provides a comprehensive analysis on the issue, distinguishing the following channels of monetary policy transmission:

Traditional Interest Rate Channel. The traditional Keynesian ISLM view of the monetary policy transition mechanism postulates that a monetary expansion (contraction) causes a decline (increase) in the real interest rate, which, in turn, increases (lowers) investment spending, leading to an increase (decline) in aggregate demand and a rise (drop) in output.[3,4] The emphasis in the above line of reasoning is on the shift in the real (rather than the nominal) interest rate caused by a monetary policy innovation. The rational here is that in a world of sticky prices, an expansionary monetary policy move, which lowers the nominal policy rate can also lead to a decline in both the short-term and long-term real interest rates, given that the latter is effectively an average of the expected future short rates. These lower real interest rates can then lead to a rise in investment spending and thus, in aggregate output. A notable objection to the tradition Keynesian view on the transmission mechanism of monetary policy is its sole emphasis on only one asset price, namely the interest rate. To address this limitation, more recent stands of research have emphasized other potential channels of monetary policy transmission, ranging from different asset classes such as foreign exchange and equities to the more recent theories of the so-called credit channels.

Exchange Rate Channel. This channel of monetary policy transmission mainly operates through the impact of exchange rate shifts on net exports and also encompasses interest rate effects, as a decline (increase) in the domestic real interest rate makes domestic-currency deposits less (more) attractive relative to foreign currency-denominated deposits. In turn, this leads to a depreciation (appreciation) of the national currency, causing a rise (decline) in net exports and thus, a rise (decline) in aggregate output.[5]

Equity Price Channel. This channel of monetary policy transmission can arguably work though two discrete mechanisms; namely the *Tobin's q* theory and wealth effects on consumption spending. As regards the Tobin's theory of investment (*q* defined as the ratio of the market value of firms to the replacement cost of capital)[6], the theory postulates that when *q* is high, companies have an incentive to issue equity for financing investment in plants and equipment, thus boosting aggregate output. On the other hand, when *q* is low, firms do not find it attractive to acquire new investment goods as their market value in now lower than the cost of capital. Instead, if companies want to acquire capital when *q* is low, they can buy another firm cheaply and obtain that firm's existing capital, a process leading to no major increase in investment expenditure. Besides the Tobin's *q* theory of investment, an alternative monetary policy transmission channel via the equity market is through wealth effects on consumption, especially when common stock is a major component of households' financial wealth.[7]

Bank Lending Channel. This channel of monetary policy transmission emphasizes the role of banks in alleviating credit market frictions.[8] This is particularly the case when: (i) there is no perfect substitutability between retail bank deposits and other sources of funding in the liability side of the banks' balance sheets; and (ii) bank lending constitutes a primary source of private sector financing. More specifically, the relevant theory postulates that an expansionary monetary policy boosts bank reserves and deposits, leading to an increase in bank loans to finance higher investment and consumer spending. Despite ample empirical evidence in support of the bank lending channel, a number of authors have raised doubts over its importance and potency, especially in view of the ongoing decline in the traditional bank lending business worldwide.[9] For instance, Driscoll (2004) tests for the presence of a bank lending channel in the U.S. by extending the Bernanke and Blinder (1988) aggregate demand model to the case of a group of small open economies under fixed exchange rates (i.e., the U.S. states). Driscoll finds that state-specific money demand shocks have economically and statistically significant effects on the quantity of loans made by banks in that state.

[3] This line of reasoning applies to both business investment and consumer spending decisions on durables and housing.
[4] For a comprehensive review of recent research on the interest rate channel of monetary policy transmission see e.g. Taylor (1995).
[5] For more analysis on how the exchange rate channel of monetary policy transmission operates see e.g. Bryan, Hoper and Mann (1993).
[6] See Tobin (1969).
[7] See e.g. Modigliani (1971).
[8] For comprehensive surveys of the credit channel literature see e.g. Bernanke and Gertler (1995), Cecchetti (1995) and Hubbard (1995).
[9] Among others, Miron, Romer and Weil (1994) and Oliner and Rudebusch (1996) provide empirical evidence supporting the view that the lending channel has, at best, an ambiguous impact on the real economy.

Yet, the author finds little evidence that shocks to the supply of bank loans have significant effects on output. In contrast to the aforementioned, Cappiello et al. (2010) apply the Driscoll (2004) framework to the euro area, providing empirical evidence in favor of the existence of a bank credit channel. The authors attribute the latter result to the much more prominent role banks have in the euro area financial system.[10]

Balance-Sheet Channel. This is another important credit channel, which purportedly arises from the presence of credit market frictions, such as asymmetric information, adverse selection and moral hazard. A schematic description of the way the balance-sheet channel works is as follows: contractionary monetary policy which causes a drop in equity prices, decreases the net worth of firms, amplifying the adverse selection and moral hazard problems. The latter is because a decline in net worth erodes the equity holders' stake in their firms, giving them the incentive to undertake riskier projects. In a similar vein, a lower net worth of firms suggests that lenders have less collateral for their loans and thus, losses from adverse selection are higher. These considerations mean that a restrictive monetary policy shock can lead to lower credit availability for financing investment spending. On the other hand, an expansionary monetary policy shock, which causes a rise in firms' equity prices (and also improves their cash flow position as a result of *e.g.* reduced interest payments on short-term debt) can lead to higher credit availability and investment spending, by alleviating the adverse selection and moral hazard problems.

Household Balance-Sheet Channel. The credit channel may also work though the effects of monetary policy changes on households' balance sheets. For instance, a contractionary monetary policy that increases the interest rates may adversely affect consumers' cash flow, leading to a consequent decline in household spending, particularly on durables and housing.

2.2 Monetary policy transmission channels and financial crises

In periods of acute financial crises such as the one experienced in 2007/2008, market activity is disrupted by asymmetric information problems, which severely affect the ability of financial intermediaries to channel funds to the real economy for the exploitation of the most productive investment opportunities.[11] Furthermore, financial crises also inflict severe dysfunctionalities in the monetary policy transmission mechanism, leading to steep increases in market rates.[12] In turn, this increases adverse selection as economic agents who are willing to take bigger risks and therefore to pay the higher interest rates will be the ones most anxious to borrow (Mishkin 1996). Higher interest rates also compress companies' cash flow (*e.g.* due to the ensuing decline in economic activity and higher debt servicing costs), deteriorating their balance sheet position and thus, rendering financial intermediaries less willing to lend to them. They also lead to sizeable stock market declines, lowering the net worth of firms and, again, increasing adverse selection and moral hazard problems in credit markets. Finally, financial crises can instigate an unanticipated decline in the general level of prices which, in turn, leads to a debt-deflation scenario, as sovereign and private debt are denominated in nominal terms.[13,14] The economic recession ensuing from a financial crisis can also result in increased uncertainty about the payoffs from debt contracts, making it harder for banks and other financial intermediaries to distinguish good from bad credit risks. Furthermore, deposit withdrawals ensue as depositors find it increasingly difficult to discriminate between banks that have made good versus bad loans. The resulting contraction in deposits and the desire of banks to increase

[10] By the end of 2007, bank loans to the private sector amounted to ca 148% of GDP in the euro area, compared to 63% of GDP in the US – see ECB (2008). As noted in L. Cappiello et al. (2010), the aforementioned trends may abstract from the fact that in the US a large part of financial intermediation is not registered on the balance sheet of commercial banks. This is illustrated by, among others, the major role played by the Government-Sponsored Agencies in the U.S. mortgage financing and the much larger volume of off-balance sheet funding by U.S. banks. For instance, by end-2007, the total amount of quoted equity and debt securities issued in the U.S. amounted to 312% of GDP compared to only 166% of GDP in the euro area – see also ECB (2009).

[11] For a comprehensive analysis of the role of asymmetric information in exacerbating financial crises see Mishkin (1991, 1994 and 1996) and Bernanke (1983).

[12] For instance, the the Libor-OIS spreads in the inter-bank money market reached historical peaks following the collapse of U.S. investment bank Lehman Brothers in September 2008.

[13] Fisher (1933) and Mishkin (1978).

[14] Mishkin (1991) documents that most financial crises in the U.S. have began with a sharp increase in interest rates, a collapse in stock prices and a sharp rise in uncertainty after the start of a recession. As a result of the ensuing deterioration in business conditions and uncertainty about their banks' health, depositors then began to withdraw their funds from the banks, leading to bank failures and panics.

their reserves relative to deposits to protect themselves from the deposit withdrawals leads then to a multiple contraction in loans and deposits and, under a more adverse scenario, to bank failures and panics.

3. Greek sovereign debt crisis and domestic banking system

3.1 Liquidity support packages and bank recapitalization programme

In Greece, the first support package to the domestic banking system was among the smallest in size relative these initially provided by other euro area governments, amounting to €28bn (or less than 12% of GDP) and mainly consisting of government guarantees to facilitate domestic banks' access to regular Eurosystem liquidity operations. This was actually a testament of the relatively strong capital position enjoyed by Greek banks (especially the four *systemically-important* ones)[15] in the period leading to the global financial crisis, chiefly because most of them had generally avoided imprudent lending practices and had very limited exposure in the so-called *toxic assets* that eventually brought down a number of U.S. and European banks.[16,17]

Yet, following the outbreak of the Greek debt crisis in late 2009 and the ensuing wave of downgrades of Greece's sovereign credit ratings, the liquidity position of the domestic banking system suffered a serious blow, as a result of huge deposit outflows, eroding collateral values and the cut off of domestic banks' access to international wholesale funding markets. In an effort to address these difficulties, three additional liquidity support packages (of a total size of €70bn) were offered to Greek banks, in the form of State guarantees to bank bond issues pledged as collateral for access to Euro system liquidity operations.[18] Eventually, and especially after the Greek debt restructuring (PSI), the entire capital position of most domestic banks was virtually wiped out, necessitating the implementation of comprehensive bank resolution and recapitalization programme (of a total size of €50bn), in the context of the second bailout agreement on Greece reached with the troika of official lenders in Q1 2012.[19,20]

At the time of writing this report, the domestic bank recapitalization and resolution programme was nearing its final stage. Alpha Bank was the first of the four systemic domestic banks to officially announce in early June 2013 that it succeeded to secure 12% private investment in its capital increase process, outperforming the minimum threshold of 10% that has was set as a pre-condition for a bank to remain under private management control.[21] On its part, Piraeus Bank has informed domestic authorities that the minimum 10% threshold for private participation has been secured, mainly thanks to the upfront commitment of participation from Millennium BCP and Société General. Similarly, National Bank of Greece will seek to tap the market and raise the 10% required threshold of private participation, thus avoiding issuance of convertible bonds (Cocos)[22]. As per the current timetable, the official recap results from both National Bank of Greece and Piraeus Bank are expected by end-June 2013. Meanwhile, Eurobank became the first fully-recapitalized systemic Greek bank after its Board decided in late April the capital requirement to be fully subscribed by the HFSF.

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[15] National Bank of Greece, Piraeus Bank, Alpha Bank and Eurobank.

[16] At the end of 2011, total bank lending to Greece's (non-financial) private sector stood at slightly less than 125%-of-GDP, pretty close to the corresponding EU average. Furthermore, the share of consumer loans to total private-sector bank loans was around 13%.

[17] For instance, note the following NY Times report of March 19, 2012, quoting a number of BlackRock managers who have been engaged in a diagnostic exercise of Greek bank loan portfolios commissioned by the Bank of Greece to help determine the recapitalization needs of the domestic banking system: *"Jessica Tan and Charles Hatami, two of BlackRock's day-to-day managers in Greece, said that they were surprised by both the quality of the data and the results. Most institutions, they said, did not lend recklessly, as the United States banks did during the real estate boom"* and *"The consumer lending market is relatively new in Greece, and they were disciplined in their approach," Mr. Phillips of BlackRock said. "Unlike other countries, the Greek consumer is not debt laden."*
http://dealbook.nytimes.com/2012/03/19/in-greek-crisis-a-little-known-adviser-with-outsize-influence/

[18] The last of these support packages (€30bn) was utilized by Greek banks only partially. Furthermore, the banks that made use of the package (for a total amount of ca €15bn) to secure liquidity from the Eurosystem (via Bank of Greece's ELA facility) did not roll-over corresponding maturities of short-term bonds coming due in late 2012/early 2013. As a result, the said package remains at this point unutilized. As regards the 2nd and 3rd of the aforementioned support packages (total size of €40bn), note that the Greek banks that made use of these packages are expected to (partially) roll-over corresponding corporate bond maturities coming due in the coming 12-15 months.

[19] For a comprehensive analysis of the structure and modalities of the Greek bank recapitalization programme see *e.g. Greece Macro Monitor, "Greek banking sector recapitalization and restructuring Program modalities, progress already made and next steps", Eurobank Research, Jan. 25, 2013.*

[20] As per Bank of Greece's "Report on the Recapitalisation and Restructuring of the Greek Banking Sector" published in December 2012, the capital needs for the four biggest domestic lenders were estimated at €27.5bn with the following allocation: National Bank of Greece: 9,756mn; Eurobank: €5,839mn; Alfa Bank: €4,571mn; and Piraeus Bank: €7,335mn

Regarding non-core banks, the HFSF is currently taking actions to make major reduction in the operating costs of both New Hellenic PostBank and Nea Proton bank with the objective of making them attractive to potential buyers and concluding their sale by mid-July, 2013. The remaining non-core banks, Attica Bank and Probank, need to secure their capital requirement fully from private sources with their capitalization programme expected to be completed by June 24, 2013. According to the revised MoU, for those non-core banks that will not finally meet the capital requirements, Bank of Greece (BoG) in coordination with HFSF will consider by end-June 2013 alternatives to resolution including Purchase and Assumption transactions (P&A) by any of the four systemic banks.

3.2 Trends in domestic bank deposits and loans in the period before and after the outbreak of the global financial crisis

Resident and non-resident deposits in the domestic banking system have been on a prolonged rising trend since the country's entry into the euro area in January 2001, with their total value peaking in H2 2009, before embarking on a broadly declining path following the outbreak of the Greek sovereign crisis in the last quarter of that year. More specifically, total deposits and repos of domestic household and non-financial corporations in domestic monetary financial institutions (MFIs) excluding the Bank of Greece hit a record high of around €237.8bn in September 2009, but declined precipitously in the following months and quarters, reflecting, among others, increased uncertainty of depositors about the outlook of the domestic economy, heightened fears about a distortedly sovereign debt default (and "GREXIT") scenario as well as the ensuing domestic economic downturn that forced domestic households and businesses to tap their existing pool of savings for financing current consumption and operating expenditure. According to BoG data, total domestic private (non-financial) sector deposits to domestic MFIs hit a multi-year low of ca€150.6bn at the end of H1 2012, amid increased political uncertainty ahead of the June 2012 national election.[23]

The massive withdrawal of domestic bank deposits following the outbreak of the sovereign debt crisis hit the Greek banking system in a particularly challenging period, characterized by a recessionary domestic environment, rising non-performing loans[24] and eroded collateral values for ECB financing (Graph 1.1 – Appendix I). Furthermore, the liquidity position of the domestic banking system came under additional pressure after a stream of downgrades of Greece's sovereign credit by international rating agencies inevitably affected the ratings of domestic banks, halting their access to interbank funding markets. Faced with this particularly adverse environment Greek banks had to navigate through a particularly difficult environment, having in addition to: (i) pay back considerable amounts in the form of maturing liabilities to other parties (wholesale funding)[25],and, most importantly, (ii) to also maintain a sizeable (pre-PSI) exposure in Greek sovereign debt, to the tune of around €15bn in the form of T-bills and €43bn in medium- and long-term government paper.

In view of these developments, and in a move to prevent a sharp contraction of domestic credit, authorities decided (as we have already noted) to extend and broaden the special government support program for bank liquidity that was introduced in late 2008 (N.3723/2008). These steps along with the sizeable Eurosystem liquidity support to domestic banks (facilitated by a further loosening in ECB's collateral acceptance criteria for Greek sovereign bonds) have prevented a much sharper contraction in bank credit that could significantly exacerbate the domestic recession. The latter is especially relevant, given the overwhelming dependence of domestic households and businesses on banks for financing relative to alternative sources of funding.

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[21] Under a ministerial cabinet act issued in early November 2012, Greek banks should meet a Core Tier 1 capital ratio of at least 6% through the *exclusive* issue of common shares. Private shareholders will be required to cover at least 10% of new common equity capital so as to keep credit institutions under private management control. Should this be the case, the remaining 90% will be covered through the issue of common shares to the Hellenic Financial Stability Fund (HFSF) with restrictive voting rights. Yet, should the Fund's participation exceeds 90% of the common equity capital increase, the HFSF shares will carry full voting rights.

[22] According to the bank recapitalization terms, contingent convertibles will bear an annual coupon of 7% plus a 50bps step-up per year. The said interest has to be paid in cash on an annual basis, provided that capital adequacy requirements are fulfilled. Yet, interest payment could be paid via the issue of common shares in case that a cash payment would result in a fall of the Core Tier 1 ratio below the minimum acceptable threshold. Common shares would then be issued at a price equal to the 50% of the bank stock weighed average price over the 50 trading days preceding the interest payment.

[23] In the 2-week period leading to the June 2012 election, some €15bn of deposits left the domestic banking system.

[24] Industry-wide NPLs in the Greek banking system stood at ca 24.5% in December 2012 compared to 7.7% at the end of 2009.

Domestic deposit dynamics have stabilized since June 2012, reflecting considerable progress made by the new coalition government in bringing the country's stabilization programme back on track and satisfying all necessary prerequisites for the resumption of official (EFSF/IMF) funding to Greece. This favorable process was reinforced by the 26/27 November 2012 Eurogroup announcement of additional relief measures aiming to improve the sustainability of Greek public debt as well as additional progress made in reducing the fiscal deficit and offsetting considerable competitiveness losses accumulating in the post EMU-entry period.

According to the latest official statistics, domestic private sector bank deposits stood at ca €162.3bn in April 2013 (Graph 1.2 – Appendix I). On the other hand, total domestic MFI credit to domestic corporations and households stood at around €225.92bn in April 2013, having declined by around 10.2% cumulatively since November 2009. As a comparison, domestic private sector deposits to domestic MFIs declined by 30.8% cumulatively over that period.

4. Empirical methodology

4.1 A model for analyzing the banking lending channel in the euro area

To empirically test the existence of a bank lending channel in the euro area we utilize an aggregate demand model initially proposed by Driscoll (2004).[26] Specifically, we apply this model to estimate the relationship between bank credit and output in a panel of 12 euro area economies, (see *Data and Empirical Results* section). In brief, the empirical methodology used consists of the follows three steps:

Step 1. Prepare data and derive demeaned variables
Step 2. Run country-specific OLS regressions of relevant monetary aggregate (e.g. M2 or M3) on real income (real GDP) and deposit interest rates
Step 3. Run OLS panel regression of real GDP growth on loans growth, instrumenting loans with money demand shocks (i.e., estimated regression errors from Step. 2).

For a formal presentation of the Driscoll (2004) model see Appendix II at the end of this document.

[25] E.g. around €8bn in 2010.

[26] For a panel study on the banking lending channel in the euro area utilizing the Driscoll (2004) model see L. Cappiello et al. (2010)

4.2 SVAR model - Greece case study

This section discusses briefly the second empirically methodology presented in this paper, which aims to take a closer look at the functionality of the monetary transmission mechanism and the intermediation role of banks in the Greek economy. Our case study utilizes a structural vector autoregressive model (SVAR) for modeling the pass-thought of monetary policy shocks to domestic retail loan rates and the real economy. Note that the SVAR framework has been extensively utilized in the literature to study the mechanism of monetary policy transmission and the effects on monetary policy innovations on real economic variables.[27]

Our baseline specification comprises of the following vector of endogenous variables:

$$Y_t = [\, y_t, p_t, MM_t, RR_t]$$

where y_t is real GDP, p_t is the GDP deflator, MM_t depicts a money market rate and RR_t is the domestic retail loan rate. The Cholesky decomposition is used to recover the structural shocks of the primitive SVAR system, even though, with quarterly data, the within period effects cannot be ruled out.[28] Then, the ordering of endogenous variables associated with the aforementioned identification strategy is as follows: real GDP, GDP deflator, money market rate and the retail loan rate. The lags of the SVAR system in our empirical study are selected by applying the usual information criteria *i.e.,* Akaike and Schwarz.

5. Data and empirical results

5.1 Panel study for analyzing the banking lending channel in the euro area

The panel study presented in this section constitutes the empirical counterpart of the Driscoll (2004) model we summarized in the previous section. The study comprises of the following 12 euro area countries: Austria (AT), Belgium (BE), Cyprus (CY), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PO) and Spain (ES).[29] The data series utilized herein are observed at quarterly frequency and span the period from Q1 2003 to Q4 2013. [30] The sources of the panel variables are Eurostat, ECB and the respective national central banks. The relevant notation and definition of variables is a follows:

Real GDP (2005 prices), ***y***
GDP deflator (2005=100), ***p***
Annualized deposits rates (non-financial corporations and households in domestic MFIs; up to 1-year maturity), ***rd***
Loans to domestic households and businesses (nominal outstanding amounts in EURs), ***l***
Monetary aggregates excluding currency in circulation, ***M2*** and ***M3***[31,32]
Our loans (***l***) and monetary (***M2*** and ***M3***) variables constitute *real* balances (respective nominal values are deflated with the corresponding GDP deflator indices). Note that all aforementioned variables (except of the deposit rate) enter our panel study in logs and they are demeaned with their respective cross-sectional mean as explained in Appendix III.

As a first step, we estimate the money demand equation for each of the euro area countries under examination. The results of this first step are reported in ***Table 1*** of ***Appendix III.***

[27] For earlier contributions utilizing the SVAR model see e.g. Cottarelli and Kourelis (1994), Borio and Firtz (1995), Mojon (2005) and Donnay andegryse (2001).
[28] For a more thorough discussion of the problem of potential simultaneity arising in this particular setting see e.g. Donnay and Degryse (2001).
[29] For the rest of the euro area economies *i.e.,* Estonia, Luxembourg, Malta, Slovenia and Slovakia there are no adequately-long time series for the variables included in our panel study and thus, we exclude them from our analysis.
[30] The time period examined in our study is after all of the countries included herein (except of Cyprus) have joined the euro area. This broadly prevents our results from being biased by any structural breaks in the estimated empirical relationships due to euro adoption.

The second step of our analysis encompasses a regression of loan growth on real GDP growth and the money demand shocks, e^{M2} and e^{M3} estimated in the previous step (see ***Table 2*** of ***Appendix III***). As the said table suggests, contemporaneous and 3rd-lag money demand shocks derived from M2 are statistically significant (Panel 2.1 of Table 2). The same applied for money demand shocks derived from M3 (Panel 2.2 of Table 2). The interpretation of the estimated coefficient of the OLS panel regressions presented in Table 2 – Appendix III is as follows:

An assumed change in the residual e^{M2}_{it} (as estimated from M2) at a rate of 1ppt above the corresponding cross-sectional mean would induce a 0.045% increase in the growth of loans above the cross-sectional average loan growth, as reflected by the estimated coefficient of e^{M2}_{it} in the Panel 2.1 of Table 2 . This effectively implies that the level of bank deposits is indeed a significant determinant of loan supply, which, in turn, constitutes an important precondition for the existence of a banking lending channel. That is, a large value of e^{M2}, which effectively indicates a larger amount of deposits in the banking system, provides the means for banks to supply more loans.

As a final step, we run panel regressions of real GDP growth on loans growth instrumented with the money demand shocks used in the previous step (see ***Table 3*** of ***Appendix III***). As demonstrated by panel 3.1 of Table 3 (Appendix III) the coefficient of loan growth variable (Δl_{it}) is statistically significant, has the theoretically-correct sign (positive) and implies a significant effect of bank loans on GDP. In additional to the instrumental variables (IV) panel regression that includes al 12 euro area countries examined in the present study, we run to additional IV panel regressions including: (i) the so-called PIGS economies (Portugal, Ireland, Greece and Spain) plus Cyprus i.e., 5 euro area countries in total; and (ii) Greece and Cyprus, i.e., 2 euro area economies. The respective empirical results of the panel regressions (i) and (ii) are depicted in Panel 3.2 and Panel 3.3 of Table 3 (Appendix III). For the purpose of the present paper, we consider the empirical results of the latter regressions as being more representative than the 12-country IV panel regression, given the economies included in the reduced cross-section regressions were these that have been more severely affected by the euro area sovereign debt crisis.[33]

The Δl_{it} variables in these two IV panel regressions enter in lags as the respective contemporaneous coefficients were found to be insignificant. Focusing on Greece and Cyprus (Panel 3.3 of Table 3), the interpretation of the estimated coefficients is as follows: A 1ppt decrease (increase) in one of these countries' loan growth relative to the two-country average causes, after a quarter, a decline (rise) of around 0.2ppts in that country's GDP growth below (above) the corresponding two-country average.

Overall, our results support the existence of a banking lending channel in the euro area. First, country-specific money demand shocks have a significant effect in the growth of loans; this effectively implies that the level of bank deposits is indeed a determinant of loan supply, which, in turn, constitutes this first key precondition for the existence of a banking lending channel. Second, the supply of bank loans has a significant effect of a country's GDP, which constitutes the second important precondition for the existence of a banking lending channel.

[31] For the period after-Q4 2007, M2 and M3 data for Cyprus constitute authors' estimates, as the Central Bank of Cyprus discontinued publishing statistics for the monetary aggregates following the country's entry into the euro area (January 2008).
[32] In line with Demetriades and Hussein (1996) and others, we subtract money in circulation from both monetary aggregates M2 and M3. The reason is to get a more relevant measure of financial debt (and banks' deposit liabilities), especially because, in some cases, M2 and M3 may contain a relatively large portion of currency outside banks and thus, a change in any of these aggregates may in fact reflect the level of monetization of the economy.
[33] With the exception of Spain, all of these economies are currently under a formal stabilization progarmme agreed with the EC/ECB/IMF troika of official lenders.

5.2 SVAR model - Case study Greece

This section discusses the data used and the empirical results of the application of our SVAR model for examining the functionality of the monetary policy transmission mechanism in Greece. The data series utilized herein are observed at quarterly frequency and span the period: Q1 2000 to Q1 2013. The sources of the data are Eurostat, ECB and Bank of Greece. The relevant notation and definition of variables is as follows:

Real GDP (2005 prices), ***y***
GDP deflator (2005=100), ***p***
Money market rate (EONIA), ***MM***
Retail loan rate, ***RR***, representing the annualized interest rate on euro-denominated new loans from domestic MFIs to domestic households & non-financial corporations.

The empirical results of our SVAR model for Greece are depicted in Appendix IV. Our baseline specification is a 4-variable SVAR, comprised of the following endogenous variables: real GDP, ***y***, GDP deflator, ***p***, EONIA, ***MM*** and retail loan rate ***IRHB***. Tables 1.1 & 1.2 of Appendix IV present the full SVAR model results for our baseline specification (in log levels and log changes, respectively). The number of lags is 2 (selection based on Akaike and Schwarz criteria) and the included "crisis" dummy, ***D08***, takes the value of 0 over the period Q1 2000-Q4 2008 and 1 otherwise.

The impulse-response functions of our baseline SVAR specifications in log levels and in log changes are depicted in Graphs 1.1 & 1.2 (Appendix IV), respectively.[34] Note that Graph 1.2 (Annex IV) portrays the *cumulative* response of real GDP growth to 1 standard deviation (S.D.) shock to the retail loan rate. Furthermore, a 2-variable SVAR model is estimated, including the following two endogenous variables, ***EONIA*** and ***IRHB*** as well as the crisis dummy, ***D08***. Graphs 2.1-2.3 (Appendix IV) depict the impulse responses of the 2-variable SVAR, estimated over full sample Q1 2000 - Q1 2013 and over the periods Q1 2000 – Q4 2008 and Q1 2009 – Q1 2013, respectively.

As demonstrated by our empirical results (Tables 1.1 & 1.2 – Appendix IV), the estimated coefficients of the lagged loan interest rate in the respective baseline GDP equations have the correct sign (negative) and are statistically significant. Moreover, the crisis dummy, *D08*, is significant in the SVAR model in which real GDP and GDP deflator enter in log differences. As regards the estimated impact of exogenous changes in the loan interest rate on real GDP, the numerical interpretation of the estimated impulse-response functions is a follows:

An exogenous increase (decrease) in the loan rate equivalent to 1 standard deviation (1.58 percentage points in our study) causes a 1-year ahead cumulative decline (rise) in real GDP by ca 0.49 percentage points (ppts), with the full impact of the shock realized over a 4-quarter period.

Practically, if one assumes that deposit rates in Greece decline by 2 percentage points and this leads to a decline in the average loan rate by, say, 1ppts, then this can lead to a cumulative boost in real GDP growth of ca 0.3ppts over a 4-quarter period. If the decline in the average loan rate is, instead, 2ppts, then the cumulative boost to real GDP growth reaches around 0.6ppts over a 4-quarter period.

[34]Cointegration tests conducted with the baseline specification show that there are multiple cointegrating vectors. Given the size of the available sample we treat the issue of cointegration with some caution and, because of the above multiplicity, we do not impose the cointegrating restrictions during estimation. Our results below, that is the estimated impulse responses, are robust to this approach and do not change either quantitatively or qualitatively by using the unrestricted VAR without cointegration. The validity of our approach is further enhanced by the analysis we have conducted in first differences, where we found the same shape of the (cumulative) impulse responses as the unrestricted levels VAR model.

As to the functionality of the monetary policy transmission mechanism in Greece, our empirical results from estimating the 2-variable SVAR model[35] show that around 44% of a given exogenous shock in the EONIA rate are transmitted within a year to the average rate on domestic FMI loans to households and businesses. Over a 16-quarter period (i.e., 4 years) the cumulative pass-through reaches around 64.7% (Table 2 of Appendix IV).

Earlier empirical studies have documented the existence of an incomplete pass-through of monetary policy shocks to domestic loan rates, with the speed of adjustment varying widely across the euro area economies and depending on such country-specific characteristics as the degree of competition in the domestic loans market and the relative size of financial intermediaries. For instance, estimating a 2-variable SVAR model similar in structure with that utilized in our study, Donnay and Degryse (2001) document a 1-year-ahead cumulative pass-through in Greece that reaches 77% for the interest rate on short-term loans to businesses and 68% in the case of long-term loans to businesses over the period 1980-2000.[36]

Although in our model the inclusion of the crisis dummy, ***D08***, controls for the impact of the global financial crisis (and the ensuing Greek sovereign debt crisis) on the functionality of the monetary policy transmission mechanism, we have also estimated the corresponding pass-through rates in two sub-periods of our full sample, namely, Q1 2000-Q4 2008 and Q1 2009-Q1 2013 (estimates available upon request). Not surprisingly, our results document a significant decline in the pass-through rate in the period following the outbreak of the global financial crisis.

6. Concluding remarks and brief discussion of policy implications

The present paper employs two discrete empirical methodologies to examine the existence of a banking lending channel in the euro area and to assess the functionality of the monetary policy transmission mechanism in Greece in the period before and after outbreak of the 2007/2008 global financial crisis.

To empirically estimate the relationship between bank credit and output we apply an aggregate demand model initially proposed by Driscoll (2004) in a panel of 12 euro area economies, including: Austria (AT), Belgium (BE), Cyprus (CY), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PO) and Spain (ES).

In line with a number of earlier empirical studies, see *e.g.* L. Cappiello et al. (2010), our results provide strong evidence supporting the existence of a banking lending channel in the euro area. Specifically, country-specific money demand shocks have a significant effect on the growth of loans, which effectively implies that the level of bank deposits is indeed a key determinant of loan supply. Furthermore, the supply of bank loans has a significant effect of on GDP and other real economic variables.

By and far, these findings reinforce the need for a close monitoring of credit developments in the context of monetary authorities' ongoing efforts to restore the proper function of the monetary policy transmission mechanism.

In the case of Greece, a panel analysis of a group of five euro area countries that have been particularly hit by the sovereign debt crisis (Greece, Portugal, Ireland, Spain and Cyprus) shows that, a 1 percentage point decrease (increase) in domestic bank loan growth relative to the cross-section average causes, after a quarter, a decline (rise) of between 0.2ppts and 0.47ppts in Greece's real GDP growth below (above) the respective cross-sectional average.

Separately, our SVAR model estimates imply that a decline (increase) in the average Greek bank loan interest rate by 1ppt can lead to a cumulative boost (contraction) in real GDP growth by around 0.3ppts over a 4-quarter period. If the decline (increase) in the average loan rate is, instead, 2ppts, then the cumulative boost (contraction) in real GDP growth can reach around 0.6ppts over a 4-quarter period.

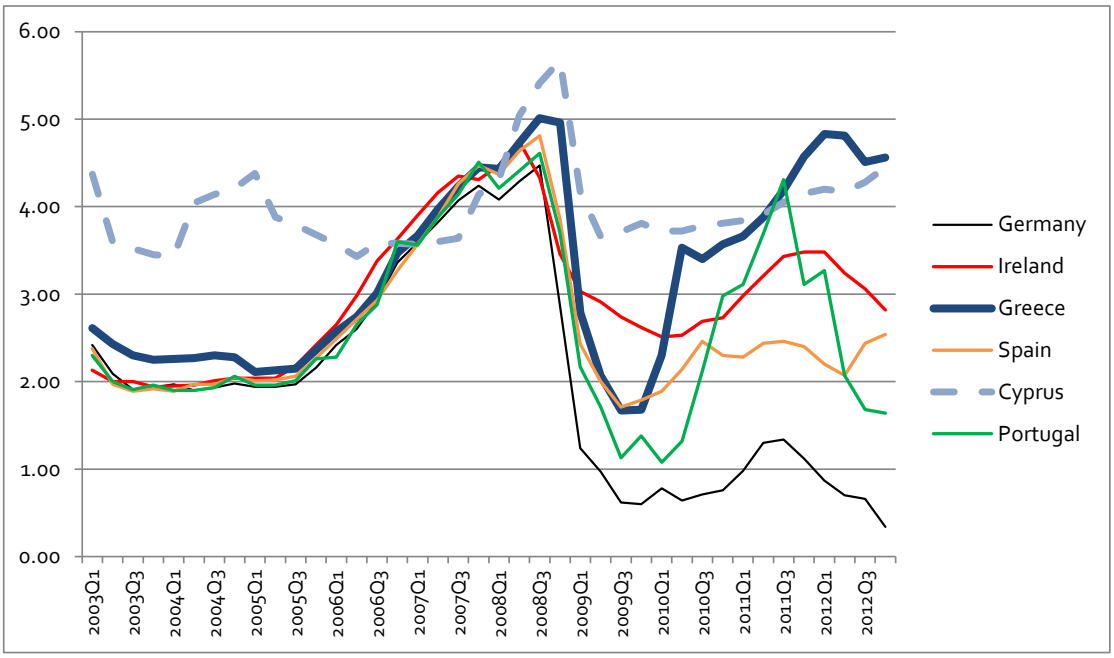
[35] 2-variable SVAR includes EONIA and IRHM as endogenous variables and the crisis dummy, D08, as exogenous.
[36] This was actually among the highest estimated pass-through rates in the euro area.

In our view, the latter results demonstrate the crucial role bank credit can play in the recovery of the Greek economy, following a prolonged domestic recession, which is expected to culminate to cumulative real output losses of around 25ppts over the period Q3 2008-Q4 2013.

Looking forward, the completion of the Greek bank recapitalization programme and the stabilization of deposits since mid-2012 are expected to facilitate a gradual improvement in domestic credit conditions. Yet, the need to continue reducing dependence on Eurosystem liquidity support (currently at ca €90bn vs. highs around €135bn in late 2012) is one of the factors arguing against a swift return to strong positive credit dynamics post-recapitalization. These considerations render the need to address domestic banks' funding costs even more pervasively.

One significant determinant of domestic banking sector funding costs is the still high domestic deposit rates (Graph A). These remained at exceptionally high levels in recent months and quarters, reflecting intense competition by domestic banks (especially a number of smaller aggressive players) to attract depositors. However, the aggressive consolidation of the Greek banking system in the context of the ongoing bank recapitalization and resolution programme establishes the base for a gradual normalization of domestic bank deposit rates in the period ahead. This process could have beneficial effects on domestic GDP, to the extent that it could also help to compress bank loan rates.

Graph A
Annualized interest rates (up to 1yr maturity) on deposits of non-financial corporations & households in domestic MFIs.
(Source: ECB)



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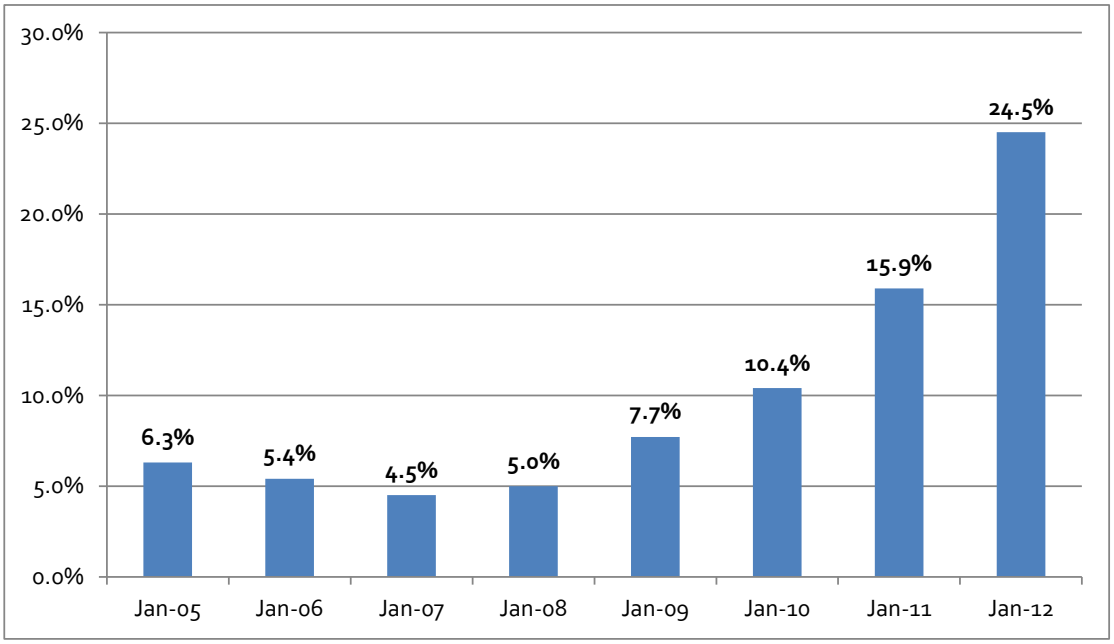
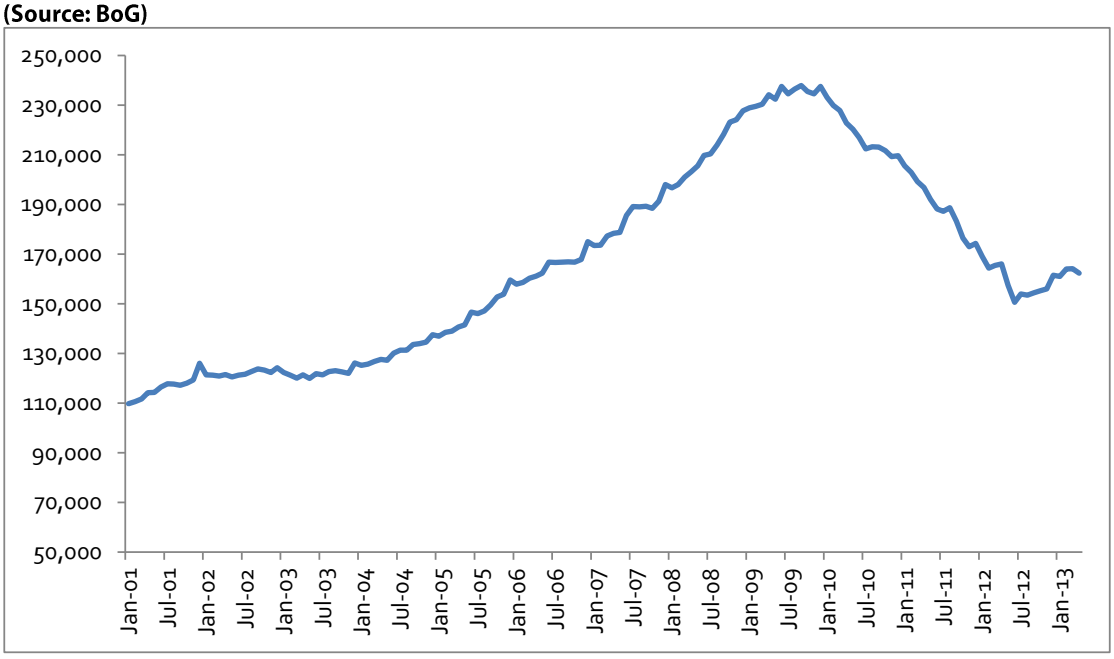
Appendix I

Greece: Evolution of domestic bank deposits and loans

Graph 1.1
Non performing bank loans (% of total loans)
(Source: BoG)



Graph 1.2
Resident private sector (household & businesses) deposits in domestic MFIs in EURmn
(Source: BoG)



Appendix II
A model for analyzing the banking lending channel in the euro area

A model for analyzing the banking lending channel in the euro area

This section provides a brief description of a model initially proposed by Driscoll (2004) to derive a testable equation for the bank lending channel.[37] In this paper we apply the aforementioned model to estimate the relationship between bank credit and output in a panel of 13 euro area economies, including Greece and Cyprus (see section *Panel Study- Data and Empirical Results* in this document).

The model extends the Bernanke and Blinder (1988) aggregate demand model, assuming that the economy is comprised of *M* states, $i = 1,..,M$, sharing a common currency and monetary policy.[38] The economy is populated by investors who have a portfolio choice between bank deposits and bonds. The interest rate on bank deposits, *rd*, can vary from one member state to another, but bonds bear the same interest rate, *r*, across states. In this stylized model, the common monetary authority can change the aggregate quantity of money, but it cannot target the quantity of money in a specific state. For each state, *i*, the equilibrium money demand and supply equation can be written as follows:

$$m_{it} - p_{it} = \gamma y_{it} - \delta(r_t - rd_{it}) + e_{it} \quad (1)$$

where $m_{it} - p_{it}$ represents real money balances, y_{it} is real income and e_{it} depicts the state-specific shock to money demand. In this Keynesian framework, real income equals aggregate expenditure, which can be disaggregated into consumption (private and public), investment and net exports. Assuming now that government spending is given and net exports depend on the exogenous exchange rate, consumption and investment will inversely depend on the interest rates on bonds and loans, r_t and ρ_{it}, respectively. Again, loan interest rates can vary from one member state to another, though bonds bear the same interest rate across states. Then, in equilibrium, the following equation holds:

$$y_{it} = -\theta r_t - a\rho_{it} + z_{it} \quad (2)$$

where z_{it} represents state-specific shocks to aggregate demand.
Supply of bank loans a function of the interest rate on bonds and loans and also depends on real money balances, given that deposits are assumed to be a major source of financing for banks that cannot be perfectly substituted by other funding sources.[39] Next, the loan supply, ls_{it}, and loan demand, ld_{it}, equations can be written as follows:

$$ls_{it} = -\lambda r_t + \mu\rho_{it} + \beta(m_{it} - p_{it}) + w_{it} \quad (3.1)$$

$$ld_{it} = rr_t - \chi\rho_{it} + \omega y_{it} + u_{it} \quad (3.2)$$

where w_{it} and u_{it} represent state-specific shocks to loan supply and loan demand, respectively.

In order to distinguish between the banking lending channel (i.e., effects of bank loans on a state's real economy) and the interest rate channel (i.e., common monetary policy effects on a state's real economy), Driscoll (2004) de-means each relevant model variable, x_{it}, with its cross sectional mean:

$$x^*_{it} = x_{it} - M^{-1}\Sigma_i x_{it} \text{ for } i = 1,\ldots,M.$$

[37] For a panel study on the banking lending channel in the euro area utilizing the Driscoll (2004) model see L. Cappiello et al. (2010)
[38] One can think of this framework as representing the euro area economy and its Member States.
[39] In the euro area banking sector balance sheet, private, non-financial sector deposits constitute around one-third of total MFI liabilities and thus, they represent the most important source of bank funding.

The system of equations (1) – (3.2) then becomes:

$$m^*_{it} - p^*_{it} = \gamma y^*_{it} + \delta rd^*_{it} + e_{it} \quad (4)$$

$$y^*_{it} = a\rho^*_{it} + z_{it} \quad (5)$$

$$ls^*_{it} = -\mu\rho^*_{it} + \beta(m^*_{it} - p^*_{it}) + w_{it} \quad (6.1)$$

$$ld^*_{it} = -\chi\rho^*_{it} + \omega y^*_{it} + u_{it} \quad (6.2)$$

Note that, by de-meaning the variables entering the model equations, we remove the possible impact of monetary policy changes on bond yields (interest rate channel). Furthermore, by assuming that $Corr(e_{it}, u_{it}) = Corr(e_{it}, z_{it}) = 0$, we also solve the endogeneity between money demand shocks and real income.[40] Here, we effectively allow money demand shocks, e_{it}, to be independent from real income and loan demand and, instead, depend on other factors such as preferences and/or institutional arrangements. If the aforementioned conditions hold, then one can show - *i.e.,* by solving equations (4) – (6.2) for real income and loans - that although country-specific money shocks are uncorrelated with output, they continue to be correlated with loans. That effectively means that money demand shocks can be used as instruments in estimating the relation between real income and loans.

The model above offers a pretty straightforward framework to empirically test for the existence of a banking lending channel in the euro area, and that is in fact the topic of the next section of our paper. Specifically, the empirical methodology used consists of the follows three steps:

Step 1. Prepare data and derive demeaned variables
Step 2. Run country-specific OLS regressions of relevant monetary aggregate (e.g. M2 or M3) on real income (real GDP) and deposit interest rates
Step 3. Run OLS panel regression of real GDP growth on loans growth, instrumenting loans with money demand shocks (i.e., estimated regression errors from Step. 2).

[40] For the more detailed analysis on how to tackle the endogeneity issue in the model above, see Driscoll (2004)

Appendix III

Panel study on the banking lending channel in the euro area

Table 1 – Estimation of money demand equation errors

Sub table 1.1 - M2 regression on real GDP (y) and deposit rates (rd)

Method: Pooled EGLS (Cross-section weights); Sample: 2003Q1 2012Q4; 40 included observations; Cross-sections included: 12; Total pool (balanced) observations: 480; Linear estimation after one-step weighting matrix

Dependent variable: *M2*

	Estimated coefficients of explanatory variables*	
	y	***rd***
Belgium	**1.383**	**0.070**
Germany	**1.240**	**0.051**
Ireland	**1.393**	**0.083**
Greece	**1.379**	**0.039**
Spain	**1.284**	**0.056**
France	**1.240**	**0.042**
Italy	**1.265**	**0.027**
Cyprus	**1.804**	**0.031**
Netherlands	**1.359**	**0.049**
Austria	**1.340**	**0.057**
Portugal	**1.414**	**0.030**
Finland	**1.313**	0.006

(*) quarterly frequency data spanning the period Q1 2003-Q4 2013; all variables are computed as deviations from their cross-sectional mean; except of the ***rd*** coefficients for Finland (insignificant) and Cyprus (significant at the 10% confidence level), all other coefficients are significant at the 1% confidence level.

Sub table 1.2 - *M3* regression on real GDP (*y*) and deposit rates (*rd*)

Method: Pooled EGLS (Cross-section weights)

Sample: 2003Q1 2012Q4; 40 included observations

Cross-sections included: 10, Total pool (balanced) observations: 400

Linear estimation after one-step weighting matrix

Dependent variable: *M3*

	Estimated coefficients of explanatory variables**	
	y	***rd***
Germany	**1.351**	**0.018**
Ireland	**1.523**	**0.109**
Greece	**1.548**	-0.008
Spain	**1.431**	**0.011**
France	**1.383**	**0.024**
Italy	**1.393**	-0.002
Netherlands	**1.495**	-0.001
Austria	**1.483**	**0.022**
Portugal	**1.572**	-0.008
Finland	**1.491**	-0.003

(**) quarterly frequency data spaning the period Q1 2003-Q4 2013; all variables are computed as deviations from their cross-sectional mean; all ***y*** coefficients are significant at the 1% confidence level; significance level of the ***dr*** coefficients is as follows: Ireland, France and Austria all significant at the 1% level, Germany and Spain significant at 10%; Finland, Italy, Netherlands, Greece and Portugal all insignificant. Sub table 1.2 contains 10 countries (2 less than Sub table 1.1) due to the lack of availability of M3 data for Belgium and Cyprus.

Table 2 – OLS panel regressions of loan growth on GDP growth and money demand shocks

Panel 2.1 – OLS panel regression of loan growth (Δl) on GDP growth (Δy) and money demand shocks from M2 (e^{M2})

Dependent Variable: Δl_t
Method: Panel EGLS (Cross-section weights)
Sample (adjusted): 2004Q2 2012Q4
Periods included: 35, cross-sections included: 12;
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δy_{t-3}	0.243720	0.106378	2.291062	0.0225
Δy_{t-4}	0.487751	0.106126	4.595955	0.0000
$e^{M2}{}_t$	0.045647	0.021583	2.114921	0.0350
$e^{M2}{}_{t-3}$	-0.069278	0.021851	-3.170484	0.0016
R-squared	0.099793			

Panel 2.2 – OLS panel regression of loan growth (Δl) on GDP growth (Δy) and money demand shocks from M3 (e^{M3})

Dependent Variable: Δl_t
Method: Panel EGLS (Cross-section weights)
Sample (adjusted): 2004Q2 2012Q4
Periods included: 35; Cross-sections included: 10
Total panel (balanced) observations: 350
Linear estimation after one-step weighting matrix

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δy_{t-3}	0.261721	0.108341	2.415730	0.0162
Δy_{t-4}	0.464046	0.107993	4.297008	0.0000
$e^{M3}{}_t$	0.050048	0.026538	1.885922	0.0601
$e^{M3}{}_{t-3}$	-0.091170	0.026074	-3.496562	0.0005
R-squared	0.116396			

OLS panel regressions 2.1 & 2.2 of loan growth on GDP growth and money demand shocks from M2 (sub-table 1.1) and M3 (sub-table 1.2); quarterly frequency data spanning the period Q1 2003-Q4 2013; all variables are computed as deviations from their cross-sectional mean; Panel 2.1 includes the entire group of euro area countries (12 in total) examined in our study, while panel 2.2 excludes Belgium and Cyprus, from which there are no data available for the M3 monetary aggregate. Lag orders of right hand-side variables in panels 2.1 & 2.2 has been selected to ensure significant of estimated coefficients at the 5% confidence level.

Table 3 – Instrumental variable (IV) panel regressions of GDP growth on loan growth

Panel 3.1 – IV panel regression of GDP growth (Δy) on loan growth (Δl), instrumenting loans with money demand shocks (i.e., estimated regression errors from Table 1 – Appendix III).

Dependent Variable: **Δy**
Method: Panel Two-Stage EGLS (Cross-section weights)

Sample (adjusted): 2003Q4 2012Q4
Cross-sections included: 12
Total panel (balanced) observations: 444
Iterate weights to convergence
White period standard errors & covariance (d.f. corrected)
Instrument specification: C DY(-1 TO -2) EM2(0 TO-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δy_{t-2}	0.228086	0.140907	1.618692	0.1062
Δl_t	0.759274	0.330228	2.299243	0.0220
Δl_{t-1}	-0.610630	0.364002	-1.677543	0.0941

IV panel regression on GDP growth and loan growth instrumented with money demand shocks from M2 (Sub-Table 1.1 – Appendix III); quarterly frequency data spanning the period Q1 2003-Q4 2013; all variables are computed as deviations from their cross-sectional mean; panel includes the entire group of euro area countries (12 in total) examined in our study;.

Panel 3.2 – IV panel regression of GDP growth (Δy) on loan growth (Δl), instrumenting loans with money demand shocks (i.e., estimated regression errors from Table 1 – Appendix III). Panel includes five euro area countries (Greece, Ireland, Spain, Portugal & Cyprus).

Dependent Variable: **Δy**
Method: Panel Two-Stage EGLS (Cross-section weights)
Date: 06/07/13 Time: 13:09
Sample: 2003Q1 2012Q4 IF VAR01="EL" OR VAR01="CY" OR VAR01="ie"
OR VAR01="es" OR VAR01="po"
Periods included: 37
Total panel (balanced) observations: 74
Iterate weights to convergence
White period standard errors & covariance (d.f. corrected)
Instrument specification: C DY(-1 TO -2) EM2(0 TO-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δy_{t-1}	0.109863	0.023607	4.653745	0.0000
Δl_{t-1}	0.466829	0.065937	7.079902	0.0000
Δl_{t-2}	-0.288961	0.101976	-2.833609	0.0060

Panel 3.3 – IV panel regression of GDP growth (Δy) on loan growth (Δl), instrumenting loans with money demand shocks (i.e., estimated regression errors from Table 1-Appendix III). Panel includes two euro area countries (Greece & Cyprus).

Dependent Variable: **Δy**
Method: Panel Two-Stage EGLS (Cross-section weights)
Sample: 2003Q1 2012Q4 IF VAR01="EL" OR VAR01="CY"
Periods included: 37
Cross-sections included: 2
Total panel (balanced) observations: 74
White period standard errors & covariance (d.f. corrected)
Convergence achieved after 6 weight iterations
Instrument specification: C DY(-1 TO -2) EM2(0 TO-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δy_{t-1}	0.233345	0.124123	1.879944	0.0642
Δl_{t-1}	0.204065	0.037219	5.482890	0.0000

IV panel regression on GDP growth and loan growth instrumented with money demand shocks from M2 (Sub-table 1.1 – Appendix III); quarterly frequency data spanning the period Q1 2003-Q4 2013; all variables are computed as deviations from their cross-sectional mean; panel 3.2 includes five countries of the euro area periphery (including Greece & Cyprus), while panel 3.3 only includes Greece and Cyprus.

Appendix IV

SVAR model results - Greece case study

Table 1 – SVAR baseline specification (real GDP and GDP deflator in log levels)

Vector of endogenous variables: ***[Y, P, EONIA, IRHB]***, where **Y** depicts log (s.a. real GDP), **P** is log (s.a. GDP deflator), **EONIA** is the interbank money market rate utilized in our study & **IRHB** represents the annualized interest rate on euro-denominated new loans from domestic MFIs to domestic households & non-financial corporations. The data series utilized herein are observed at quarterly frequency and span the periods: Q1 2000 to Q1 2013. The sources of the data are Eurostat, ECB and Bank of Greece. Crisis dummy, ***D08***, takes the value of 0 over the period Q1 2000 – Q4 2008 and 1 otherwise.

Vector Autoregression Estimates
Sample (adjusted): 2000Q3 2013Q1
Included observations: 51 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOG(Y_SA)	LOG(P_SA)	EONIA/100	IRHB/100
LOG(Y_SA(-1))	0.655357	0.014876	0.033881	-0.010433
	(0.13971)	(0.09615)	(0.04316)	(0.01861)
	[4.69086]	[0.15472]	[0.78493]	[-0.56063]
LOG(Y_SA(-2))	0.322745	0.055009	-0.021583	0.000770
	(0.14327)	(0.09860)	(0.04427)	(0.01908)
	[2.25264]	[0.55791]	[-0.48759]	[0.04033]
LOG(P_SA(-1))	0.127038	0.435481	0.090393	0.042985
	(0.19167)	(0.13190)	(0.05922)	(0.02553)
	[0.66281]	[3.30154]	[1.52649]	[1.68372]
LOG(P_SA(-2))	-0.194807	0.467147	-0.102536	-0.036717
	(0.18829)	(0.12958)	(0.05817)	(0.02508)
	[-1.03459]	[3.60503]	[-1.76257]	[-1.46397]
EONIA(-1)/100	0.911325	0.443087	0.961775	0.414012
	(0.63112)	(0.43433)	(0.19499)	(0.08406)
	[1.44398]	[1.02017]	[4.93251]	[4.92496]
EONIA(-2)/100	-0.560038	-0.295250	-0.259641	-0.267806
	(0.46203)	(0.31796)	(0.14274)	(0.06154)
	[-1.21213]	[-0.92857]	[-1.81891]	[-4.35168]
IRHB(-1)/100	-2.518758	-0.484877	0.287013	0.887984
	(0.92276)	(0.63503)	(0.28509)	(0.12291)
	[-2.72959]	[-0.76355]	[1.00675]	[7.22470]
IRHB(-2)/100	1.377686	0.360605	-0.132578	-0.211113
	(0.74328)	(0.51152)	(0.22964)	(0.09900)
	[1.85352]	[0.70497]	[-0.57733]	[-2.13238]
C	0.517070	0.031051	-0.022062	0.046371
	(0.23094)	(0.15893)	(0.07135)	(0.03076)
	[2.23899]	[0.19538]	[-0.30921]	[1.50749]
D08	-0.014857	0.008943	-0.003322	0.001793
	(0.01268)	(0.00873)	(0.00392)	(0.00169)
	[-1.17179]	[1.02500]	[-0.84802]	[1.06180]
Adj. R-squared	0.979130	0.991029	0.926118	0.968748

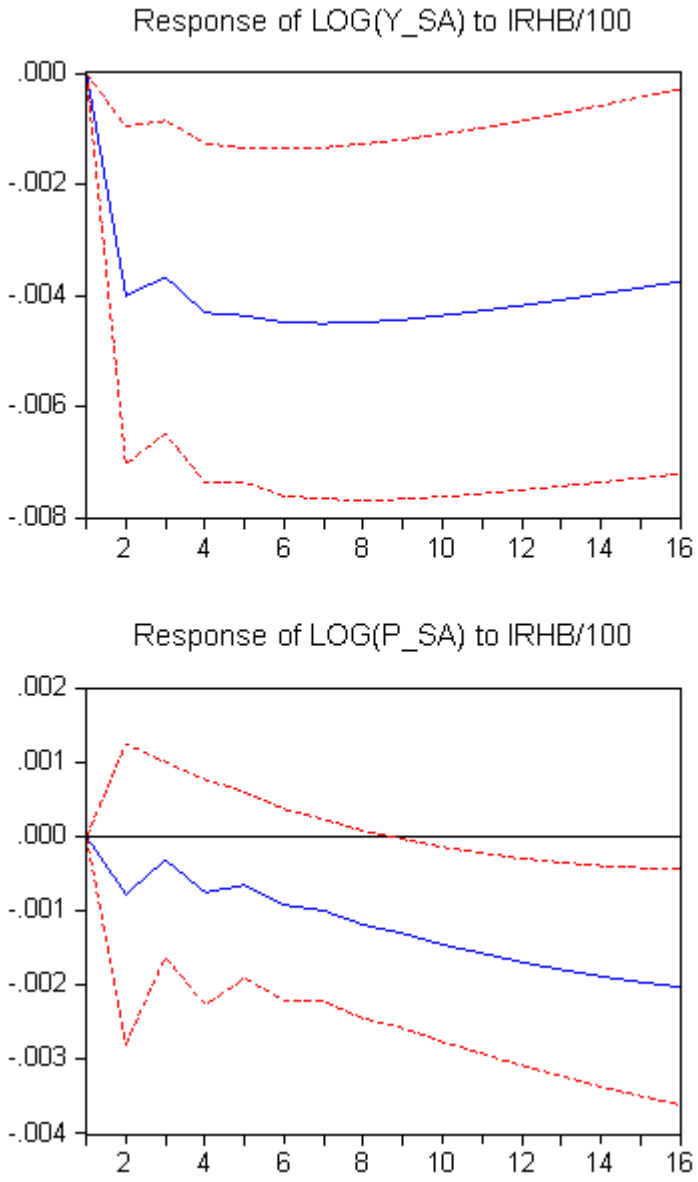
Table 1.1 – SVAR (real GDP and GDP deflator in log change)

Vector of endogenous variables: ***[Y, P, EONIA, IRHB]***, where **Y** depicts Δlog (s.a. real GDP), **P** is Δlog (s.a. GDP deflator), **EONIA** is the interbank money market rate utilized in our study & **IRHB** represents the annualized interest rate on euro-denominated new loans from domestic MFIs to domestic households & non-financial corporations. The data series utilized herein are observed at quarterly frequency and span the periods: Q1 2000 to Q1 2013. The sources of the data are Eurostat, ECB and Bank of Greece. Crisis dummy, ***D08***, takes the value of 0 over the period Q1 2000 – Q4 2008 and 1 otherwise.

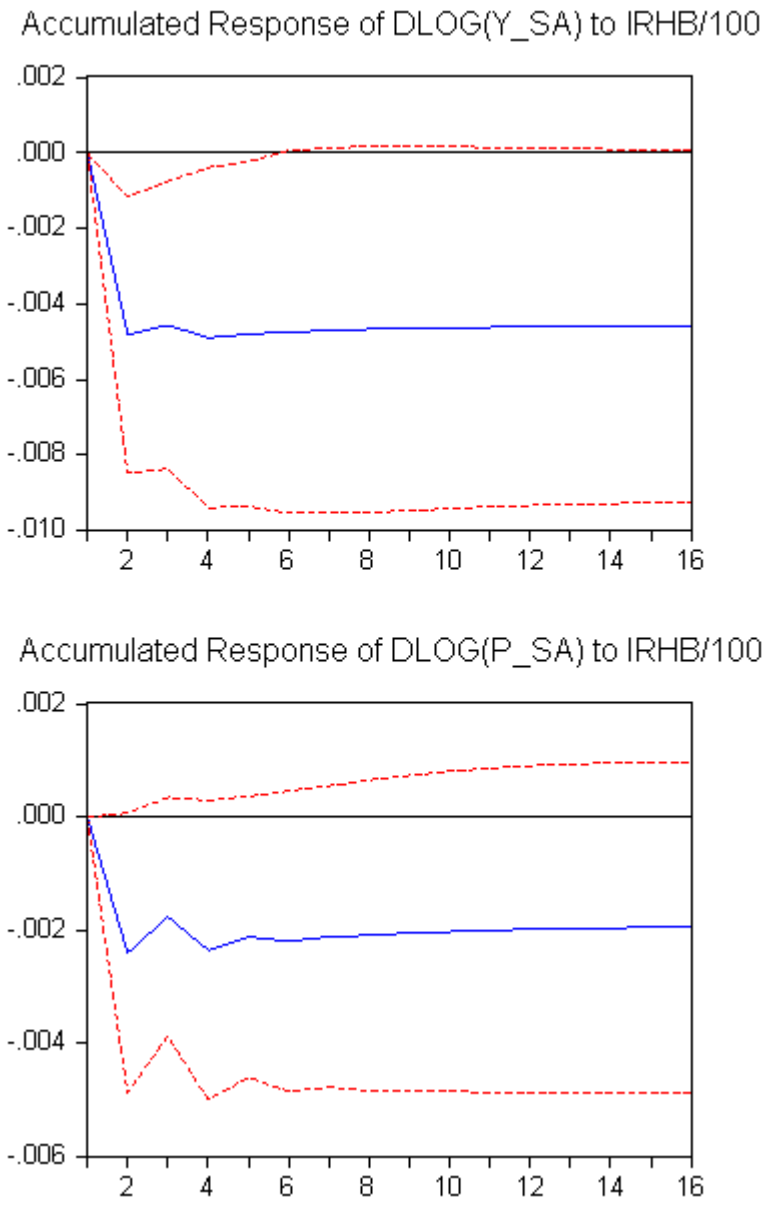
Vector Autoregression Estimates
Sample (adjusted): 2000Q4 2013Q1
Included observations: 50 after adjustments
Standard errors in ( ) & t-statistics in [ ]

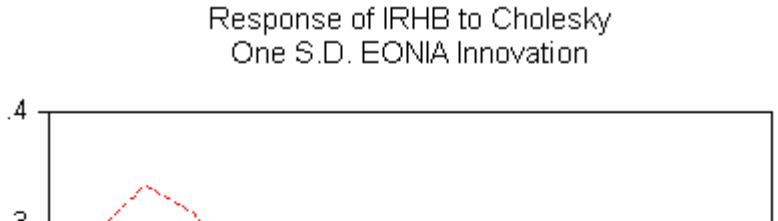
	DLOG(Y_SA)	DLOG(P_SA)	EONIA/100	IRHB/100
DLOG(Y_SA(-1))	-0.289668	0.010849	0.026794	-0.007800
	(0.15128)	(0.10371)	(0.04473)	(0.01998)
	[-1.91477]	[0.10461]	[0.59903]	[-0.39046]
DLOG(Y_SA(-2))	-0.035281	0.000900	-0.013990	-0.007711
	(0.16159)	(0.11077)	(0.04778)	(0.02134)
	[-0.21833]	[0.00812]	[-0.29281]	[-0.36134]
DLOG(P_SA(-1))	0.113322	-0.530300	0.130622	0.034466
	(0.22514)	(0.15434)	(0.06657)	(0.02973)
	[0.50334]	[-3.43600]	[1.96223]	[1.15928]
DLOG(P_SA(-2))	-0.013096	-0.067063	0.040729	0.003572
	(0.23034)	(0.15790)	(0.06810)	(0.03042)
	[-0.05686]	[-0.42472]	[0.59804]	[0.11743]
EONIA(-1)/100	0.447787	0.613480	0.969729	0.364845
	(0.63189)	(0.43317)	(0.18683)	(0.08344)
	[0.70865]	[1.41626]	[5.19035]	[4.37232]
EONIA(-2)/100	-0.400878	-0.070253	-0.262562	-0.273674
	(0.49549)	(0.33966)	(0.14650)	(0.06543)
	[-0.80906]	[-0.20683]	[-1.79219]	[-4.18259]
IRHB(-1)/100	-2.800557	-1.395366	0.306752	0.939714
	(1.02734)	(0.70426)	(0.30376)	(0.13567)
	[-2.72602]	[-1.98133]	[1.00985]	[6.92666]
IRHB(-2)/100	1.991061	0.785292	-0.145603	-0.204953
	(0.71245)	(0.48839)	(0.21065)	(0.09408)
	[2.79469]	[1.60791]	[-0.69120]	[-2.17844]
C	0.059439	0.033651	-0.003091	0.013714
	(0.02260)	(0.01549)	(0.00668)	(0.00298)
	[2.63005]	[2.17205]	[-0.46260]	[4.59528]
D08	-0.031191	0.001010	-0.004883	0.001499
	(0.01033)	(0.00708)	(0.00306)	(0.00136)
	[-3.01827]	[0.14254]	[-1.59802]	[1.09832]
R-squared	0.512015	0.362990	0.935650	0.955684

Graph 1.1 – Impulse responses (SVAR model in log levels)
Response to Cholesky one S.D. innovations +/-2 S.E.

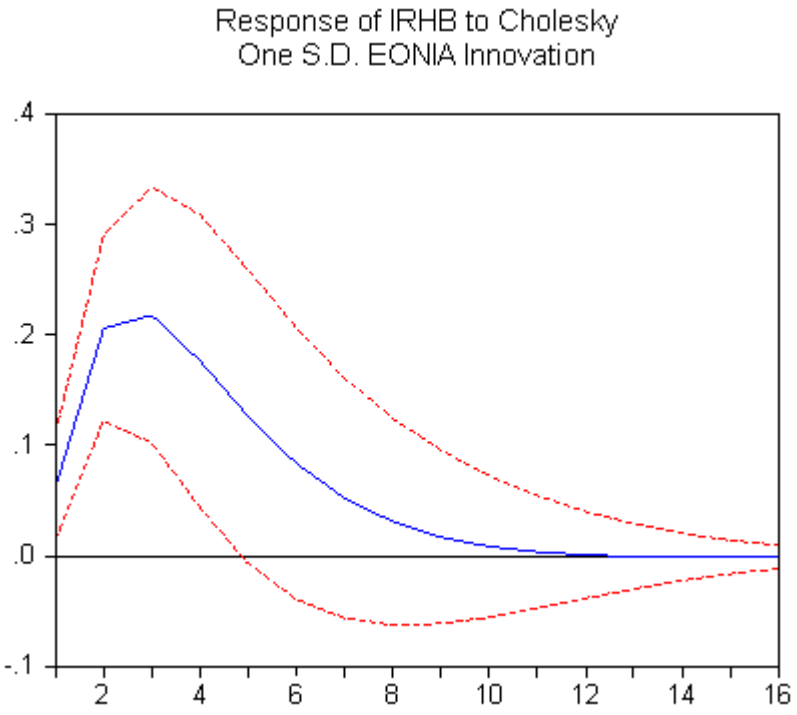


Graph 1.2 – Cumulative impulse response (SVAR model in log changes)
Response to Cholesky one S.D. innovations +/-2 S.E.

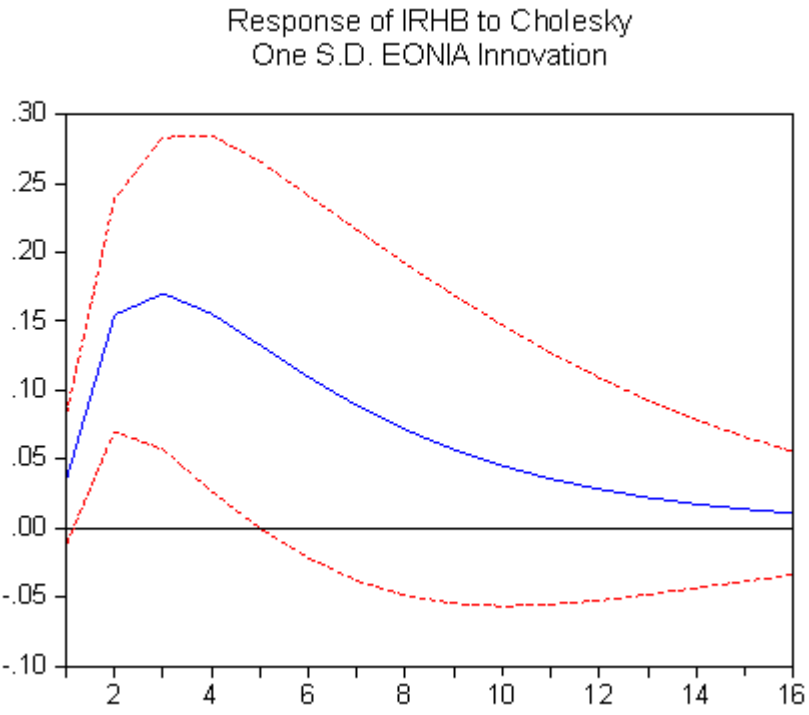




Graph 2.1: Impulse responses of 2-variable SVAR (full sample Q1 2000-Q1 2013) (EONIA and domestic retail loan rates)



Graph 2.2: Impulse responses of 2-variable SVAR (sample Q1 2000-Q4 2008) (EONIA and domestic retail loan rates)



Graph 2.3: Impulse responses of 2-variable SVAR (sample Q1 2009-Q1 2013) (EONIA and domestic retail loan rates)

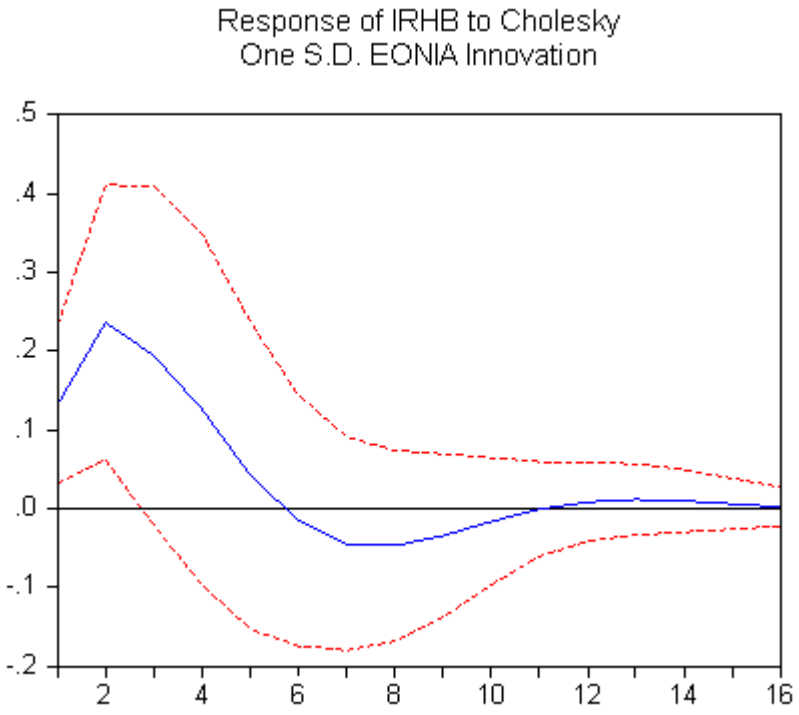


Table 2

Estimated pass-through of EONIA rates to domestic loan rates (in percentage points) SVAR esitmated over full-sample (Q1 2000 - Q1 2013)	
# of quarters ahead	**Pass-through**
1	4.1%
2	17.7%
3	32.1%
4	43.8%
5	52.1%
6	57.6%
7	61.1%
8	63.1%
9	64.2%
10	64.7%
11	64.9%
12	65.0%
13	64.9%
14	64.8%
15	64.8%
16	64.7%

Research Team

Editor, Professor **Gikas Hardouvelis**
Chief Economist & Director of Research Eurobank

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Theodoros Stamatiou: *Research Economist*

Eurobank 20 Amalias Av & 5 Souri Str, 10557 Athens, tel: +30.210.333 .7365, fax: +30.210.333.7687, contact email: Research@eurobank.gr

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