



**The Global Financial Crisis and the European  
Sovereign Debt Crisis revisited from the perspective of  
credit supply in Portugal**

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## **Biographical Note**

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## **Abstract**

Both the Global Financial Crisis and the European Sovereign Debt Crisis have significantly impacted the monetary and credit conditions within the Eurozone. As result of the losses suffered on their portfolios as well the lack of confidence within the financial system, funding became more costly and difficult to obtain for banks, and therefore they decreased their credit supply to non-financial corporations and households. Considering the importance of well-functioning credit markets for growth and macroeconomic stability, as well the decisive role that the restarting of credit plays in economic recovery after a downturn, there is a growing interest on the impact that recent crises have performed on bank supply of credit. Despite the relevance of the issue, we cannot find however significant literature for the specific case of Portugal. Trying to fill that gap, with this study we intend to provide a deep approach on the topic, by investigating to which extent the banks operating in Portugal and more vulnerable to the dry up in the interbank markets and to the sovereign debt shock have reduced lending to non-financial corporations during the period of the Global Financial and the European Sovereign Debt Crisis, respectively.

**Key-words:** Credit rationing; Credit supply; Financial Crisis; European Debt Crisis

**JEL Codes:** E32; E51; G01

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## 1. Introduction

The first was described as the worst financial crisis since the Great Depression. The second as the most immediate threat to global growth. Over the last almost 10 years, the Global Financial Crisis and the European Sovereign Debt Crisis have determined the path where the economy goes, and the credit markets were no exception. Since the private sector depends on the access to credit to fund investment and consumption, *i.e.* since the dynamism of the real economy is highly dependent on the vitality of credit markets, a key question that has been raising special attention since 2007/2008 is how the referred crises affect the banking system and, as result of that, the availability of credit for companies and consumers. According to some authors (e.g. Del Giovane et al., 2013) credit market developments have been quite homogenous across countries during the first phase of the crisis. On the other hand, during the period of the Sovereign Debt Crisis only some countries seem to have been affected by the tensions on the sovereign markets, such that this period has been characterized by a significant heterogeneity.

On the specific case of Portugal, there is no consensus regarding the effect that the Global Financial Crisis has had on the banking system and, then, on credit markets. In several circumstances, the leaders of the main Portuguese banks and also the representatives of the Bank of Portugal have expressed their confidence in the system and made public statements claiming that it was not vulnerable to the crisis and has remained strongly solid as it had no relevant exposure to the subprime and no real estate bubble took place in Portugal (as it happened, for instance, in Spain and Ireland). Notwithstanding, considering the low aggregate rate of savings in Portugal, and therefore, the high banks' reliance on external funding, it is not clear if they were not significantly exposed to the Financial Crisis of 2007/2008 through the interbank market, and if the global dry up on such market has not led Portuguese banks to face increasing funding costs, then passed to their clients through the adoption of more restrictive credit policies. In other words, we do not have a clear perception if some banks, possibly impacted by the liquidity shock occurred in the interbank markets, have reduced lending and/or increased the interest rates charged, therefore creating a credit crunch situation. On the other hand, regarding to the European Sovereign Debt Crisis, the evidence is clear on the fact that Portugal was on the epicenter of the crisis and that the Portuguese banking system was deeply affected by that. Indeed, following the significant deterioration of Portuguese public accounts and also due to contagion effects from the Greek crisis, Portuguese Government sovereign yields

increased abruptly and, therefore, banks incurred in large losses as they held significant amounts of sovereign debt on their portfolios. Moreover, following the request for a bailout and the signature of a Memorandum of Understanding with the IMF, the ECB and the European Commission, Portuguese banks were forced to initiate a process of deleveraging and to follow stricter rules in order to comply with the imposed capital ratios. Although the evidence shows that credit flows decreased in a significant way, and the circumstances suggest that there is a link between such decrease and the deterioration of the conditions within the Portuguese banking system, the true is that there is again no quantification of such effects, and there is no clear identification of the factors behind the reduction on credit granted to firms. As crises like the Global Financial Crisis and the European Sovereign Debt Crisis have generally associated a deterioration on the economic outlook, it is possible that changes in credit markets were, in fact, induced by demand factors instead of supply motives.

Understanding the determinants of credit market developments is, however, of utmost importance. Particularly when designing policy responses, decision-makers have to know exactly where a reduction in credit volumes or a rise in interest rates is the result of supply or demand effects as only in that way they are able to assess which kind of policy response is the most appropriate.

Looking to contribute with this kind of knowledge on the specific case of Portugal - which until the moment received little attention in this regard - we study the effects of the Global Financial Crisis and the European Credit Crisis on the credit supplied to non-financial corporations. With that purpose, and in order to disentangle demand and supply factors, we follow the firm-fixed effects methodology first used by Khwaja and Mian (2008). Main findings suggest that during the Financial Crisis of 2007/2008 banks that rely more on interbank market and, therefore, more exposed to the crisis have decreased lending at a larger scale. Similarly, during the period of the European Sovereign Debt Crisis, banks with a higher portion of sovereign debt in their portfolios also reduced lending more than other banks. As we control for firm fixed effects, for both periods we find evidence of the occurrence of a credit crunch, as there is a reduction on credit supply, independent of demand.

Next sections are organized as follows. On Section 2 we present an overview of the two crisis periods approached on this work, with the main concern of understanding the mechanisms that were behind the two crises, and particularly the channels through which

banks and credit supply became affected. On Section 3 the main literature is reviewed, with particular focus on the studies which analyze in an empirical way the effects of the Financial Crisis of 2007/2008 and the European Sovereign Debt Crisis on credit supply, as well on the existing literature for the specific case of Portugal. On Section 4 we perform an empirical study specifically for the Portuguese case, examining whether there was a credit crunch following the Subprime crisis in the US and the same for the period of the European Sovereign Debt Crisis. On Section 5 we provide some details regarding the research that is in progress with the purpose to improve our analysis for future publication. Finally, in Section 6 main conclusions of this work are presented and some topics for future research are suggested.



## **2. The Financial Crisis of 2007/2008 and the European Debt Crisis**

### **2.1 The subprime, No trust in the system and The Credit Crunch**

#### ***2.1.1 Cooking the perfect storm***

The steady growth and the low interest rates that prevailed during the late 90s and the beginning of the new century have created a supportive environment for credit expansion in the United States. With the flow of global savings both from emerging and oil-exporting countries<sup>1</sup> also contributing for lower long-term interest rates and stable macroeconomic conditions characterized by low volatility<sup>2</sup>, the US have experienced an authentic credit boom.

While the general macroeconomic conditions were working as a strong incentive for credit growth both on the demand and supply side, the market for securitization has also witnessed huge developments. Historically, the mortgage market (the most important and developed in terms of securitization at that time) was dominated by savings and loans associations and also by commercial banks, which either held mortgages in their portfolios or securitized them through government-sponsored entities (GSEs) such as Fannie Mae, Freddie Mac and Ginnie Mae. Considering that the GSEs guarantee the timely payment of principal and interest on their mortgage backed-securities (MBS), they were permitted to securitize only investment grade mortgages. Consequently, since lenders who made non-investment grade loans were forced to keep them on their books, they had little appetite for making riskier loans. However, by the middle of the 90s, and particularly after the year 2000, the structure of the market changed significantly with the

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<sup>1</sup> In a speech made in 2005 as Governor of the Federal Reserve, Ben Bernanke argued that the substantial expansion of the current account deficit in the United States, the equally impressive rise in the current account surpluses of many emerging-market economies, and a worldwide decline in long-term real interest rates could be explained, in part, by the emergence of a “Global Saving Glut”, driven by the transformation of many emerging-market economies - notably, rapidly growing East Asian economies and oil-producing countries - from net borrowers to large net lenders on international capital markets (Bernanke, 2005). Another important reason was that following the Asian crisis of 1997, many affected countries, with the purpose to peg the exchange rates at an export-friendly level and to protect their currency regime hedging against a depreciation of their own currencies against the dollar, adopted a monetary policy based on the accumulation of official reserves denominated in currencies less vulnerable to speculative behavior. In this context, the demand for US dollar increased, as well for US Treasuries and US denominated bonds, which raised their prices and lowered the long-term interest rate (Mizen, 2008; Brunnermeier, 2009).

<sup>2</sup> The period of declining macroeconomic volatility (low and stable inflation, strong and stable GDP growth) experienced in the United States (but also in many other advanced economies) from the mid-1980s to 2007 is commonly referred as the “Great Moderation”.

appearance of a new class of specialized mortgage lenders and securitizers unrestricted by regulations governing traditional lending and securitization. Instead of securitize mortgages through GSEs, this new kind of lenders started to securitize them through unregulated, private conduits managed by investment banks, and in order to circumvent the problem of the GSE's guarantee they re-designed the securities, issuing them with new mechanisms of credit enhancement. Specifically, it was in this context that emerged the division of the securities backed by a pool of mortgages into a cash flow waterfall that allocated default risk on the mortgages by a hierarchy of tranches, therefore allowing to create AAA securities from risky underlying mortgages (Levitin *et al.*, 2009). Taking advantage from this tranching mechanism, riskier loans started to be used for securitization. Moreover, the demand of new categories of debt products (car loans, student loans, credit card payments, trade receivables, etc) for securitization purposes also intensified and new and more complex structured products were developed (like CDOs and CDOs-squared). Driven by the “private segment”, the market for securitization grew exponentially.

With securitization growing in importance, banks moved from the traditional “originate-to-hold” to the “originate-to-distribute” model. In the “originate-to-hold” model, the banks provide loans to firms and individuals and hold these loans until the maturity, which means they bear the credit risk as the assets stay in their balance sheet. On the other hand, in the “originate-to-distribute” model, the loans granted are repackaged and sold to a third party (the Special Purpose Vehicles (SPVs), with loans being pooled, tranced and then resold via securitization), with banks retaining little or no interest in the pool of securitized assets. Because a substantial part of the risk is borne by other financial institutions (as we will see later this revealed not to be completely true) banks essentially face only the pipeline risk of holding a loan for some months until the risks are passed on, so they have little incentive to take particular care in approving loan applications and monitoring loans, *i.e.* they have little incentive to pay attention to the credit worthiness of its customers (Brunnermeier, 2009).

Pressured by the intense demand for loans induced by low interest rates, and enabled by the adoption of this “originate-to-distribute” model to get additional funding without increasing the risk held in their portfolios, banks have progressively lowered their lending standards. In the case of the mortgage market, it was particularly evident, namely because

a third factor was contributing for that: the behavior of prices in the housing market. Indeed, as housing prices were continuously increasing, banks started to provide loans even to people with no proven capacity to repay them, just on the basis that in the limit the borrower could always refinance the loan using the increased value of the house (for instance, it became famous the NINJA loans, granted to people with no income, no job and no assets). With loans granted to people with a high probability to fail on repayments the conditions for the burst of the housing bubble to happen sooner or later were created.

Regarding the question of the rising house prices it is also important to take another perspective on the role they have performed on the development of the Financial Crisis of 2007/2008, which means to focus on rating agencies. Accused for being one of the main responsible for the financial meltdown, rating agencies have performed a very poor job and acted negligently on the risk assessment of securitized assets during the years prior to 2007. As it came to public, rating agencies based their risk models on very unrealistic assumptions, namely they relied on the hypothesis of constantly appreciating home prices and ignored the possibility that those prices could fall<sup>3</sup> (Coval *et al.*, 2008). Notwithstanding, other reasons help to explain the wrongful behavior of institutions like Fitch, Standard & Poor's and Moody's. As noted by Brunnermeier (2009), rating agencies had an incentive to attribute better ratings to structured products as they collected higher fees on such kind of products. Indeed, the true is that banks worked closely with the rating agencies in order to ensure that AAA tranches were sliced exactly in the manner that these just crossed the dividing line to reach the AAA rating.

The short-term incentives were, indeed, decisive over the course of events that led to the financial crisis and that became also evident when we look to the Credit Default Swap (CDS) market. Indeed, on such market, managers had a compensation structure that rewarded short-term revenues instead of long-term performance, such that selling CDSs today and worrying about counterparty risk tomorrow was also the most profitable

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<sup>3</sup> Until that point the American economy had never experienced an economy-wide decrease in home prices of more than 1%, and past downturns in housing prices were primarily regional phenomena (Coval *et al.*, 2008; Brunnermeier, 2009). Additionally to the assumption made on housing prices, the statistical models adopted by credit-rating agencies and professional investors were also based on historically low mortgage default and delinquency rates (Brunnermeier, 2009).

strategy to adopt. This, combined with the moral hazard which dominated the system, *i.e.* the generalized idea that CDS sellers like AIG were “too big to fail”, encouraged CDS sellers to issue more insurance than they could cover in the belief that any remaining losses would be socialized (Levitin *et al.*, 2009).

Returning to the main question of securitization, and in order to complete the description of the main factors that were on the origin of the Financial Crisis of 2007/2008, it is important to refer a last aspect: the fact that banks increasingly financed their asset holdings with shorter maturity instruments, which left them especially vulnerable to a dry-up in funding liquidity. Indeed, in the years leading up to the crisis, the same financing maturity mismatch that characterized the traditional banking model was transferred to a shadow banking system of off balance-sheet investment vehicles and conduits set up for securitization purposes. As these vehicles adopted a strategy of investing in long-term assets and borrowing with short-term paper, and as to ensure funding liquidity for the vehicles the sponsoring banks granted them a credit line (the so-called liquidity backstop), the liquidity risk from holding long-term assets and making short-term loans never left the system<sup>4</sup> (even though it was not directly reflected on the banks’ balance sheets), making predictable that significant tensions would impact the financial system if any reduction in funding liquidity occurred (Brunnermeir, 2009).

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<sup>4</sup> An additional explanation for the risk to have remained within the banking system is the evidence that banks were among the most active buyers of structured products.

### ***2.1.2 When trust is the main piece***

As previously described, the combination of different factors have created the conditions for the perfect storm. The big question was when the storm would finally happen and what would effectively cause it.

In early 2007 the answer arrived. Indeed, the increase in subprime mortgage defaults verified at that time just worked as the trigger for the subprime and financial crisis that followed.

*“The root of the crisis: homeowners who could not make payments falling into foreclosure and the lenders putting these homes up for sale at fire sale prices, resulted in an increase in supply. This pushed down real estate values, which left many other homeowners with negative equity - their homes were worth less than they owed on their mortgages. Paying a mortgage on a property with negative equity is economic renting, and with cheaper rental rates many home owners who otherwise would continue making payments despite financial reversals simply stopped making their mortgage payments and walked away from their properties, feeding more foreclosures. More fuel was thrown on this fire as the economy declined. As unemployment rose more mortgages became unaffordable, resulting in more foreclosures, and further price declines leading to more negative equity.” (Levitin et al., 2009)*

Although these first signs have provoked some reactions from the market they were, however, just an indication of what was going to come. On April 2007, New Century Financial, a subprime specialist, have filed for Chapter 11 bankruptcy. One month later UBS closed its internal hedge fund, Dillon Read, after incurring \$125M in subprime mortgage-related losses. Also in May, Moody’s put 62 tranches across 21 subprime securitization deals on downgrade review, which led to a deterioration of mortgage-related products. In subsequent months new episodes of downgrades and losses took place. Moody’s, Standard&Poor’s and Fitch, all they have downgraded the ratings of other tranches. At the same time, in June 2007, two hedge funds run by Bear Sterns had trouble meeting margin calls, requiring Bear Sterns to inject \$3.2 billion to support the funds. Finally, in July, Countrywide, a major US mortgage lender, reported large losses.

Until this moment the crisis was almost limited to the mortgage market and to the United States. However, soon the situation changed and the US subprime crisis turned into a Global Financial Crisis. Suddenly, problems in subprime market, which represented only a small proportion of total US mortgages, have spread to new domains and geographies. For instance, in Europe, the first big signal of the crisis appeared in July 2007, when German IKB Deutsche Interbank conduit incurred losses and revealed to be unable to roll

over its asset-backed commercial paper, then being bailed out by its major shareholder in August of the same year. Also in August, French bank BNP Paribas suspended withdrawals from three hedge funds heavily invested in CDOs, claiming its inability to value structured products.

Two main factors proved to be crucial in the spread of the crisis.

First of all, investors not only from US but internationally, all they were invested in ABS markets. In a context of low interest rates, traditional investments could not provide the higher yields the investors were looking for, so demand moved for innovative and riskier financial instruments and for greater leverage. New and more complex products were developed and much of this demand was satisfied by residential MBSs and CDOs, which were sold internationally, therefore spreading the inherent risks in the US subprime sector to international investors (Mizen, 2008).

On the other hand, the asset backed commercial paper (ABCP) market froze, therefore contaminating other segments of the financial sector. Indeed, following some unexpected downgrades of mortgage-related products<sup>5</sup>, rating agencies were put under some criticism and began to reassess and adjust their ratings models for these kind of products, thereby introducing further uncertainty about the reliability of their ratings. At the same time, the losses incurred by some entities and the increasing concern and difficulty to value structured products<sup>6</sup>, together with the lack of confidence in rating agencies, have led investors to pull back from structured products in general. As the SIVs and conduits were traditionally funded through the issuance of short-term asset-backed commercial paper, the increasing uncertainty about the value and the exposures to underlying mortgage backed-securities made investors less willing to roll over the corresponding ABCP and, therefore, these entities became unable to obtain the necessary short-term funding from these markets. The need for rollover funding has then created additional pressure on banks' liquidity, with banks being forced to rescue those SIVs and conduits they had sponsored by providing liquidity or by taking back their respective assets onto their

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<sup>5</sup> For instance, in June and July 2007, several assets backed by subprime residential MBS were downgraded by rating agencies from AAA to A+, *i.e.* four notches down, which even led the OECD to comment and describe such downgrades as unexpected (Mizen, 2008)

<sup>6</sup> Regarding this it is important to mention that the fact there was no secondary market and financial institutional kept the securities in their portfolios and they were not actively traded made impossible to "keep the market honest". Indeed, without a trading market for the securities, short-selling couldn't occur and, therefore, without short-selling the market couldn't indicate or correct underpricing.

balance sheets. As a result, the balance sheet of those financial institutions were particularly strained by this reabsorption, which in addition was amplified due to declining asset values<sup>7</sup> and led banks to hoard liquidity in a way that the level of interbank lending declined significantly.

As documented in the literature (Acharya *et al.*, 2013; Nathaniel *et al.*, 2008; Mizen, 2008) both credit and liquidity risks are used to explain why banks have started to hoard liquidity. While the fear of counterparty risk, *i.e.* the uncertainty regarding the exposure of other banks to mortgage market and the losses they could incur was indeed important in the slowdown of lending relationships in the money market, with banks becoming reluctant to lend to each other unless they were compensated with larger risk premiums, it seems that the behavior adopted by banks was primarily conducted by liquidity concerns. This idea is precisely supported by Acharya *et al.* (2013) who claim that banks engaged in liquidity hoarding due to a precautionary response to its own heightened funding risk in markets for external finance in wake of increased risk or anticipation of losses and capital shortfalls. By studying the behavior of large settlement banks on the Sterling Money Market for the period between January 2007 and November 2008, the authors show that banks hold more liquidity on days with greater volume of payments and settlements activity, which are argued to be the days with greater uncertainty in terms of liquidity needs and which therefore have associated an increased risk of payment shortfall. This is especially true for banks which rely more heavily in wholesale funding and that incurred in greater losses during the crisis, in other words, weaker banks and banks with greater funding risk, which reinforces the idea that banks hoarded liquidity for precautionary motives instead of counterparty risk concerns. Furthermore, despite the results reveal a strong causal impact of liquidity on interbank rates, they do not show any difference on the effects on rates experienced on secured and unsecured interbank lending, which once again suggests the prevalence of the precautionary motive over the one associated with counterparty risk. Additionally to these findings, the authors verified that the rise in aggregate liquidity during the crisis has resulted in an increase on interbank

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<sup>7</sup> “A further strain on banks’ balance sheets came from warehousing a higher than expected amount of mortgages and leveraged loans, the latter usually passed on to investors in order to fund the highly leveraged debt deals of private equity firms. Both the market for mortgages and leveraged loans dried up from the collapse of transactions in the mortgage-related securitization market and collateralized loan obligations (CLOs). Banks also felt obliged to honor liquidity commitments to alternative market participants, such as hedge funds and other financial institutions, which also suffered from the drain of liquidity.” (Nathaniel *et al.*, 2008)

rates due to a rise in the borrowing cost of weaker banks and also due to a rise in the lending rates demanded for such weaker banks. In fact, empirical evidence suggests that contagion took place: (i) in the form of an individual bank's borrowing cost being determined by other banks' hoarding behavior; and (ii) in the form of an individual bank's hoarding behavior affecting other banks' average borrowing cost<sup>8</sup>.

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<sup>8</sup> The impact of an individual bank's hoarding behavior on the borrowing cost supported by other banks seems to be significant only when the individual bank is large and a prominent player in the interbank market (Acharya *et al.*,2013)



### ***2.1.3 Spillover effects to the real economy and the collapse of Lehman Brothers***

The tensions in ABCP market have forced banks to rescue the SIVS and conduits they set up for securitization purposes and to take them back onto their balance sheets. Simultaneously, as investors pulled back from structured finance market, the value of the securitized mortgages and other structured products that banks held on their balance sheets declined abruptly, leading them to recognize extensive write-downs. The increasing distrust and uncertainty regarding the value of securitized assets as well on the exposures and potential losses have also induced banks to hoard liquidity. Therefore, the interbank funding costs increased and also as result of the frictions in the money market and subsequent funding liquidity costs pressures, banks were forced to deleverage, further depressing asset prices.

As the subprime mortgage crisis rapidly evolved into a banking crisis, with banks showing depressed balance sheets and poor solvency conditions, the difficulties they faced to obtain funding soon transmitted to the real economy in the form of credit constraints. The volumes of credit provided to households and companies decreased and the interest rates asked for new loans increased.

Aware of the impact that the tensions on the money markets was having on the banking system and also on the real economy, central banks reacted and looked to inject some liquidity in the system. On the beginning of August 2007, the European Central Bank (ECB) injected €95 billion in overnight credit into the interbank market, with additional operations totaling around €100 billion in the following weeks. Also in August, the Federal Reserve injected approximately \$25 billion and extended its normal lending period to 30 days and cut the discount rate by 50 basis points. Following to this, further measures were adopted, with central banks extending, for instance, the type of instruments accepted as collateral and launching term lending programs.

While the intervention of central banks was contributing to somehow alleviate the conditions, some events put additional pressure on the market. It was the case, for instance, of the Northern Rock bank run in 2007 and the arranged takeover of Bear Stearns by JP Morgan Chase as well the public rescue of Fannie Mae and Freddie Mac in 2008. Differently from these situations, where the consequences could be controlled and minimized as far as possible, the collapse of Lehman Brothers at September 2008 revealed to be really disastrous for the global economy. Considering all that had happened

until then, the fall of Lehman Brothers had a much higher impact since it has brought into the game two new elements. First of all, the Lehman Brothers was the 4<sup>th</sup> largest investment bank in the US and one of the main ones worldwide. It had several counterparties across the globe, which in turn had connections with several other financial institutions, so the potential for contagion was tremendous. Besides that, the collapse of Lehman Brothers meant the State was no longer the lender of last resort (at least, in certain situations it would not act like that), which significantly increased the uncertainty within the financial system and generated more fear among the investor community.

*“Following the failure of Lehman Brothers, panic set in that any bank, irrespective of its size, could go bankrupt. Market participants revised their investment decisions. The banks themselves started to fear that any of their counterparties could fail and stopped lending money to each other, causing the interbank market, which had already been under stress for months, to dry up. In the four weeks following the bankruptcy of Lehman Brothers, the European stock exchanges plunged by around 30%, more than the total fall recorded over the previous 12 months. The three-month Euribor spread, which measures tensions in the interbank market, more than doubled, exceeding 170 basis points.”*

*(Speech by Lorenzo Smaghi, Member of the Executive Board of the ECB, 20 October 2008)*

## **2.2 Public Debt, Banks fragilities and the New Credit Crunch**

### ***2.2.1 It is all about debt and banks***

In the words of Caruana and Avdjiev (2012), the foundations of the European Debt Crisis lie on the confluence and interaction of three key initial conditions which revealed determinant on what turned to be an intertwined sovereign and banking crisis. First of all, when the global financial crisis erupted, many financial institutions were poorly capitalized and highly leveraged and presented significant balance sheet mismatches. Therefore, the fact that many banking systems of most major developed economies entered the crisis with inadequate capital made them quite vulnerable to the original shocks and exacerbated the perverse feedback effects between banks and sovereigns. Like banks, many sovereigns entered the crisis unprepared and without sufficient fiscal buffers to deal with the shocks that hit the international financial system in 2007/2008 and the subsequent slowdown in economic activity. The macroeconomic stability characterized by low interest rates and growth and the private credit boom that allowed the states to achieve temporary, unsustainable increases in revenues have instilled the erroneous idea of security and encouraged them to implement expansionary policies in expansionary economic cycles and to live beyond their means. As consequence, even if governments were able to quickly provide the support required for the recapitalization of their banking system and to give a little stimulus for the economic recovery, the small reserves they held were not sufficient to give a sustainable response to the crisis. To add to this, the high degree of international integration and interconnection of the financial system aggravated the situation as the links among sovereigns and financial institutions around the world intensified and propagated the crisis.

When we examine the countries that were on the epicenter of the European Debt Crisis, the so-called PIIGS (Portugal, Ireland, Italy, Greece and Spain), we verify that different reasons made them the most vulnerable and harmed. Indeed, countries like Ireland and Spain entered in distress due to significant debt overhang in the financial sector. On the other hand, in countries such as Greece, Portugal and Italy the main problem was on public finance. During the crisis, however, the problems in banks and sovereigns actually became intertwined, as risk was transmitted from one sector to the other through multiple channels.

In the wake of the financial crisis, the first of the five PIIGS's countries to show signs of distress was Ireland. As argued before, the Irish public accounts were sound: for most of the decade leading up to the crisis the country had achieved budget surpluses<sup>9</sup> and the debt-to-GDP ratio stood at approximately 25% at the end of 2007. However, the banking sector was highly dependent on international markets, where banks were able to find at a low cost the funds with which they fueled the Irish property bubble and consumption and, therefore, much of the country's growth. Besides that, the increased competition contributed to very low loan spreads and a loosening of lending standards. As the global financial crisis emerged and international credit markets gradually froze, the Irish banks lost their main source of funding. Additionally, the collapse of construction sector, to which banks have provided large amounts in loans, and the fall in property prices led them to incur in huge losses. Moreover, many financial institutions were exposed to a significant amount of low-quality, subprime debt from the US, which reinforced their vulnerability to the financial crisis.

In order to avoid further deterioration of the conditions in which the financial sector was operating, and in an attempt to limit its repercussions to the real economy, the Irish government launched several actions to support its banking system: from the provision of a general guarantee of the liabilities of the banking system to banks' recapitalizations and nationalizations and the creation of a "bad bank" to dispose of low-quality assets within the system<sup>10</sup>. With the costs of rescuing the financial sector hitting the 40 billion euros until 2010, and with tax revenues significantly declining due to the collapse of the housing sector, Irish budget balances rapidly evolved from surpluses to deficits: after a small surplus of 0.1% in 2007, it rapidly declined to -7.4% in 2008 and up to -32% in 2010 (more than ten times the limit imposed on Eurozone economies by Brussels).

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<sup>9</sup> The only exception was 2002, when it showed a deficit of -0.3%. However, from that year until 2007 the Irish Government always achieved a budget surplus, which increased year over year from 2003 to 2006 (2003: 0.4%; 2006: 2.9%).

<sup>10</sup> In September 2008, the government provided a general guarantee of the liabilities of the banking system. This guarantee covered a broad range of liabilities (from deposits to some existing subordinated debt and covered bonds) for a period of two years and was intended to promote confidence and improve the banks' funding situation (a second guarantee scheme was also later implemented). Following to this, and once the authorities became aware that the banks' problems were not limited to the difficulty of get funding but were also related to their weak solvency conditions, the Government decided to recapitalize the banking system. In this context, by June of 2009 the Government had injected 10 billion euros into the three major banks. Moreover, on January 2009 it nationalized Anglo Irish Bank, the Irish Republic's third largest lender, as its insolvency seemed to be even closer. Furthermore, and still in 2009, it was established the National Asset Management Agency (NAMA), with the objective of removing commercial property and development loans from banks' balance sheets (Honohan, 2012; Gerlach, 2013).

Simultaneously, public debt rose abruptly, increasing about four times in a five years' time frame: right after the first signals of the financial crisis being felt in Ireland the public debt almost doubled to 45% in 2008; just two years later, in 2010, it reached the 87.4% and in 2011 it surpassed the barrier of the 100%.

Similarly to Ireland, the cessation of the credit boom was especially troubling for Spain. Although the fiscal position was apparently healthy – at the end of 2007 Spain had the third largest budget surplus of Euro Area (1.9%) and a debt to GDP ratio of 36.1%<sup>11</sup> -, before the crisis the economy was heavily reliant on a credit-fueled bubble in residential property and construction, and banks also relied a lot on cheap credit available in the international financial markets. Like this, the decline in construction sector was a major shock to domestic economic activity. In other words, as credit markets froze and the real estate bubble burst, the Spanish economy lost its major engine for economic growth. From a GDP growth rate above 3% previous to 2008 and even positive, at 1.1%, in that same year, it declined abruptly to -3.7% in 2009 and remained negative in the following years. In the same way, unemployment also rose much significantly – it surpassed the 10% in 2008 and reached levels near 20% in 2009 and 2010 - with the cost of the country's unemployment insurance spiking at a time when tax revenues dropped. Moreover, banks accumulated significant losses as several projects were abandoned and housing prices fell significantly and as the likelihood of defaults on mortgage payments and business loans increased with higher unemployment.

Looking to fight recession and unemployment and to stabilize the financial sector, the Spanish Government took some measures. Particularly regarding the banking system, it was created in 2009 a state-backed bank restructuring fund, the FROB (Fund for Orderly Bank Restructuring), intended to promote the merger of regional savings banks (“cajas”) and thus improve solvency and make them more efficient. Later, the FROB was given extra powers in order to directly inject cash into those lenders facing trouble to get the private funds needed to raise their capital ratios up to minimum levels. Like in the case of Ireland, the adoption of these policies led to a serious deterioration of public accounts.

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<sup>11</sup> After three decades of budget deficits, Spain was able to rebalance its budget and to bring it into positive levels from the year 2005 until 2007. Indeed, the recovery was evident all along the first years of the new millennium (and even before that), and it also became reflected in the debt to GDP ratio which declined from more than 60% in the years prior 2000 to levels below 40% in 2006 and 2007 (so, clearly below the 60% ceiling established in the Stability and Growth Pact).

The Government has accumulated successive and sizable deficits - for instance, -4.5% immediately in 2008, -11.1% in 2009 and -9.4% in 2010 and 2011- and the public debt has risen above the 60% of GDP in 2010 and near 70% in 2011.

Both the cases of Ireland and Spain are perfect examples of how the distress in banking system has been transmitted to the public sector in the years following the Global Financial Crisis. Considering the importance it played on the beginning of what was then called the European Debt Crisis, several authors have written about the mechanisms through which this transmission of financial sector risk to sovereigns operates. In the words of Merler and Pisani-Ferry (2012a), the most immediate way in which the tensions on the banking system can spill over to sovereigns is through the perceived cost of bank rescue. The main idea is that markets incorporate the expectations regarding a future bailout in current prices, which means that as they reflect the concerns about the future sustainability and creditworthiness of the sovereign, prices move up. If the simple anticipation of a future bailout may impact prices, in the sense it leads to an increase of government yields and sovereign CDS spreads, the same applies when public financial support is effectively provided to one or more banks. Indeed, no matter the form that public support takes (liquidity assistance, direct injections of capital, asset purchase programs or debt guarantees), the government balance sheet becomes weakened with the increase of explicit or implicit obligations (Caruana and Avdjiev, 2012). Sharing the view of the referred authors, Acharya *et al.* (2012) consider that these financial sector bailouts, although intended to rescue strategic but distressed banks and to avoid a credit crunch and subsequent loss of real sector output, are costly and run the risk of amounting to what they call a “Pyrrhic victory for the sovereigns”. In one hand there is a negative impact on the liability side of the government balance sheet, as mentioned by Caruana and Avdjiev (2012). On the other hand, if the value of the bailouts achieve such a level that puts into question even the soundness of the sovereign, and if it then creates within the private sector the expectation that the sovereign’s additional debt will lead to a higher taxation, it is possible that as this dilutes long-run returns in real sector and human-capital investments, the resulting under-investment in the economy can cause growth and productivity to slow down, affecting the sovereign’s credit risk through the asset-side of its balance sheet. Even when there is no bailout, the tensions on financial sector can be transmitted into sovereigns in the form of declining tax revenues and increasing

government expenditures (Caruana and Avdjiev, 2012<sup>12</sup>). Indeed, as the bank fragilities both in terms of funding and solvency result in credit supply constraints, it is probable that there is a downturn in economic activity, accompanied by diminishing value on collected taxes and higher costs with unemployment insurance.

While all these views were built on the evidence found during the European Debt crisis, the true is that they are in accordance with the idea that several other authors have expressed that banking crises are many times followed by a sovereign debt crisis (*e.g.* Valencia and Laeven, 2008; Reinhart and Rogoff, 2011)

Unlike Ireland and Spain, in the case of Greece and Portugal (and also Italy) the crisis had its starting point on the fragilities of the public sector. Indeed, as we analyze the historical data on both countries we find that they accumulated successive budget deficits for more than four decades and that their public debt increased to excessive, unsustainable levels namely considering their lack of competitiveness and incapacity to generate significant economic growth. For instance, in Portugal, the last time the Government was able to reach a budget surplus was in 1973. In the five years comprehending 2004 to 2008, the fiscal deficit always surpassed the 3%, and the government debt to GDP ratio increased from approximately 58% in 2004 (below the 60% barrier) to near 72% in 2008. In an even worse situation, Greece budget deficits stood always above the 5%, and the public debt reached the 100% in 2005, then increasing to approximately 105% by the end of 2007.

Once again risk was transmitted between the public and financial sectors, but at this time in the opposite direction. According to the literature (BIS, 2011; Acharya *et al.*, 2012; Caruana and Avdjiev, 2012; Merler and Pisani-Ferry, 2012a), several mechanisms may justify why the deterioration in public accounts and sovereign's creditworthiness possibly feedback adversely onto the financial sector. One of the channels through which it may occur involves the direct portfolio exposure of banks to sovereign debt. Indeed, as banks

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<sup>12</sup> This idea is also shared by Reinhart and Rogoff (2009). According to the authors, only part of the huge debt increase observed in the aftermath of financial crises can be directly attributed to the bank rescue, while a considerable part of it is the result of the collapse in tax revenues in the wake of the slowdown in economic activity associated with banking crises.

hold significant amounts of sovereign debt<sup>13</sup>, the higher bond yields and lower bond prices that result from the increasing sovereign risk mean that banks incur in losses and that the value of their portfolio becomes negatively affected. As these losses weaken banks' balance sheets via the effect on profitability and capital, the perceived risk of banks also increases and funding becomes more costly and difficult to obtain. Of course we may say that if the bank's exposure to sovereign debt is adequately dispersed among countries with different risk profile, the impact that tensions in sovereign markets have on banks' balance sheet is not so alarming. Regarding this topic, however, Acharya *et al.* (2012)<sup>14</sup> show evidence that during the European Debt Crisis home bias in government bond holdings was on average close to 60% and it was particularly strong for banks of troubled sovereigns, which means they were particularly vulnerable to shocks on sovereign debt markets through this balance sheet channel of risk transmission. One other channel through which risk may be transmitted is the so-called liquidity channel. Since banks traditionally resort to sovereign securities as collateral to secure wholesale funding from central banks, private repo markets and covered bond markets, the higher sovereign risk reduces the value (or even the eligibility) of the collateral they can use, and so their funding capacity.

The implicit and explicit guarantees that the government provides to the financial sector are also referred to play an important role. Indeed, when banks enter in a situation of distress it is common to see the government providing them some support, for example, through bank recapitalizations. Moreover, and despite some exceptional episodes, the government is still perceived as the lender of the last resort, the one that is there to bailout a bank when it seems to be no other solution to avoid its bankruptcy. Considering this, as the sovereign's creditworthiness declines and a government is perceived to be in a weaker fiscal position, it provides less credible and valuable guarantees or financial support to banks, and this increases the credit risk of the financial institutions. Related to this we must refer the ratings channel. The idea here is that downgrades in sovereigns' ratings tend to negatively influence the ratings of domestic banks, therefore increasing their funding costs and potentially impairing their access to money market and deposit markets.

Besides these four channels typically mentioned by major authors, Caruana and Avdjiev (2012) make reference to two additional mechanisms of risk transmission. One of these

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<sup>13</sup> Government bonds were especially demanded by banks because they could be easily used as collateral and due the Basel regulatory framework, which allowed for the zero-risk weighting of bonds issued by euro area governments.

<sup>14</sup> See also Merler and Pisani-Ferry (2012b).



mechanisms relates to the possibility of government debt crowding out private sector debt. According to these authors, banks and sovereigns compete to raise funds from investors, particularly when the sovereign loses its riskless status once the two forms of debt become closer substitutes in investor's portfolios. Therefore, as sovereign risk increases, and increases the cost of sovereign debt (and so the remuneration for investors), the same tends to occur to the cost of bank debt, whose availability possibly also decreases. The other mechanism mentioned by the two authors is linked with the possibility that the loss of market confidence in sovereign debt may trigger fiscal consolidation, which by affecting aggregate demand and economic activity may then further impact credit quality and bank profitability.

### ***2.2.2 But it is also much about contagion***

As we have seen before, countries like Ireland and Spain were particularly vulnerable to the effects of the Global Financial Crisis as their banking systems were highly dependent on international interbank markets and economic growth was strongly driven by the credit boom in real estate and construction sectors. The fragilities of national banks forced the Governments of both countries to take measures and as a result of that, budget surpluses turned into deficits and public debt increased significantly. Notwithstanding some initial expected tensions, Euro Area sovereign debt markets remained relatively calm during 2008 and most of 2009 (Lane, 2012). In Ireland, the yield on ten-year government bonds floated between 4% and 5% in 2008, and after a rapid increase reaching a peak above the 6% in the beginning of 2009 (in reaction to the nationalization of the Anglo Irish Bank) it returned again to the 4.5%/5% in the second semester of the year. On the other hand, in Spain, the behavior of yields was a little more erratic. Still, after a slight increase in the first six months of 2008, it tended to decline until the end of 2009, from about 5% to 3.5%.

In late 2009, however, the European Debt Crisis entered a new phase, particularly with the news originated in Greece (Lane, 2012). On October 2009, newly elected Greek government revised the country's 2008 deficit to 7.7% of GDP rather than the 5% previously reported by the preceding government, and also revised the 2009 deficit projection upward from 3.7% of GDP to 12.5%. In subsequent months, the Government announced it would implement several austerity measures and on January 2010 it also presented a three-year reform plan that was dismissed as being overly optimistic. Following these adverse developments, rating agencies downgraded the rating for Greece sovereign debt, markets reacted with loss of confidence and yields on Greek sovereign bonds rose significantly. The access to financial markets became increasingly difficult and costly, and so on May 2010, when there were serious fears that Greece could enter in a situation of default, Greek Prime Minister called for a Eurozone-IMF rescue package and Eurozone finance ministers agreed to provide €110 billion in financial assistance over a period of three years.

With the developments on Greece, investors started to fear that countries with poor fundamentals could also enter in a similar situation. Therefore, they have increasingly sought refuge from the sovereign debt of risky countries, and started to invest in countries seen as safe like Germany. Rapidly, the yields on sovereign debt of Portugal and Ireland

also moved up and both countries were forced to require a bailout. Then, on a second phase, the yields of Spain and Italy were also negatively affected.

As suggested by many authors, all these countries were “victim” of a sovereign-sovereign contagion phenomenon with origin on the Greek debt crisis. Regarding that, Constâncio (2012) presents two different approaches to investigate contagion during the European Debt Crisis. The first approach is a state-space model performing, in real time, multivariate frequency decompositions. By applying that model, the author finds evidence that contagion from Greece, Ireland and Portugal explains a significant share of Italian and Spanish government bond yields evolution, of around 30/40% in 2011. The second approach estimates the effect of an increased probability of a default for one country on the likelihood of a default for other countries, with probabilities being estimated from premiums of sovereign credit default swaps traded in the market. Following this approach, the findings show that contagion effects between Greece and Portugal and Ireland were at play in 2009 and 2011.

Similar conclusions are reached by Missio and Watsaka (2012), who by estimating dynamic conditional correlation models for government yields spreads of selected Euro-area countries identify contagion effects from Greece to other Euro-area countries, namely Ireland, Portugal and Spain, generated by negative rating announcements in Greece between 2009 and 2010.

In the same direction, Mink and de Haan (2013) observe that news about both the economic situation in Greece and a Greek bailout have had an impact on sovereign yields of Ireland, Portugal and Spain. Notwithstanding, according to the authors this impact may not necessarily mean contagion, as it is also in line with the so-called “wake-up call” view. According to this view a crisis initially restricted to one country may provide new information prompting investors to reassess the vulnerability of other countries.

### 3. Literature Review

In Section 2 we had the opportunity to mention some of the most important papers that have been written regarding both the Global Financial Crisis and the European Sovereign Debt Crisis, and particularly on the mechanisms through which problems in specific financial segments or in the public sector are transmitted into the banking industry and, in turn, to the real economy through the bank lending channel. In this section our purpose is different. Looking to provide a comprehensive framework for the study to be performed in Section 4, our intention here is to make a deep review of the empirical studies developed regarding the impact that the two recent crises have had on credit supply, giving particular attention to the results obtained, but also importantly on the different methodologies applied.

Our work is related and contributes to different strands of the literature. From a broad perspective, it is related with the literature that studies the costs of banking crises and credit crunches (e.g. Bernanke, 1983; Bernanke and Lown, 1991; Peek and Rosengreen 2000; Ongena *et al.*, 2003)

However, our study is focused on two specific events, and how they have affected the banking sector and the real economy. In this regard we may clearly distinguish two kinds of scientific research. On the one hand, we have some authors that focus their analysis on the way banks' performance has evolved during the period of the Global Financial Crisis/European Sovereign Debt Crisis, considering their prior vulnerability to the shock (e.g. Demirguc-Kunt *et al.*, 2013; Beltratti and Stulz, 2012; Hoque, 2013; Angeloni and Wolff, 2012; Correa *et al.*, 2014; Arezki *et al.*, 2012). For instance, Demirguc-Kunt and Huizinga (2009) find that during the Global Financial Crisis better capitalized banks achieved a better stock market performance, particularly in the case of larger banks. On the other hand, we find some studies that focus directly on the impact of the crises on real economy, namely on GDP growth (e.g. Fuerceri and Zdzienicka, 2011; De Paoli *et al.*, 2009). Using a sample of 154 countries for the period between 1970 and 2008, Fuerceri and Zdzienicka (2011) analyze the short and medium-term impact of debt crises on output, with the results suggesting that in short-term a debt crisis leads the GDP growth to decline by about 6 percentage points while in medium-term (for instance, eight years after the occurrence of the crisis) the output tends lower by about 10 percent. Besides

present evidence that debt crises produce significant and long-lasting output losses, this study also suggests that GDP growth declines by about 1.8 percentage points when the gross debt-GDP ratio exceeds 70 percent. In line with this, by analyzing 40 episodes of sovereign debt crises, De Paoli *et al.* (2009) find evidence not only on the fact that output losses are prolonged and large but also that they tend to be of a much larger dimension when associated with banking and currency crises.

In a more particular way, our work tries to understand how bank lending has been impacted by the two shocks, for the specific case of banks operating in Portugal. The reason for this study basically lies on the fact that Portuguese firms are, in general, highly dependent on credit markets such that they are extremely vulnerable to credit rationing events and, therefore, events of that kind may significantly damage the economy thus requiring special attention as to be avoided and minimized. Considering this is the strand of the literature which our study is most related with, in the next subsections we review the main research made on bank lending during the Financial Crisis of 2007/2008, the European Sovereign Debt Crisis, and also for the specific case of Portugal.

### 3.1 Global Financial Crisis

Regarding the period of the Global Financial Crisis, Ivashina and Scharfstein (2010) has become a reference and one of the most cited papers on the topic. With a strong descriptive nature, this study provides a deep and very detailed analysis on the behavior of lending in US during the Financial Crisis of 2007/2008, covering all the different segments of the market and describing the main movements occurred in each one of them. While the conclusions are numerous, each of particular interest *per se*, there are two that deserve our special attention. Regarding to the general levels of lending, the authors find that new lending in 2008 was significantly below new lending in 2007, even before the banking panic in the fourth quarter of 2008, with the level of loans granted depressing, however, at a more accelerated pace during the banking panic period<sup>15</sup>. Moreover, taking into consideration each segment individually, the authors also find that lending volumes decreased across all types of loans<sup>16</sup>. With a contribution to the literature that goes beyond this kind of descriptive characterization, Ivashina and Scharfstein (2010) also examine the cross-sectional determinants of bank lending during the financial crisis. Looking to test whether banks more vulnerable to the shock have reduced their lending in a greater magnitude as compared to other banks, the authors find that banks with low deposit financing and, therefore, more reliant on short-term funding, and also banks with a greater risk of credit-line drawdowns, experience more declines in lending. In line with Ivashina and Scharfstein (2010), the studies developed by Kwan (2010) and Gambacorta and Marques-Ibanez (2011) also find evidence of deteriorating conditions in credit supply during the Global Financial Crisis. With focus on US, but this time on the loan interest rates instead of the volumes of credit granted, Kwan (2010) finds that during the period of the crisis the cost of commercial and industrial loans<sup>17</sup> was, on average, 66 basis points

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<sup>15</sup> In the fourth quarter of 2008, the dollar volume of lending was 47% lower than it was in the prior quarter and the number of issues was 33% lower than it was in the prior quarter.

<sup>16</sup> Regarding the dollar volume of restructuring loans as at the fourth quarter of 2008, the authors find that it is 84% below its level at the peak of the credit boom, while for real investment loans it was 72% below its level at the peak. For the case of investment-grade lending it was 77% less than its level at the peak of the credit boom, and non-investment grade lending was 91% below the peak. Regarding the new issues of credit-lines facilities and term loans both declined, but the decline in term loans (67%) was larger than the decline in credit lines (27%).

<sup>17</sup> While the paper from Ivashina and Scharfstein (2010) resorts to information from syndicated loan market, Kwan (2010) uses a sample that includes all commercial and industrial loans made by a panel of 350 domestic large and small banks (for the period between 1997 and 2010), which means that it covers a wider range of borrowers as the access to syndicated loan market is more limited to larger companies.

or 23 percent above normal, *i.e.* above its long-term average (here interpreted as the average for the period between 1997 to 2010).

Between the second quarter of 2007 and the first quarter of 2010 the loan rate spread increased by almost 1 percentage point. According to the authors, this tightening effects appears to have been stronger within large and medium-sized banks, which raised their loan spreads on about 30% (against the 8% verified for small banks), while they find no evidence that bank-dependent borrowers<sup>18</sup> have suffered more from bank tightening than other borrowers. Additionally, by adjusting their pooled time-series cross-sectional model to include four new variables that account for bank specific characteristics, the authors also find that the loan portfolio quality, the capital ratios and the amount of unused loan commitments have an impact on loan prices, while profitability does not seem to affect loan pricing<sup>19</sup>. All-in-all, these findings provide evidence in support of the supply-side effect of loan pricing. On the other hand, the study developed by Gambacorta and Marques-Ibanez (2011) is centered on the effect of the Global Financial Crisis in Europe. Using a sample of more than 1.000 banks from GIIPS countries, Core-European countries and also US for the period between 1999 and 2009, this paper provides answers to three specific questions: a) Do certain bank-specific characteristics affect the loan supply?; b) Do certain bank-specific characteristics affect the impact of monetary shocks on the lending supply?; c) Have these effects changed in magnitude during the financial crisis of 2007/2008? In spite of the conclusions on each one of these questions, what deserves our biggest attention in this paper is the fact that, regarding the importance of the traditional variables typically used in the study of loan supply movements, the authors get some "surprising" results that do not confirm the predictions of most theoretical models. Clarifying this observation, it is worth to mention that according to the estimates of the authors both the size and the liquidity of the banks seem not to influence credit supply (during normal times and also during the crisis period), while the effect of bank capital

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<sup>18</sup> To identify bank-dependent borrowers the authors use as proxy instrument the loan size. Small loans are proxies for small borrowers who are less likely to have access to the capital market and who are more likely to be dependent on a relationship with a single bank.

<sup>19</sup> Loan portfolio quality: particularly in the case of large banks and, at a larger scale, in the case of small banks, institutions with poorer portfolio quality charge a higher loan rate. Capital ratios: for large and medium banks higher capital ratios are associated with higher interest rates reflecting the idea that more risk-averse banks choose to hold more capital; for small banks lower capital ratios are associated with higher loan rates, which is consistent with the idea that banks capital constrained reduce lending. Amount of unused loan commitments: independently of the size of the bank, banks with more unused loan commitments -which are associated with excess lending capacity- charge lower interest rates.

seems to have a negative effect on lending during normal times (contradicting the general idea that well-capitalized banks provide more credit<sup>20</sup>) and exactly the opposite effect during the crisis (during this kind of periods, capital works as a buffer to compensate adverse shocks). Indeed, during the years leading to the crisis, credit supply is apparently driven by bank capital but also by securitization activity. Securitization activity is positively related with credit growth, which is consistent with the idea that it works as a source of capital relief and additional funding (this idea is also supported by Altunbas *et al.*, 2009). Moreover, during the crisis period the importance of the banks' business models on credit supply is even more evident as not only securitization activity appears to influence lending but the same happens with the reliance on short-term funding and the weight of non-traditional (non-interest income) activities (even in these two cases the effect is negative). In summary, all these results suggest that there were deep changes on the bank-related factors determining bank lending and also on the whole monetary transmission mechanism<sup>21</sup> prior to and during the financial crisis of 2007/2008. Following the deregulation, financial innovation and increasing role of institutional investors, new factors more related with the banks' business model assumed a higher relevance compared to more traditional variables such as size and liquidity.

Common to the three studies analyzed above we have the fact that they rely on loan data only disaggregated at the bank level. As further developed in next subsection, this represents a limitation in terms of the disentanglement of supply and demand effects on bank lending. In this regard, the methodologies followed by Sette and di Patti (2012) and Bord and Santos (2014) allow to avoid such problems. Relying on a sample of 630.000 bank-firm relationships in Italy in the first phase of the Global Financial Crisis (June 2007-December 2007) and 655.000 in the second one (June 2008-December 2008), and

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<sup>20</sup> This result is, however, consistent with the thesis that higher levels of capital during normal times reflect a higher risk aversion and, therefore, more restrictions when supplying credit.

<sup>21</sup> Analyzing the interaction between bank-specific characteristics and the transmission mechanism of monetary policy, the authors also find surprising results as they suggest that size and liquidity do not matter for the way as bank lending reacts to monetary changes during normal times, while the same is found for liquidity and capital during the crisis period. Also controversial is the result found for the role of securitization: banks more active in securitization market are able to lend more both during normal times and the crisis period and there is a positive interaction between securitization and monetary policy which means they are better able to buffer their lending activity against shocks related to the availability of external finance. Although this insulation effects reduces during the crisis period, considering the fact that banks have difficulties in originating and distributing asset-backed securities, the fact is that it not reflects the idea banks more exposed to this market incurred in higher losses in their balance-sheets and then became more financially constrained and started lending less.



following the firm-fixed effects methodology of Kwaja and Mian (2008) – also explained in more detail in next subsection –, Sette and di Patti find that during the first phase of the crisis, credit supply was mainly impacted by the banks' reliance on interbank funding, as well on the level of activity in securitization markets prior to the crisis and on the share of liquid assets. Indeed, as reported by the authors: a) a one standard deviation increase in the exposure to the interbank market leads to a decrease on lending by 0.86 p.p. (and an increase on interest rates of 17 b.p.); b) a one standard deviation increase in the ratio of amount of loans securitized to total assets leads to a reduction of 1.5 p.p in credit granted (and an increase on interest rates of 52 b.p.) and; c) a one standard deviation decrease in the share of liquid assets leads to a decrease of 0.56 p.p.. Regarding the level of capitalization, loan write-offs and ROA, their effect seems to be negligible. On the other hand, during the second phase of the crisis, *i.e.* after the fall of the Lehman Brothers, bank profitability and the reliance on interbank funding appear to be the main factors determining the volumes of credit granted (a one standard deviation increase in the exposure to the interbank markets and on the ROA leads, respectively, to a decrease on lending of 0.71 and 2.55 p.p.) while the level of loan charge-offs significantly impacts the cost of credit. As regard liquidity, it seems to play a more limited role due the support provided by the Eurosystem to the banking sector.<sup>22</sup> While the methodology followed by Sette and di Patti (2012) is more common to find after being introduced by Kwaja and Mian (2008), the approach of Bord and Santos (2014) is very unusual and unique. Exploring the liquidity shock that impacted the banking system following the collapse of the ABCP market in the fall of 2007, Bord and Santos (2014) try to establish a link between a bank's liquidity position and credit supply, with main focus on the price it charges to corporations for granting them access to liquidity (the undrawn fee) during the period of crisis. By using as proxy for the liquidity shock (*i.e.* as measure of their vulnerability to the shock) the amount of funding that banks raised from the sources of liquidity to which they resort mainly when they are unable to meet their liquidity needs in the market (for instance, the FHLB system and the Fed's discount window), the authors find that: (i) banks' use of this funding sources does play a more important role on the

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<sup>22</sup> In line with this paper, Albertazzi and Marchetti (2010) analyze the six month period after Lehman collapsed (September 2008-March 2009) to explore the relevance of evergreening by banks and the role of bank capital, and they find a negative effect on the growth of loans to risky borrowers for larger less-capitalized banks but no effect for smaller less-capitalized banks, which suggests that other determinants could be playing a role.

undrawn fees that banks charge on the credit lines they extend during the crisis, when compared to the pre-crisis period; (ii) banks that had to resort to these sources increased more the price they charged corporations for granting them access to liquidity, with this effect being driven by banks' larger exposure to the ABCP market<sup>23,24</sup>. Additionally to these findings, the authors also conclude that these effects are more pronounced among credit lines that pose more liquidity risk to banks (i.e. the ones that require banks to set aside more liquidity to meet their funding demands as the borrowers tend to draw down more frequently on their available lines or they have a less predictable drawdown pattern). They also conclude that banks differentiate among their borrowers and pass their additional cost of accessing liquidity only onto their dependent borrowers. Altogether, these findings provide important support to the thesis that banks' liquidity condition does play an important role on the price they charge to corporations seeking access to liquidity. Going a little further, the authors apply the same kind of analysis to the all-in-drawn spread (which also incorporates the credit spread, set to compensate the bank credit risk of the borrower), and by also distinguishing between the effect on credit lines with high and low liquidity risk they get additional evidence on the fact that changes in the prices charged on supplied credit were driven by the deterioration on banks' liquidity conditions (supply factor) and not on the risk of borrowers (demand factor).

Resorting to much less richer data, *i.e.* by following a cross-country panel-econometric approach, and relying on aggregated information (by country) on the quarterly growth of loans both to firms and households as well on banks' responses to the Bank Lending Survey (which allows for disentangling loan supply and demand effects), Hempell and Sorensen (2010) find evidence that factors associated with banks' balance sheet positions are important for credit supply in the Euro-Area, both in terms of prices and volumes, and for corporate and household loans, and that contrarily to the idea that loan developments are mainly driven by cyclical and demand factors, during the crisis such supply-side effects revealed to be strongly relevant. Indeed, analyzing the period corresponding to the Global Financial Crisis, the authors find that liquidity constraints and difficulties to access to market funding led banks to restrict lending, while these two variables seem no to be

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<sup>23</sup> Indeed, the authors show evidence that allows to establish this link between the banks' weak liquidity position that leads them to apply for those "lenders of last resort" - and which results in increasing undrawn fees - and their exposure to ABCP market

<sup>24</sup> These findings are robust to bank, firm, and credit line specific controls and to bank fixed effects.

much relevant for credit supply prior to the crisis. In this regard, the authors also find that such adjustment on lending was mainly reflected on prices and not so much on volumes.

Finally, as regard the study of how the effect of the Global Financial Crisis may affect the real economy through the bank lending channel, we may also refer the works of Chodorow-Reich (2014), Cingano *et al.* (2013) and Bentolila *et al.* (2013). Differently from our research and the ones reported in the lines above, these authors shed light on the evolution of credit markets by analyzing how firms have performed depending on the banks with which they have a lending relationship. For instance, relying on employment data on the US economy and also on loans and banks specific information, Chodorow-Reich (2014) finds that firms more dependent (prior to the crisis) on lending from banks that struggled during the crisis greatly reduced employment as compared to firms that had relationships with healthier ones. In Europe, for the specific case of Italy, Cingano *et al.* (2013) find that firms with lending relationships with banks more exposed to the interbank market have experienced a larger drop in investment and employment levels following the Global Financial Crisis, while in Spain, Bentolila *et al.* (2013) find that firms more dependent on banks more vulnerable to the crisis (here proxied by the fact they have obtained or not assistance from the Government) recorded a larger job destruction than other firms.

## 3.2 Sovereign Debt Crisis

The identification of a credit crunch (here defined as a supply driven reduction on the volumes of credit granted and/or an increase in the loan interest rates charged) following a crisis with the characteristics of the Financial Crisis of 2007/2008 or the Sovereign Debt Crisis poses two main methodological challenges which have been addressed in several ways in the literature. In this regard, the main studies with focus on the period of the Sovereign Debt Crisis are very enlightening and reflect the different approaches followed and the differences between them.

The first of the referred challenges derives from the own definition of credit crunch and is related with the disentanglement of supply and demand effects on bank lending. Very often, crises with a financial, sovereign or banking nature are accompanied by economic recession, *i.e.* they are correlated with a deterioration of the economic conditions. At the same time as banks face increasing difficulties to get funding and to guarantee a stable and solid financial position as to accomplish, for instance, the regulatory capital ratios, firms are negatively impacted for a decreasing demand on their products and recurrently decide to cut down their investment plan. Therefore, following the shock, not only banks reveal to be less available to grant credit or start to charge higher interest rates, but also firms reduce their demand for credit, making it difficult to assess the real effect of the shock on credit supply<sup>25</sup>. Taking into account the importance this identification has, namely for policy-makers, in the sense that some monetary policies are more adequate than others if the changes in credit markets are demand or supply driven, we may find in the literature different approaches proposed to overcome this problem. As described by Hempell and Sorensen (2010) and Altunbas *et al.* (2009), in more traditional studies, individual bank-specific characteristics are claimed to be the only ones with directly influence in the supply of loans, while demand for loans is commonly assumed to be independent of the situation of individual banks and to rather depend on macroeconomic factors. Consequently, on the construction of the models used in these studies, there is no need to control for demand in order to assess the impact of supply-side factors on bank lending. More recently some studies started to use the information collected from the

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<sup>25</sup> A similar problem arises when following the shock the risk of the firms increase, as the reduction on the levels of credit granted is, in that case, attributable to evolution on firms and not on banks.

ECB Bank Lending Survey (BLS) – or other lending surveys, for the case in which the reality under analysis is not the European<sup>26</sup>. In the context of the Bank Lending Survey, every quarter, participating banks provide information on lending standards and credit demand from firms. Such figures are then used, respectively, as proxies for unobserved supply and demand therefore allowing for the desired disentanglement. Also in response to the BLS, banks provide additional, detailed information about the underlying factors related to banks' decision to supply credit and to the related changes in their credit terms and conditions for their customers. Hence, this information may be used to identify the specific factors driving bank lending. Both the “traditional approach” and this one relying on ECB Bank Lending Survey have some limitations. The first one is based on a strong and somehow unrealistic assumption that only banks-specific characteristics determine credit supply. On the other hand, on the “BLS approach” the quality of the results depends on the reliability and the truthfulness of the respondents' answers. A much better methodology, already adopted in some research papers, was introduced by Kwaja and Mian (2008). Applicable only when we have available data disaggregated at the bank-firm level, this approach allows us to more accurately disentangle supply and demand factors influencing credit policies. The idea consists, basically, on using firm fixed effects which means that we compare for the same firm the volumes of credit granted or the interest rates charged by two or more banks that have been affected to a different degree by the crisis. As we take the same firm as reference, any differences in the credit provided by one bank may only be justified with the conditions of the bank itself. From a different perspective, as banks more vulnerable to the shock may lend to a different set of firms, the use of firm fixed effects allows to control for firm level demand, firm's riskiness and, very important, for firm unobserved heterogeneity.

The second methodological challenge typically faced by researchers when assessing the impact of supply side factors on credit markets in contexts of crises has to do with the identification of the degree to which banks were affected by the crisis. Indeed, this assessment is very important in order to establish a link between the bank credit supply and the shock under analysis and, therefore, to quantify the part of the changes in lending policies (for instance, the decrease on loans granted or the increase on loan interest rates)

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<sup>26</sup> For instance, for the United States, some authors resort to the FED's Senior Loan Officer Opinion Survey of Bank Lending Practices (e.g. Lown *et al.*, 2000; Basset *et al.*, 2013)

that can be effectively attributed to such shock. In order to account for this, and as proxy of the bank's vulnerability, authors have been using both dummy and continuous variables. For instance, for the case of the European Sovereign Debt Crisis, both Bofondi *et al.* (2013) and Acharya *et al.* (2015) use the bank's country of corporation, with national banks being identified as more affected. Differently, Popov and van Horen (2013) distinguishes affected banks from non-affected banks as the ones being in the top half in terms of exposure to GIIPS sovereign debt. For the case of the Financial Crisis of 2007/2008, both the exposure to interbank markets and the level of securitization activity as before the crisis are used by Sette and di Patti (2012), with banks more dependent on interbank borrowing and more active in securitization (prior to the crisis) being the most vulnerable to the shock. The inclusion of a variable that captures the vulnerability of a bank to the shock is needed, however, only when we are using the Kwaja and Mian (2008) methodology. In traditional studies as well in those where the supply and demand disentanglement is made resorting to the ECB BLS, what we have in general is a variable that measures the intensity of the shock. For instance, for the case of the Sovereign Debt Crisis, the spread between the yield on the long-term government bonds of the country under analysis and the yield on German Bunds (or a similar one) is commonly used in order to measure the tensions in the sovereign markets and to assess how credit supply reacts to each percentage point increase or decrease in the such spread.

The approach we follow, the rigor of the model we build and then the quality of the results achieved also depend, of course, on the data available for the purposes of the study and, more specifically, on the level of data disaggregation.

In this regard the simplest models we find rely on data aggregated by country. Using the information aggregated by member country published by the European Central Bank on the interest rates charged on new loans (excluding overdrafts) to non-financial corporations as well on residential mortgages (both with initial maturity up to one year), Neri (2013) finds evidence that sovereign tensions have had a substantial impact on bank lending rates in the peripheral countries (Italy, Spain, Greece and Portugal), but practically none in the core countries (Germany, France, Belgium, the Netherlands, Austria and Finland). Considering the period from 2003 to 2012, the authors find that after one quarter, an increase of 100 basis points in the spread between the yields on 10-year government bonds and that of swap contracts in euro of equal maturity leads interest

rates on loans to non-financial corporations to increase by 33 basis points in Italy, 20 in Portugal, 16 in Spain and 7 in Greece. On the other hand, regarding the interest rates on loans to households for house purchase, the authors also conclude that an increase on sovereign spread negatively impacts the cost of loans with particular relevance on Italy (+31 b.p.), Portugal (+16 b.p.) and Spain (+11 b.p.). Interestingly, an opposite, although small, effect is found in Greece. By running a counterfactual exercise based on the assumption that the spreads would have remained constant at the values recorded in April 2010, before the heightening of the tensions on Greek bonds (with all other variables assumed to follow their actual paths) the author further finds that at the end of 2011 the interest rates on new loans to non-financial corporations and residential mortgages in the peripheral countries would have averaged respectively 130 and 60 basis points lower than their actual values<sup>27</sup>. Similarly, by relying on a similar kind of aggregated data<sup>28</sup>, and by running a Factor Augmented Vector Autoregressive (FAVAR) model, Neri and Ropele (2013) provide a quantification of the macroeconomic effects resulting from the tensions on the sovereign debt markets (for instance, they test the impact of a 400 b.p. unexpected increase in the ten-year Greek spread, which corresponds to the rise in the Greek sovereign spread between August and September 2011) and confirm that such tensions have led to a significant deterioration in credit access both for firms and households in peripheral countries during the crisis period. Regarding the increase on the interest rates charged on loans to non-financial corporations, it is estimated to be larger in Portugal and Greece (about 40 b.p.) as compared to Spain and Italy (about 20 b.p.), which somehow contradicts the results presented above. As for the loans to households similar results are reported.

More advanced works have, however, been developed, relying on data disaggregated at the bank level. Albertazzi *et al.* (2014), using individual data for all Italian banks and also using the adjusted BTP-Bund spread as measure of sovereign debt tensions in Italy, take conclusions not only on the evolution on bank lending but also on the conditions of

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<sup>27</sup> For non-financial corporation, in Italy, Spain, Portugal and Greece, respectively, the interest rates would have been lower by 130, 50, 150 and 190 b.p. For households, rates would have been 120, 30 and 110 basis points lower in Italy, Spain and Portugal. The same opposite effect is found for Greece, as previously.

<sup>28</sup> Namely a balanced panel of 173 monthly macroeconomic variables (151 country-level and 22 euro-area wide) pertaining to: bank rates, credit aggregates, monetary aggregates, industrial production, unemployment rates, inflation rates, intra-EMU exports, confidence indices, and other real and financial variables.

funding and on the performance of banks<sup>29</sup>. Referring only to the effects on lending interest rates, the authors find that changes in the sovereign spread exert a significant effect on the interest rates on loans to firms and on mortgages to households, with that effect being stronger during the periods of crisis. Quantifying these effects, they show that during the European Sovereign Debt Crisis a temporary (one-quarter) 100 b.p. rise in the sovereign spread is associated - with a one-quarter lag - with a rise of 50 b.p. and 30 b.p., respectively, for business loans and households mortgages. On the other hand, a similar increase is associated with a reduction of about 1 p.p. of the annual growth for loans to households and of 0.7 p.p. for loans to firms. Moreover, by performing some “robustness” tests, the authors also find that the impact of the sovereign shock is roughly three and two times stronger for the largest banks for the case of loans to firms and loans to households, respectively. Comparing the effect depending on the size of the loans, they conclude that the impact of an increase in the sovereign spread is bigger for loans over €1 million in about 10/20 basis points. Differently from these authors, Del Giovane *et al.* (2013) and Zoli (2013) focus also on the situation of Italy but they use the “BLS approach” instead of the “traditional” one to disentangle supply and demand. In this regard, by running a system of two simultaneous equations estimated using the two-step efficient GMM<sup>30</sup>, Del Giovane *et al.* (2013) find evidence of a credit rationing phenomena during the period of the Sovereign Debt Crisis as well of the Global Financial Crisis (also analyzed in the paper), as banks limit their supply of credit even if the borrowers are willing to pay higher margins. Comparing both periods, the authors conclude the effect of the supply factors on the cost and availability of credit revealed to be stronger during the period of the Sovereign Debt Crisis than in the Global Financial Crisis<sup>31</sup>. Moreover, while during the Financial Crisis of 2007/2008 the supply effects on the cost of credit were mostly associated with banks’ risk perception, during the sovereign crisis “pure”

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<sup>29</sup> About the funding costs, the authors find that changes in the sovereign spread exert a significant effect on the interest rates on term deposit, repurchase agreements and newly issued bonds but not on the remuneration of other instruments such as the households’ overnight deposit (which is consistent with the common low correlation between this type of interest rates and the current market conditions as well the fact they embed a virtually zero risk premium). About the performance of banks, they find that the positive effect on the loan-deposit rate differential generally prevails over the negative effect on loan amounts. A 100 b.p. increase in the sovereign spread is associated with a 2% increase in the net interest income.

<sup>30</sup> Generalized Method of Moments.

<sup>31</sup> The authors estimate a negative cumulative effect (since the beginning of the crisis until the 2Q2012) at around 220 basis points (or 2.2 percentage points), of which about a third came during the global crisis and two thirds during the sovereign debt crisis. Regarding the growth of loans, demand conditions are estimated to have determined a cumulative reduction of about 12 percent. On the other hand, supply factors are estimated to have had a cumulative impact of more than 8 percent, with the negative effect attributed to credit rationing being estimated on about 4 percent, equally distributed in the two phases of the crisis.



supply factors, related to difficulties in the access to funding and to the banks' balance-sheet position, became predominant. By including in their original model an additional variable to assess the impact of changes in the sovereign spreads on credit markets during the period of the European Sovereign Debt Crisis, the authors further find that a 100 b.p. increase in the sovereign spread leads to an immediate 25 b.p. increase in the cost of new loans (and a cumulative effect of about 30 b.p. after one quarter) and a 0.4 p.p. reduction in the quarterly loan growth rate. On the other hand, Zoli (2013) finds evidence that changes in sovereign spreads are rapidly transmitted into corporate borrowing cost. For instance, by analyzing the situation of Italian banks for the period between January 2006 and September 2012, the authors conclude that about 30-40 percent of the increase in sovereign spreads is transmitted to firm borrowing rates within three months, and 50-60 percent within six months, with this effect being larger for small loans. Additionally, by disentangling supply and demand effects, the author concludes that while supply constraints driven by bank funding difficulties at the peak of the Italian sovereign debt crisis seem to have prevailed over weak demand until the end of 2011, in 2012 the weak demand appears to be the main driver of credit contraction considering the effects of the LTRO and other policies implemented by ECB.

As previously described, the most accurate studies tend to be, however, the ones that rely on data disaggregated at the firm-bank level, *i.e.* micro level data that specifies the lending relationships existent between each bank and firm. Three examples of this are the works of Bofondi *et al.* (2013), Acharya *et al.* (2015) and Popov and van Horen (2013). By applying a Difference-in-Difference approach on a sample of 670,000 bank-firm relationships involving 567 banks (of which 49 foreign) operating in Italy, following the firm-fixed effects methodology from Khwaja and Mian (2008) and distinguishing between more and less affected banks according to their country of incorporation, with domestic banks being assumed to be more vulnerable to the Sovereign Debt Crisis<sup>32</sup>, Bofondi *et al.* (2013) find that lending of Italian banks (the most affected banks) grew by about 3 percentage points less than that of foreign banks during the period of the

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<sup>32</sup> Foreign banks operating in Italy are assumed to be the less affected by the crisis because: a) they are headquartered in countries where the sovereign risk was more contained; b) their assets portfolio is less concentrated in government bonds of peripheral countries, such that the increase in riskiness of their asset side due to sovereign risk over the second half of 2011 was relatively milder; and c) although they lend to Italian firms, a significant fraction of their liabilities is represented by interbank transfers from their headquarters that raise funds either in their home country or in the international wholesale markets, which contributed to a much lower increase in funding cost.

Sovereign Debt Crisis. Also, the interest rates charged were 15/20 basis points higher for revolving credit lines and term loans, respectively, and about 35 basis points for new terms loans. Similar results are found when the authors further apply a model modified by the inclusion of a continuous measure of exposure to sovereign risk. Studying all the GIIPS countries (and not only Italy) and using as sample all the syndicated loans originated by European banks in the period 2006 to 2012, Acharya *et al.* (2015) – which also apply a Difference-in-Difference model, the firm-fixed effects methodology of Khwaja and Mian (2008) and the country of incorporation to distinguish more and less affected banks – shed some light on the credit supply contraction verified during the European Sovereign Debt Crisis. They do this by showing that firms more dependent on GIIPS banks present a kind of behavior typical for financially constrained firms, in the sense that they have lower leverage, demonstrate a significantly positive propensity to save cash out of their cash flows, and increase the fraction of their cash holdings relative to bank lines of credit in their liquidity management (moreover, these firms more dependent on GIIPS banks have lower levels of investment, lower employment growth and lower sales growth as compared to firms with lower GIIPS bank dependence). Additionally, in the process to identify what are the relevant bank lending channels through which the effects of the sovereign debt crisis are transmitted to the real sector, the authors further develop a model to estimate the contraction of lending supply by banks, both in terms of volumes and spreads, concluding that during the period of the sovereign crisis, the affected banks reduced lending more than non-affected banks by more than 35 p.p. and increased spreads in more than 3.6 b.p. Finally, concerning the studies that rely on firm-bank disaggregated data, Popov and van Horen (2013) find that after the third quarter of 2010, affected banks increased lending by 20% (or above) less than non-affected banks, with these results holding when controlling for both time-varying bank characteristics and for bank fixed effects, as well as after including borrower country-quarter fixed effects which control for unobservable borrower demand and/or quality at the country level, and industry and firm fixed effects. Differently from the two studies previously analyzed, and as already mentioned above, Popov and van Horen (2013) distinguish more and less affected banks by taking into account the bank's exposure to sovereign debt securities from GIIPS countries weighted by the respective risk.

Further studies could be here analyzed also with greater detail. It is the case of De Marco (2014) – which shows that European banks more exposed to the sovereign shock significantly reduced credit supply during the crisis, with a 1% increase in losses-over-total assets ratio leading to a decrease of the growth rate of domestic loans of about 4/5% - Balduzzi *et al.* (2014) – which is in line with the study developed by Acharya *et al.* (2015), although with some limitations, since it analyzes the effect of the Sovereign Debt Crisis on real variables as transmitted through the bank lending channel, with the vulnerability of the banks to the shock being assessed by their CDS spread – and also Ciccarelli *et al.* (2013) – that by using data aggregated at the country level for 12 euro area countries finds that the impact of monetary shocks on gross GDP growth is amplified through the credit channel in countries under sovereign stress.

### 3.3 The specific case of Portugal

The literature on the effects of the Global Financial Crisis and the Sovereign Debt Crisis on credit supply for the specific case of Portugal is scarce. As we have seen before, there are some studies which are focused on the GIIPS and so they approach the situation of all the countries included in that group. However, it is difficult to find research focusing exclusively on the case of Portugal and doing a deep analysis of on this topic.

Probably the main exception to this is the work developed by Iyer *et al.* (2014). Relying on bank-firm level data on loans collected from the Central Credit Register (and then combined with bank and firm specific variables collected from the Bank of Portugal Central Balance Sheet Database), and following the firm-fixed effects methodology of Kwaja and Mian (2008) implemented through the estimation of a Difference-in-Difference econometric model, Iyer *et al.* (2014) exploit the initial exogenous and unexpected shock to the interbank markets verified in August 2007 in order to assess how banks operating in Portugal have adjusted their credit lending policies and how such adjustment was felt in a different way by borrowers with different characteristics. With that purpose, and similarly to Sette and di Patti (2012), the authors also use the banks' dependence on interbank borrowing as a measure of its vulnerability to the shock. By following this strategy, the authors find that, on average, a firm that borrows more from banks with a higher interbank borrowing ratio prior to the crisis experience a greater reduction in credit granted. For instance, a 10% increase in interbank borrowing of the lending bank is associated with a 3.7% reduction in the credit available for the firm during the crisis period. By including some controls for bank and firm specific characteristics before the crisis, the authors also conclude that credit is tightened in a different way depending on who lends and who borrows. For instance, banks larger in size are less likely to cut credit and smaller firms tend to be more negatively impacted by the credit rationing, while for large firms there is no evidence of such credit contraction arising from the banks' exposure to interbank markets. Finally, a last conclusion that deserves here our mention is the fact that, on average, firms are not able to perfectly substitute credit supply reductions (*i.e.* they are not able, in general, to borrow from a different bank if their bank does not lend to them) neither to substitute bank credit with other sources of financing.

Besides the work of Iyer *et al.* (2014), other papers, namely developed internally by the members of the Bank of Portugal, deserve our reference (Farinha and Félix, 2014; Antunes and Martinho, 2012; Augusto and Félix, 2014).

Using a sample of 50.200 observations on credit provided to Portuguese SMEs (aggregated by firm) collected from IES (Simplified Business Information) and following a disequilibrium model approach through which credit demand and supply equations are estimated simultaneously, Farinha and Félix (2014) find that for the period between 2010 and 2012: a) approximately 15 percent of Portuguese SMEs with bank loans were partially rationed, with the most affected firms being the i) younger (26%), ii) very small (19%) and iii) operating in the construction sector (21%); b) approximately 32 percent of firms with no bank loans were fully rationed, with the most affected firms being again the i) younger (26%) and ii) very small (19%), although the firms of other dimensions are also strongly affected (above 20% for all firms, independent of the size)<sup>33</sup>; and c) banks restricted more intensively the supply of loans to firms with higher leverage and less able to provide better guarantees. With all these results, Farinha and Félix (2014) show that there was indeed a credit tightening in Portuguese economy in the crisis period between 2010 and 2012 (during the European Sovereign Debt Crisis) and they highlight the firm-specific characteristics driving credit supply. However, they do not provide any insight on the bank specific characteristics that lead banks to reduce lending and, particularly, they do not establish any link between the vulnerability of banks to the crisis and their supply of credit, which does not allow to clearly quantify the impact of the crisis on the bank lending channel.

Aiming to study the availability of credit to firms in the period following the Global Financial Crisis and leading to the European Sovereign Debt Crisis, Antunes and Martinho (2012) apply two different approaches, one based on interest rates and other based on the volumes of credit granted. In the first case, the authors build a model that relies on June 2010 data as reference to predict the interest rates of October 2011, with the actual and observed interest rates at that time being then compared in order to identify which part of the changes in observed interest rates can be explained by changes in firm and loan specific characteristics, and which part should be attributed to other factors such as credit restrictions, negative business outlook (not explained by changes in firms'

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<sup>33</sup> In this case, all the activity sectors faced credit restriction (with the percentage of affected firms being always above 30%).

balance sheets), increasing risk aversion, increased costs of financing by creditors, systemic increases in interest rates and increased costs of capital. Performing this exercise, Antunes and Martinho (2012) find evidence that the increase in loan interest rates verified between June 2010 and October 2011 is only explained, in a very small part (18 in 226 basis points), by the changes on firm and loan characteristics, therefore suggesting that there were other factors that induced such increase, for instance, the change in the Euribor, the increase in funding costs for banks and the change in banks' behavior towards risk.

In a different line of research, Augusto and Félix (2014) study how the bank recapitalizations that occurred in Portugal between the first quarter of 2010 and the last quarter of 2013 have impacted credit supply. In this regard, the authors find that government recapitalizations had a positive effect on bank lending, with that effect being negatively related with the banks' capital buffer. Moreover, they find that when lending, recapitalized banks did not differentiate firms according to their financial conditions. Furthermore, they conclude, by running a sector analysis, that for the specific case of the construction and real estate sector companies have benefited from a credit supply increase of about 3.5 percent after the government recapitalizations occurred. In summary, through this work the authors present some interesting evidence on the effectiveness of government interventions on the banking sector.

### 3.4 Summary of Main Literature Review

*Table 1: Summary of main Literature Review*

Author	Country	Period	Crisis event	Level of data disaggregation	Methodology [Disentanglement Supply vs Demand]	Specific Measure of (1) Exposure to the shock OR (2) Intensity of the shock
Sette and di Patti (2012)	Italy	2Q2007-4Q2008	GFC	Firm-bank level	Khwaja and Mian (2008)	(1) Interbank borrowing and Securitization activity
Iyer <i>et al.</i> (2014)	Portugal	2Q2007-2Q2009	GFC	Firm-bank level	Khwaja and Mian (2008)	(1) Interbank borrowing
Bord and Santos (2014)	US	1Q2005-4Q2007	GFC	Firm-bank level	Other	(1) Funding raised from "lenders of last resort" (Exposure to ABCP market)
Ivashina and Scharfstein (2010)	US	2Q2006-4Q2008	GFC	Bank level	Traditional approach	(1) Short-term funding and Exposure to credit-line drawdowns
Kwan (2010)	US	1997-2010	GFC	Bank level	Traditional approach	-
Gambacorta and Marques-Ibanez (2011)	GIIPS Core-European US	1999-2009	GFC	Bank level	Traditional approach	(1) Securitization activity, Short-term funding and Non-traditional activities
Hempell and Sorensen (2010)	GIIPS Core-European	4Q2002-4Q2009	GFC	Country level	BLS approach	-
Del Giovane <i>et al.</i> (2013)	Italy	4Q2002 - 2Q2012	GFC/SDC	Bank level	BLS approach	(2) Sovereign spread
Bofondi <i>et al.</i> (2013)	Italy	4Q2010-4Q2011	SDC	Firm-bank level	Khwaja and Mian (2008)	(1) Country of Incorporation
Acharya <i>et al.</i> (2015)	GIIPS	2006-2012	SDC	Firm-bank level	Khwaja and Mian (2008)	(1) Country of Incorporation
Popov and van Horen (2013)	European non-GIIPS countries	3Q2009-4Q2011	SDC	Firm-bank level	Khwaja and Mian (2008)	(1) Exposure to GIIPS sovereign debt
Zoli (2013)	Italy	2006-2012	SDC	Bank level	BLS approach	(2) Sovereign spread
Albertazzi <i>et al.</i> (2014)	Italy	1991-2011	SDC	Bank level	Traditional approach	(2) Sovereign spread
Neri (2013)	GIIPS Core-European	2003-2012	SDC	Country level	Traditional approach	(2) Sovereign spread
Neri and Ropele (2013)	GIIPS Core-European	2007-2012	SDC	Country level	Traditional approach	(2) Sovereign spread

## **4. Empirical Study: the specific case of Portugal**

Once we have reviewed the main literature, it is the purpose of this section to assess, for the specific case of Portugal, if following the Global Financial Crisis and/or the European Sovereign Debt Crisis banks operating in Portugal reduced lending and a credit crunch took place, therefore impacting the real economy.

### **4.1 Identification Issues**

As we have already mentioned, the identification of a credit crunch as result of a crisis with the characteristics of the Financial Crisis of 2007/2008 or the European Sovereign Debt Crisis poses some challenges, namely related to the disentanglement of supply and demand effects, and also the identification of the degree to which banks were affected by the crisis in order to establish a causal effect between the shock under analysis and credit supply and, therefore, to quantify which changes in lending policies can be effectively attributed to such shock.

On the disentanglement of the supply and demand effects on bank lending, we follow the methodology first implemented by Khwaja and Mian (2008). Relying on data from the Portuguese Central Credit Register and collected by the Bank of Portugal, which contains detailed information about each loan provided by all banks operating in Portugal to non-financial corporations, we are able to compare exactly for the same firm the evolution of credit supplied by two or more banks that have been affected to a different degree by the Global Financial Crisis or the Sovereign Debt Crisis, depending on the case under analysis. Therefore, by running a regression with firm-fixed effects, we have the possibility to isolate the effect of supply factors on bank lending, expurgating from our analysis the possible decrease in the volumes of credit granted arising from a reduction of the demand induced by the deterioration of economic conditions in the context of the crisis. Moreover, by using always the same firm and exploiting the fact it holds a lending relationship with two or more banks with different exposure to the shock, we can also account for the fact that banks more exposed to the crisis could lend to a different set of firms. Indeed, in the limit, if the portfolio of clients from one group and the other was completely different, we could not develop a comparable analysis in such straight way. In summary, by following this approach, as we control for firm level demand, firm's riskiness and firm unobserved heterogeneity, we ensure that any differences verified in lending are only due to differences on the supply side.



As regarding the assessment of the degree to which banks were affected by the crisis, the measure that we use as proxy of their vulnerability to the shocks is different according to the specific period under analysis. For the case of the Global Financial Crisis, we use the level of Interbank Borrowing prior to the crisis measured as the ratio of total borrowing from other banks to total assets. As an alternative measure we could use, for instance, the level of securitization activity. However, once the Portuguese banking system was not particularly active on that kind of markets (as they were banks in US but also in Spain), but instead it seems to have been impacted by the general freezing on the interbank markets, it is our understanding that the selected measure captures in a better way the effect that the Global Financial Crisis had, in fact, in the capacity of Portuguese banks to lend credit. On the other hand, for the period of the European Sovereign Debt Crisis, we use as proxy of their vulnerability the exposure of each bank to sovereign markets prior to the crisis, measured by the amount of sovereign debt hold in their balance sheet. We do not include in this case only the holdings of sovereign debt from GIIPS countries, however, it is our belief that this has no implication for the results obtained since the great majority of the sovereign debt hold by the Portuguese banks is from the own Portuguese government and also from other GIIPS countries.

An additional identification issue not yet discussed has to do with the fact that the shock analyzed has to be exogenous with respect to the situation of Portuguese banking system. This condition is verified both for the period of the Global Financial Crisis and the period of the European Sovereign Debt Crisis. For instance, in the first case, we exploit an exogenous and not predicted shock coming from the interbank market and started in August 2007, when due to the lack of confidence within the system banks stopped lending each other, the market froze and interbank loan spreads increased in a significant magnitude, such that banks (in general, and also in Portugal) found more difficult to get liquidity and the cost of funding increased. On the other hand, in the case of the European Sovereign Debt Crisis, the shock is also exogenous once the increase verified in Portuguese sovereign spreads was not motivated, like in other countries such as Spain and Ireland, by a deterioration of the financial conditions of domestic banks such that it was required a public intervention at a large scale. Indeed, in spite of the cases of BPN and BPP, the rise on Portuguese sovereign spreads was mainly related with the weakness of Portuguese public accounts (high levels of public debt and successive deficits), which was reinforced by the contagion on sovereign markets following the Greek crisis and led,

in fact, the Portuguese government to ask for bailout in April 2011 and to sign a Memorandum of Understanding with the IMF, the European Commission and the ECB that predicted the adoption of several measures, many of them with direct consequences on the banking system.

## 4.2 Empirical Strategy (Baseline Model)

In order to quantify the effect of the Global Financial Crisis and the European Sovereign Debt Crisis on credit supply in Portugal we estimate two similar models where the independent variable captures the lending relationship for a firm-bank pair both prior and during the crisis, and then replicates that for several firm-bank pairs, allowing to measure the differences on credit policies applied by banks with different exposure to the shock. In other words, we use a difference-in-difference approach where the change in the (log) credit granted by a given bank to a certain firm is the independent variable, and where the main explanatory variable is a measure of the bank's vulnerability to the crisis under analysis (being different depending on which of the two crises we are analyzing). In its simplest version our baseline model is defined as follows:

$$\text{Global Financial Crisis:} \quad \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{InterbankBorrowing} + \varepsilon \quad (1a)$$

$$\text{Sovereign Debt Crisis:} \quad \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \varepsilon \quad (1b)$$

In equation (1a) the independent variable ( $\Delta \ln(\text{Loans})$ ) is defined as the change in the log level of committed credit volume for each firm-bank pair between 2Q2007 and 2Q2009, while in equation (1b) a similar definition applies but instead for the period between 1Q2011 and 4Q2012. On the other hand, in equation (1a) the exposure of banks to the Global Financial Crisis (*InterbankBorrowing*) is measured by the ratio of total borrowing from other banks to total assets as of 2Q2007 (so, immediately prior to the crisis). In equation (1b) the log amount of sovereign debt held in the balance sheet as of 1Q2011 (*Sov. Debt Exposure*) is used as proxy for the banks' vulnerability to the European Sovereign Debt Crisis.

Considering all the advantages already exposed, we improve the model by following the methodology of Khwaja and Mian (2008), *i.e.* we include firm fixed effects (in the model below,  $\Theta$ ) in order to control for firm level demand, firm's riskiness and firm unobserved heterogeneity. This allow us to exploit the multiple relationships that several firms hold with banks in order to assess if those banks cut back credit in a different magnitude depending on the extent they were affected by the crisis.

$$\text{Global Financial Crisis:} \quad \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_2 \cdot \theta + \varepsilon \quad (2a)$$

$$\text{Sovereign Debt Crisis:} \quad \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_2 \cdot \theta + \varepsilon \quad (2b)$$

We further improve our model through the inclusion of a set of bank specific variables. *Bank Size* is defined as the log of Total Assets. *Bank Liquidity* is measured as the ratio of Short-Term Assets to Total Assets. For *Bank Capital* we use the ratio of Equity to Total Assets. To measure *Bank Profitability* we consider the Return on Assets (Net Income/Total Assets). Finally, as regarding the *Bank NPL* we take as reference the ratio of impaired loans to Total Assets. For the period of the Sovereign Debt Crisis we include an additional variable, *Bank Leverage*, which corresponds to the Loan-to-Deposits ratio.

$$\begin{aligned} \text{Global Financial Crisis: } \Delta \ln(\text{Loans}) = & \beta_1 \cdot \text{InterbankBorrowing} + \\ & \beta_{2a} \cdot \text{Bank Size} + \\ & \beta_{2b} \cdot \text{Bank Liquidity} + \\ & \beta_{2c} \cdot \text{Bank Capital} + \\ & \beta_{2d} \cdot \text{Bank Profitability} + \\ & \beta_{2e} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \end{aligned} \quad (3a)$$

$$\begin{aligned} \text{Sovereign Debt Crisis: } \Delta \ln(\text{Loans}) = & \beta_1 \cdot \text{Sov. Debt Exposure} + \\ & \beta_{2a} \cdot \text{Bank Size} + \\ & \beta_{2b} \cdot \text{Bank Liquidity} + \\ & \beta_{2c} \cdot \text{Bank Capital} + \\ & \beta_{2d} \cdot \text{Bank Leverage} + \\ & \beta_{2e} \cdot \text{Bank Profitability} + \\ & \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \end{aligned} \quad (3b)$$

In next subsections alternative specifications of this baseline model are also employed to run complementary tests. To perform the great majority of those tests we just divide the sample according to a specific criteria (e.g. 5 largest banks vs Others banks; Exporting vs Non Exporting Firms). However, additional variables are also considered, for instance, firm-specific variables. For a deeper analysis we use, therefore, three different measures intended to account for the dimension of the firm: *Firm Size (Assets)*, defined as the log of Total Assets; *Firm Size (Turnover)*, defined as the log of Total Revenues; and *Firm Size (Employees)*, defined as the log of the number of employees. We also use *Firm Age* taking into consideration the date of incorporation of the firm. For *Firm Leverage* we take the ratio of Debt to Total Assets. Finally, for the *Firm Interest Coverage* we consider the relation between operating profits and interest expenses, while for *Firm Profitability* we take the ratio of profits to Total Assets. All bank and firm specific variables are considered as of December 2006, or as of December 2010, depending if we are carrying out our study for the period of the Global Financial Crisis or for the European Sovereign Debt Crisis.

### 4.3 Data

For the purposes of our empirical research we rely on loan confidential data from the Portuguese Central Credit Register. The Central Credit Register is a database with information collected by the Bank of Portugal on all loans above 50 Euros granted by banks operating in Portugal both to non-financial corporations and households. This data is available at monthly frequency and contains detailed information on bank-firm lending relationships. For instance, it contains information both on granted and drawn amounts (amounts outstanding at the end of each month) as well other loan specific information such as the original and residual maturities, the type/purpose of the loan or the existence of collateral and personal guarantees.

For bank-specific information, we rely on two different sources. For the period of the Financial Crisis of 2007/2008 we use bank balance-sheet variables also compiled by the Bank of Portugal, while for the period of the European Sovereign Debt Crisis we rely on the same information provided by the APB - Portuguese Banking Association. In this case we only have data available for 33 banks, which we believe that does not significantly impact the results obtained as they include most Portuguese banks and foreign banks operating in Portugal and represent around 96% of the assets in the banking system.

Finally, for firm-specific information we rely on data recorded by the Central Balance-Sheet Database from the Bank of Portugal. This database contains information on main financial variables as well on other quantitative and qualitative data such as the number of employees or the industry in which it develops its main activity.

For the analysis developed on the period of the Global Financial Crisis we compute the difference on credit granted between the 2Q2007 and the 2Q2009. Bank and firm specific information is collected as of December 2006 (prior to the crisis). For the analysis on the European Sovereign Debt Crisis we compute the difference on credit granted between the 1Q2011 and the 4Q2012. We therefore exploit the reaction of banks operating in Portugal during the most acute stage of the crisis, and following the request for bailout from the Portuguese Government. Bank and firm specific information is collected as of December 2010 (prior to the sovereign shock). In both cases we restrict our sample to lending relationships established with firms that borrow from at least 2 different banks.

## 4.4 Main Results

### 4.4.1 Credit supply in Portugal during the Global Financial Crisis

The results from the estimation of equations (1a) to (3a) of our baseline model are presented in Table 2.

In Column 1 we regress our model in the simplest version, *i.e.* considering the change in our independent variable – the log level of committed credit volume for each firm-bank pair between 2Q2007 and 2Q2009 - as explained only by the level of Interbank Borrowing. The results strongly suggest that banks more dependent on funding from interbank markets prior to the crisis have reduced lending more than other banks. Indeed, the coefficient of the *InterbankBorrowing* variable is statistically significant (at the level of 1%) and indicates that an additional bank's dependence of 1% from interbank borrowing leads to a reduction in credit supply of almost 0.6%.

In Column 2 we regress our baseline model improved through the inclusion of firm-fixed effects. As we have already seen, crises like the Global Financial Crisis tend to have associated a deterioration of economic conditions and, therefore, a reduction of credit demand. Moreover, it is possible that banks with different exposure to the shock (as proxied by their reliance on interbank funding) have also a different portfolio of clients, then lending to firms, for instance, with a higher or lower credit risk. In order to control for this, by including firm fixed effects we are able to compare the evolution of credit supplied exactly to the same firm, comparing banks with different exposure to the interbank market, and thus capturing only the effects on lending volumes coming from the supply side. Similarly to the results presented before, the results reported on Column 2 also suggest that banks which borrowed more from other banks prior to the crisis have reduced credit at a larger scale. In this case, the coefficient for the explanatory variable *InterbankBorrowing* is even bigger, indicating that the impact of a 1% increase in interbank borrowing is stronger and equivalent to a decrease on bank lending above the 0.62%.

Finally, in Column 3, we run our most complete version of the baseline model, which includes several controls for bank-specific characteristics in addition to the explanatory variable *InterbankBorrowing*. All the new variables are statistically significant, meaning they are useful to explain differences in the evolution of credit supply during the period of the Global Financial Crisis. Therefore, the main question is what is the sign of their

coefficients and what do they indicate. According to the traditional literature large, liquid and well capitalized banks, as well as banks with a higher profitability, were expected to react less negatively to the crisis and not to reduce lending in the same magnitude as other banks. On the other hand, banks with a less incidence of non-performing loans were also expected to be more resilient, with that being reflected in a lower reduction on credit available for firms. Considering the results reported on Column 3, we may say that some of our estimates are surprising from the perspective of the traditional literature. As expected, we find that larger banks and more liquid banks are less prone to reduce lending, which is compatible with the traditional idea that they may have access to alternative sources of funding (besides the interbank market) and that the share of liquid assets which they hold work as a buffer if they need to expand credit. Moreover, we find that banks with a higher Return on Assets are also less likely to cut credit (a higher ROA may result in higher retained earnings and hence additional capital both to support and to fund bank lending; additionally, it may also lead to a higher risk tolerance and, so, on the easing of lending standards), with a small increase in profitability having apparently a very positive impact on credit supply. Notwithstanding, as regarding bank capitalization and the incidence of non-performing loans our results do not confirm the expectations. For the first case, according to the traditional literature we would expect that banks with higher levels of capital would reduce credit supply by less than other banks as capital works as a buffer to compensate for adverse shocks. Our results, however, suggest that it has happened exactly the opposite, which according to Kwan (2010) may be explained with the fact that a bank's capital position also reflects its risk aversion, and more risk-averse banks tend to be even more selective when lending during a period of crisis. For the case of non-performing loans, our results also contradict the theory that positively relates the quality of a portfolio of loans with credit supply. As explained by Kwan (2010), banks who present a higher ratio of non-performing loans tend to be pressured by supervisory authorities to deleverage and they face additional capital constraints due to higher provisioning for loan losses in the future. Moreover, banks which have a higher incidence of bad loans, after taking into account their bad portfolio outcomes tend to review and turn more restrictive their lending strategy. In spite of all this, during the period of the Global Financial Crisis these effects seem to have been overturned, and banks with higher ratios of bad loans did not cut back credit as much as the other banks, which may be possible explained with the adoption of a loan evergreening behavior from these institutions (Albertazzi and Marchetti, 2010; Iyer *et al.*, 2014). In line with the results

obtained for previous regressions, the results presented in Column 3 also show evidence that banks more dependent on interbank markets prior to the crisis have reduced their credit supply more significantly, with an additional bank's dependence of 1% from interbank borrowing leading to a reduction in credit supply of approximately 0.37%.

After improving our model through the inclusion of bank specific variables, we now run two additional regressions which allows us to better understand if and how the dry up in the interbank market has affected different classes of banks.

The first test we perform is intended to understand if there was any difference in the credit policies followed by the five largest banks (ranked by the assets) operating in Portugal in comparison with the remaining banks. Indeed, as there are differences between the two groups both in terms of balance-sheet characteristics as well as business models and lending strategies, we expect they have reacted differently to the developments in the interbank market. In order to perform this test, we follow a straight methodology: we first divide our sample in two, taking into account the banks that belong to one group or the other, and then regress our model separately for both samples. As reported in Table 3, our results suggest that among the five largest banks a 1% increase in interbank borrowing results in a decrease on bank lending of 0.36%, while for the remaining banks the same increase in the dependence on interbank markets leads to a decrease in credit supply of about 0.34%. This means that the impact of interbank borrowing was important for both classes of banks, but slightly more significant for the group of the five largest banks. As regarding the other bank-specific variables we find, for both groups, that banks with a higher share of liquid assets, more profitable and with a higher incidence of bad loans are less prone to reduce lending, exactly has we have concluded from previous estimations. Moreover, we find that bank size is not statistically significant for the group of smaller banks, while for the group of the largest five banks it seems to be negatively related with credit supply (although the effect is small). Finally, as regarding bank capital, among the largest five banks the results continue to suggest that better capitalized banks reduce credit supply more than other banks (giving support to the thesis that higher levels of bank capital reflect a higher risk-aversion). For the remaining banks operating in Portugal, bank capital seems to be positively correlated with credit supply, confirming the predictions of the traditional literature.



We also perform a very similar test but dividing our sample in domestic banks and foreign branches and subsidiaries. The idea here is to analyze if the reliance on interbank market impacts differently the supply of credit of banks incorporated in Portugal comparing with other banks that operate in Portugal but are an extension in here of a foreign banking group. Interestingly, we find that while among domestic banks a 1% increase in interbank borrowing leads to a decrease in credit supply of about 0.38%, the effect among foreign branches and subsidiaries has exactly of the same dimension but on the opposite direction (Table 4).

After studying how a higher vulnerability to the Global Financial Crisis have differently impacted credit supply among different classes of banks, we now turn our attention to the side of the firms in order to clarify if and how the reduction on bank lending affected all them in a similar way. With that purpose we start by running a model similar to the one defined in equation (2a) but to which we add interaction effects between interbank borrowing and firm specific variables. As mentioned in a previous section, we use three different measures which account for the dimension of the firm based on its Assets, Turnover and Employees. We also use a measure for the firm age, and additional measures intended to identify if banks tightened credit in a large scale depending on the firm's leverage, profitability and interest coverage ratio.

Results for these regressions are presented in Table 5. As illustrated in Columns 1, 2 and 3 the impact of the dry up in the interbank market on credit supply was passed at a large scale to smaller firms, independently of our measure to take into account the assets, the revenues or the number of employees. Similarly, firms with a shorter period of activity were also the most affected in the context of the credit crunch occurred during the period of the Global Financial Crisis, as reported in Column 4. Additionally, the coefficients for the other three variables – Columns 5, 6 and 7 – suggest that firms with a higher leverage, a lower capacity to repay debt (*i.e.* a higher interest coverage ratio as measured by the Interest Expenses over the Profits) and more profitable were not the ones to which banks reduced credit supply more significantly. Although this could be explained with the fact that banks support firms with increasing difficulties in order to reduce potential loan defaults (Iyer *et al.*, 2014), the true is that according to our estimations these coefficients are not statistically significant, thus suggesting (even if we may consider that strange) that

these variables were not relevant during the transmission of the liquidity shock on interbank markets.

To further strength our analysis as regarding the effects of this credit crunch among firms with different characteristics, we run three additional tests, using again the methodology of dividing the sample in two (or more) subsamples and regress our model for those subsamples separately.

In the first of these three tests, we divide our sample in Micro & Small Firms, Medium Size Firms and Big firms. We use the definition proposed by the European Commission and so, we consider as: (i) Micro & Small Firm a company with less than 50 employees and with a turnover or a balance sheet that does not exceeds the 10 million Euros; (ii) Medium Size Firm a company with less than 250 employees and with a turnover that does not exceeds the 50 million Euros or a balance sheet that does not exceeds the 43 million Euros, and which does not fulfill the criteria previously defined for Micro & Small Firm; and (iii) Big Firm a company that does not fulfill any of the two criteria previously defined. Results are reported in Table 6 and in accordance to our previous findings suggest that the magnitude of the credit tightening arising from the shock on interbank market was higher for smaller firms. Indeed, while for Big Firms a 1% increase in interbank borrowing results in a decrease on bank lending of approximately 0.36%, for Medium Size Firms the effect is estimated in 0.38% and for Micro&Small Firms in 0.40%. These results are therefore an additional evidence of the financing problems faced by SMEs in Portugal in the last years.

For our second test we divide the sample in exporting and non-exporting firms. We believe that in general the higher capacity to export is seen as an (additional) indicator of the quality and the strength of the company, such that we expect to find a lower exposure of these firms to the credit crunch occurred during the period of the Global Financial Crisis. For this purposes, we follow the rule defined by the Bank of Portugal and classify a company as an exporting firm if at least 50% of its Revenues correspond to exports, or at least 10% in the cases when the value of exports is equal or exceeds the 150 thousand Euros. Results are reported in Table 7 and confirm our expectations, although we do not find such a significant difference among the two kinds of firms. Indeed, for Non-Exporting Firms a 1% increase in interbank borrowing results in a decrease on bank

lending of approximately 0.38% while for Exporting Firms the decrease is lower, corresponding to approximately 0.34%.

Finally, considering that the Global Financial Crisis was associated to problems in the subprime sector, and with repercussions in all real estate market and also on the construction industry, and considering the problems faced since then by Portuguese companies operating on such sectors, we test to which extent credit supply was reduced in a larger extent to those firms but we find no significant evidence of that (Table 8).

#### ***4.4.2 Credit supply in Portugal during the European Sovereign Debt Crisis***

The results from the estimation of equations (1b) to (3b) of our baseline model are presented in Table 9.

Similarly to what we have done for the period of the Global Financial Crisis we start by running our baseline model in its simplest version and, then, we regress its improved version through the inclusion of firm-fixed effects. According to the estimates for these two versions of the baseline model (Columns 1 and 2), banks more exposed to sovereign debt do not seem to have reduced credit supply more than did the other banks. Indeed, in the first case, the coefficient of our main explanatory variable – which captures the banks' vulnerability to the European Sovereign Debt Crisis – is not even statistically significant. On the other hand, in the second case, the coefficient is positive suggesting an effect exactly the opposite we would expect.

When we further improve the model by including additional bank-specific variables (Column 3) we arrive to different conclusions. Specifically regarding the coefficient of the variable *Sov. Debt Exposure* it turns negative, being statistically significant at the 1% level. For a 1% increase in the sovereign debt exposure we find that banks decrease credit supply by approximately 0.05%. Therefore, and according to our expectations, we find evidence that banks more exposed to the Sovereign Debt Crisis have reduced lending more than other banks. Regarding the significance and the information contained on the coefficients of the other explanatory variables we have that - as we have also found for the period of the Global Financial Crisis – large and more profitable banks react less negatively to the sovereign shock and do not reduce lending in the same magnitude of other banks. Differently, however, we find there is a negative correlation between credit supply and the variables related to liquidity and the incidence of non-performing loans. On this last variable, the results are in accordance with the traditional literature as banks with a portfolio of loans of lower quality are expected to reduce lending more than other banks since they suffer the pressure of supervisory authorities to deleverage and they face additional capital constraints due to higher provisioning for loan losses in the future. Finally, regarding the variables related with bank capitalization and leverage we find that the first is not statistically significant while the second is economically significant, therefore suggesting they do not explain any differences in bank lending.

In order to complement our analysis on the period of the European Sovereign Debt Crisis we further perform two additional tests. For instance, and exactly as we have done during our analysis on the period of the Global Financial Crisis, we test whether the effect of an additional exposure to the Sovereign Debt Crisis was transmitted to the supply of credit in a different way among the five largest banks operating in Portugal and among the domestic banks (Table 10).

For the first case, our results do not indicate that among the five largest banks the effect of a higher exposure to the sovereign debt has impacted credit supply in a scale larger than the one we find when considering the full sample. For instance, in this regard we find that a 1% increase in sovereign debt exposure leads to a decrease in credit supply of about 0.057%, which compares with the 0.055% effect we found when analyzing the entire sample. A possible explanation for this has to do with the fact that a huge part of our observations correspond exactly to observations for these five largest banks.

Regarding the second test, the results suggest that the transmission of the sovereign debt shock was significantly more intense among the domestic banks. Indeed, among such class of banks we find that a 1% increase in sovereign debt exposure leads to a decrease in credit supply of about 0.24%.

## 5. Research in progress

Looking to improve our research for publishing purposes, we are currently collecting additional data which will allow us to run in near time new complementary analysis as well to improve some of the analysis already performed and presented in here. All the methodology to follow and the new models to run were already defined (and are presented below), now depending just on the collection of the respective data.

The main lines of investigation under current research are the following: A) Heterogeneity in the transmission of the sovereign shock on credit supplied to firms; B.1) The effect of the liquidity shock in interbank markets on the supply of short term loans vs medium and long term loans; B.2) The effect of the sovereign debt shock on the supply of short term loans vs medium and long term loans; C.1) The evolution of loan interest rates charged by banks with different exposure to the Global Financial Crisis; C.2) The evolution of loan interest rates charged by banks with different exposure to the European Sovereign Debt Crisis.

### A) Heterogeneity in the transmission of the sovereign shock on credit supplied to firms

#### i) Accounting for Firm specific variables

$$a. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Size (Assets)}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

$$b. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Size (Turnover)}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

$$c. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Size (Employees)}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

$$d. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Age}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

$$e. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Leverage}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

$$f. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Interest Coverage}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

$$g. \Delta \ln(\text{Loans}) = \beta_1. \text{Sov. Debt Exposure} + \beta_2. \text{Firm Profitability}. \text{Sov. Debt Exposure} + \beta_3. \theta + \varepsilon$$

, where:

- $\Delta \ln(\text{Loans})$  – Change in the log level of committed credit volume for each firm-bank pair between 1Q2011 and 4Q2012;
- Sov. Debt Exposure -  $\ln(\text{Exposure to GIIPS Sovereign Debt})$ , as of 1Q2011;
- Firm Size (Assets) -  $\ln(\text{Total Assets})$ , as of December 2010;
- Firm Size (Turnover) -  $\ln(\text{Sales+Services})$ , as of December 2010;
- Firm Size (Employees) -  $\ln(\#\text{employees})$ , as of December 2010;
- Firm Age –  $\ln(1+\text{Age})$ , as of December 2010;
- Firm Leverage - Debt/Equity, as of December 2010;
- Firm Interest Coverage –  $\text{Interest Expenses/Total Profits}$ , as of December 2010;
- Firm Profitability –  $\text{Total Profits/Assets}$ , as of December 2010;
- $\Theta$  - firm fixed effects.

#### ii) Micro&Small Firms vs Medium Size Firms vs Big firms

$$a) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF MICRO\&SMALL FIRM}$$

$$b) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF MEDIUM SIZE FIRM}$$

$$c) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF BIG GIRM}$$

#### iii) Exporting Firm vs Non-Exporting Firm

$$a) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF EXPORTING FIRM}$$

$$b) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF NON-EXPORTING}$$

#### iv) Construction and Real Estate Sectors

$$a) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF CAE 41, 42, 43}$$

$$b) \Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon \text{ IF CAE 68}$$

**B.1) The effect of the sovereign debt shock on the supply of short term loans vs medium and long term loans**

a)  $\Delta \ln(\text{Loans}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Profitability} + \beta_{2e} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon$   
IF SHORT-TERM LOAN

b)  $\Delta \ln(\text{Loans}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Profitability} + \beta_{2e} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon$   
IF MEDIUM AND LONG TERM LOAN

**B.2) The effect of the sovereign debt shock on the supply of short term loans vs medium and long term loans**

a)  $\Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon$  IF SHORT-TERM LOAN

b)  $\Delta \ln(\text{Loans}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \beta_3 \cdot \theta + \varepsilon$  IF MEDIUM AND LONG TERM LOAN

**C.1) The evolution of loan interest rates charged by banks with different exposure to the Global Financial Crisis**

a)  $\Delta(i_{STLoans\_small}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$

b)  $\Delta(i_{STLoans\_big}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$

c)  $\Delta(i_{MTLoans\_small}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$

d)  $\Delta(i_{MTLoans\_big}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$

e)  $\Delta(i_{LTLoans\_small}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$

f)  $\Delta(i_{LTLoans\_big}) = \beta_1 \cdot \text{InterbankBorrowing} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$



, where:

- $\Delta(i_{STLoans\_small})$  – Change in the average (percentage) interest rate charged by each bank on short-term loans (maturity up to 12 months) up to €1 million between 2Q2007 and 2Q2009;
- $\Delta(i_{STLoans\_big})$  – Change in the average (percentage) interest rate charged by each bank on short-term loans (maturity up to 12 months) above €1 million between 2Q2007 and 2Q2009;
- $\Delta(i_{MTLoans\_small})$  – Change in the average (percentage) interest rate charged by each bank on medium-term loans (maturity between 1 and 5 years) up to €1million between 2Q2007 and 2Q2009;
- $\Delta(i_{MTLoans\_big})$  – Change in the average (percentage) interest rate charged by each bank on medium-term loans (maturity between 1 and 5 years) above €1 million between 2Q2007 and 2Q2009;
- $\Delta(i_{LTLoans\_small})$  – Change in the average (percentage) interest rate charged by each bank on long-term loans (maturity over 5 years) up to €1 million, between 2Q2007 and 2Q2009;
- $\Delta(i_{LTLoans\_big})$  – Change in the average (percentage) interest rate charged by each bank on long-term loans (maturity over 5 years) above €1 million, between 2Q2007 and 2Q2009;
- Interbank Borrowing - Ratio of total interbank borrowing, as of 2Q2007;
- Bank Size -  $\ln(\text{Total Assets})$ , as of 2Q2009;
- Bank Liquidity – Short term assets/Total assets, as of 2Q2007;
- Bank Capital –Equity/Total Assets, as of 2Q2007;
- Bank Leverage - Debt/Total Assets, as of 1Q2007;
- Bank Profitability – ROA (Net Income/Total Assets), as of 2Q2007;
- Bank NPL – Impaired Loans/Total Assets, as of 2Q2007;

## **C.2) The evolution of loan interest rates charged by banks with different exposure to the European Sovereign Debt Crisis**

$$a) \Delta(i_{STLoans\_small}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$$

$$b) \Delta(i_{STLoans\_big}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$$

$$c) \Delta(i_{MTLoans\_small}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$$

$$d) \Delta(i_{MTLoans\_big}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$$

$$e) \Delta(i_{LTLoans\_small}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$$

$$f) \Delta(i_{LTLoans\_big}) = \beta_1 \cdot \text{Sov. Debt Exposure} + \beta_{2a} \cdot \text{Bank Size} + \beta_{2b} \cdot \text{Bank Liquidity} + \beta_{2c} \cdot \text{Bank Capital} + \beta_{2d} \cdot \text{Bank Leverage} + \beta_{2e} \cdot \text{Bank Profitability} + \beta_{2f} \cdot \text{Bank NPL} + \varepsilon$$

, where:

- $\Delta(i_{STLoans\_small})$  – Change in the average (percentage) interest rate charged by each banks on short-term loans (maturity up to 12 months) up to €1 million between 1Q2011 and 4Q2012;
- $\Delta(i_{STLoans\_big})$  – Change in the average (percentage) interest rate charged by each banks on short-term loans (maturity up to 12 months) above €1 million between 1Q2011 and 4Q2012;
- $\Delta(i_{MTLoans\_small})$  – Change in the average (percentage) interest rate charged by each banks on medium-term loans (maturity between 1 and 5 years) up to €1million between 1Q2011 and 4Q2012;
- $\Delta(i_{MTLoans\_big})$  – Change in the average (percentage) interest rate charged by each banks on medium-term loans (maturity between 1 and 5 years) above €1 million between 1Q2011 and 4Q2012;
- $\Delta(i_{LTLoans\_small})$  – Change in the average (percentage) interest rate charged by each banks on long-term loans (maturity over 5 years) up to €1 million, between 1Q2011 and 4Q2012;
- $\Delta(i_{LTLoans\_big})$  – Change in the average (percentage) interest rate charged by each banks on long-term loans (maturity over 5 years) above €1 million, between 1Q2011 and 4Q2012;
- Sov. Debt Exposure -  $\ln(\text{Exposure to GIIPS Sovereign Debt})$ , as of 1Q2011;
- Bank Size -  $\ln(\text{Total Assets})$ , as of 1Q2011;
- Bank Liquidity –  $\text{Short term assets}/\text{Total assets}$ , as of 1Q2011;
- Bank Capital –  $\text{Equity}/\text{Total Assets}$ , as of 1Q2011;
- Bank leverage -  $\text{Debt}/\text{Total Assets}$ , as of 1Q2011;
- Bank Profitability –  $\text{ROA (Net Income}/\text{Total Assets)}$ , as of 1Q2011;
- Bank NPL –  $\text{Impaired Loans}/\text{Total Assets}$ , as of 1Q2011;

## 6. Main Conclusions and Further Research

In this paper we study the impact of the Global Financial Crisis and the European Sovereign Debt Crisis on the lending activity of banks operating in Portugal. With that purpose we analyze whether some banks, more vulnerable to such crises, have behaved differently from other banks in the sense they cut back credit at a larger scale. In order to identify the vulnerability of a bank to each one of the crisis, we use two different measures. For the period of the Global Financial Crisis we take into account the ratio of interbank borrowing. For the period of the European Sovereign Debt Crisis we use the exposure to the sovereign market as measured by the amount of sovereign debt hold in the balance sheet. Additionally, to disentangle the effects of supply and demand factors on credit developments we follow the firm-fixed effects approach introduced by Khwaja and Mian (2008), which means that we compare exactly for the same firm the volumes of credit granted by two or more banks that have been affected to a different degree by the crisis.

To perform this analysis we rely on loan confidential data from the Portuguese Central Credit Register. This detailed information on bank-firm lending relationships is also combined with bank and firm specific information.

Main results suggest that following the Global Financial Crisis and the European Sovereign Debt Crisis, banks more vulnerable to such crises have reduced lending more than other banks. Regarding the period of the Global Financial Crisis, we find that an additional bank's dependence of 1% from interbank borrowing leads to a reduction in credit supply of approximately 0.37%, after controlling for bank specific variables. Moreover, we find that larger banks, more liquid banks and more profitable banks are less prone to reduce lending while banks with a higher level of capital and a higher incidence of non-performing are more likely to do that, with that reflecting their risk-aversion and propensity to loan evergreening. Additionally, we find that the negative effect of Interbank Borrowing in credit supply is higher among the five largest banks. Exploiting the magnitude of these effects as depending on firm specific characteristics, we also find that the impact of the dry up in the interbank market on credit supply was passed at a large scale to smaller firms, as well to the younger ones, while the reduction in lending was less significant for exporting companies. Regarding the European Sovereign Debt Crisis, we find that a 1% increase in the sovereign debt exposure leads banks to decrease credit

supply by approximately 0.05%. Similarly to our findings for the period of the Global Financial Crisis, we also conclude that large and more profitable banks react less negatively to the sovereign shock and do not reduce lending in the same magnitude of other banks. Additionally to this, our results suggest that the transmission of the sovereign debt shock was significantly more intense among the domestic banks. Indeed, among such class of banks we find that a 1% increase in sovereign debt exposure leads to a decrease in credit supply of about 0.24%.

Concerning the recent developments on credit markets, and considering the only recent attention granted to the issue, several topics still to be investigated, therefore representing an interesting line for future research. For instance, regarding the specific case of Portugal, it could be interesting to investigate how credit supply reacted to the main measures introduced by the European Central Bank. Indeed, one of the main problems of the monetary policy followed in the Euro-Area is that due to the fragmentation of the market “one size does not fit all”, *i.e.* the same measure may not be effective for all its members. Another interesting topic for research would be to study the transmission (both in terms of dimension and time lag) of funding costs to credit granted and interest rates charged. Additionally, and similarly to the study developed by Acharya *et al.* (2015), it could be interesting to measure the impact of the dry up in the interbank market and the sovereign debt shock on real variables (GDP growth, employment, investment, etc) as transmitted through the bank lending channel. Finally, a study similar to ours could be performed also for the case of credit supplied to households.

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## 8. Annex: Tables

*Table 2: Credit Supply during the Global Financial Crisis / Baseline Model*

	(1)	(2)	(3)
<i>Interbank borrowing</i>	-0.5874613*** (0.0102387)	-0.6233045*** (0.0124806)	-0.3715585*** (0.0171625)
<i>Bank size</i>			0.0702364*** (0.0022786)
<i>Bank liquidity</i>			0.3370019*** (0.0370624)
<i>Bank capital</i>			-0.5427315*** (0.1376231)
<i>Bank profitability</i>			11.25613*** (1.459048)
<i>Bank NPL</i>			3.672901*** (0.2491215)
Firm Fixed Effects	No	Yes	Yes
Number of observations	218.024	218.024	217.982
Adjusted R2	0.0149	0.0149	0.0238

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively



**Table 3: Credit Supply during the Global Financial Crisis / 5 Largest Banks vs Other Banks**

	<i>All banks</i>	<i>5 largest banks</i>	<i>Other banks</i>
<i>Interbank borrowing</i>	-0.3715585 <sup>***</sup> (0.0171625)	-0.3621666 <sup>***</sup> (0.0177851)	-0.3448688 <sup>***</sup> (0.1290718)
<i>Bank size</i>	0.0702364 <sup>***</sup> (0.0022786)	-0.0737118 <sup>***</sup> (0.0024422)	-0.012015 (0.0174155)
<i>Bank liquidity</i>	0.3370019 <sup>***</sup> (0.0370624)	0.351447 <sup>***</sup> (0.0383735)	1.054429 <sup>***</sup> (0.2817802)
<i>Bank capital</i>	-0.5427315 <sup>***</sup> (0.1376231)	-0.5391061 <sup>***</sup> (0.1415428)	4.737485 <sup>***</sup> (1.231249)
<i>Bank profitability</i>	11.25613 <sup>***</sup> (1.459048)	11.27755 <sup>***</sup> (1.491173)	40.50616 <sup>***</sup> (13.79235)
<i>Bank NPL</i>	3.672901 <sup>***</sup> (0.2491215)	3.536379 <sup>***</sup> (0.2540007)	14.11021 <sup>***</sup> (2.730016)
Firm Fixed Effects	Yes	Yes	Yes
Number of observations	217.982	204.474	13.508
Adjusted R2	0.0238	0.0247	0.0097

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 4: Credit Supply during the Global Financial Crisis / Domestic vs Non Domestic Banks**

	<i>All banks</i>	<i>Domestic Banks</i>	<i>Foreign Branches and Subsidiaries</i>
<i>Interbank borrowing</i>	-0.3715585 <sup>***</sup> (0.0171625)	-0.3871809 <sup>***</sup> (0.0177851)	0.3874268 <sup>***</sup> (0.1290718)
<i>Bank size</i>	0.0702364 <sup>***</sup> (0.0022786)	.06268 <sup>***</sup> (0.0024422)	0.2014643 (0.0174155)
<i>Bank liquidity</i>	0.3370019 <sup>***</sup> (0.0370624)	0.2221883 <sup>***</sup> (0.0383735)	0.6244119 <sup>***</sup> (0.2817802)
<i>Bank capital</i>	-0.5427315 <sup>***</sup> (0.1376231)	-0.4602786 <sup>***</sup> (0.1415428)	1.922311 <sup>***</sup> (1.231249)
<i>Bank profitability</i>	11.25613 <sup>***</sup> (1.459048)	7.342144 <sup>***</sup> (1.491173)	-49.84685 <sup>***</sup> (13.79235)
<i>Bank NPL</i>	3.672901 <sup>***</sup> (0.2491215)	3.676579 <sup>***</sup> (0.2540007)	2.540714 <sup>***</sup> (2.730016)
Firm Fixed Effects	Yes	Yes	Yes
Number of observations	217.982	168.986	48.977
Adjusted R2	0.0238	0.0247	0.0441

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 5: Credit Supply during the Global Financial Crisis / Differences on credit granted across firms**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Interbank borrowing</i>	-2.25336*** (0.1072225)	-1.712026*** (0.1061598)	-0.8554626*** (0.0274829)	-0.9707708*** (0.0418364)	-0.6460308*** (0.0234731)	-0.6176666*** (0.0142672)	-0.650853*** (0.0132593)
<i>Firm Size (Assets)*Interbank borrowing</i>	0.1173374*** (0.0077896)						
<i>Firm Size (Turnover)*Interbank borrowing</i>		0.0780517*** (0.0077795)					
<i>Firm Size (Employees)*Interbank borrowing</i>			0.0834106*** (0.0101056)				
<i>Firm Age*Interbank borrowing</i>				0.1398955*** (0.0160804)			
<i>Firm Leverage*Interbank borrowing</i>					0.0353916 (0.0230622)		
<i>Firm Interest Coverage*Interbank borrowing</i>						-6.88E-06 (0.0000306)	
<i>Firm Profitability*Interbank borrowing</i>							-5.51e-06 (0.0000311)
<b>Firm Fixed Effects</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Number of observations</b>	<b>194.676</b>	<b>188.756</b>	<b>186.845</b>	<b>217.973</b>	<b>162.850</b>	<b>162.710</b>	<b>194.582</b>
<b>Adjusted R2</b>	<b>0.0145</b>	<b>0.0169</b>	<b>0.0165</b>	<b>0.0129</b>	<b>0.0138</b>	<b>0.0142</b>	<b>0.0159</b>

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 6: Credit Supply during the Global Financial Crisis / Firms by Size**

	<i>Micro&amp;Small Firms</i>	<i>Medium Size Firms</i>	<i>Big firms</i>
<i>Interbank borrowing</i>	-0.3983169 <sup>***</sup> (0.0195179)	-0.3832666 <sup>***</sup> (0.0646962)	-0.3335938 <sup>***</sup> (0.0337043)
<i>Bank size</i>	0.080448 <sup>***</sup> (0.0025704)	-0.0505518 <sup>***</sup> (0.0646962)	0.0681724 <sup>***</sup> (0.004534)
<i>Bank liquidity</i>	0.3730969 <sup>***</sup> (0.0428406)	0.2586668 <sup>**</sup> (0.1507883)	0.1792864 <sup>***</sup> (0.0686095)
<i>Bank capital</i>	-0.7091534 <sup>***</sup> (0.15555)	0.8157837 (0.1507883)	-0.2180836 (0.2574626)
<i>Bank profitability</i>	13.05786 <sup>***</sup> (1.708964)	-1.010664 (5.400746)	9.414645 <sup>***</sup> (2.647844)
<i>Bank NPL</i>	3.781084 <sup>***</sup> (0.2893017)	5.241335 <sup>***</sup> (0.7674683)	2.294523 <sup>***</sup> (0.4894338)
Firm Fixed Effects	Yes	Yes	Yes
Number of observations	165.751	15.666	65.136
Adjusted R2	0.0304	0.0118	0.0213

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 7: Credit Supply during the Global Financial Crisis / Exporting vs Non Exporting Firms**

	<i>Exporting Company</i>	<i>Non-Exporting Company</i>
<i>Interbank borrowing</i>	-0.3418908*** (0.0300116)	-0.382206*** (0.020961)
<i>Bank size</i>	0.0688303*** (0.0040218)	0.0715364*** (0.0027693)
<i>Bank liquidity</i>	0.1805444*** (0.0629654)	0.4217657** (0.0459093)
<i>Bank capital</i>	-0.3856333 (0.2353447)	-0.6370852 (0.1696866)
<i>Bank profitability</i>	9.052892*** (2.404777)	12.84432 (1.838357)
<i>Bank NPL</i>	2.435147*** (0.4290964)	4.33416*** (0.3061819)
Firm Fixed Effects	Yes	Yes
Number of observations	77.563	140.419
Adjusted R2	0.0217	0.0254

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 8: Credit Supply during the Global Financial Crisis / Construction and Real Estate**

	<i>CAE 41+42+43 (Construction)</i>	<i>CAE 68 (Real Estate)</i>
<i>Interbank borrowing</i>	-0.3912978 <sup>***</sup> (0.0382823)	-0.3680432 <sup>**</sup> (0.0187633)
<i>Bank size</i>	0.0608539 <sup>***</sup> (0.0050462)	0.065546 <sup>***</sup> (0.0024732)
<i>Bank liquidity</i>	0.3304769 <sup>***</sup> (0.0860132)	0.3539597 <sup>*</sup> (0.0405723)
<i>Bank capital</i>	-0.7533787 <sup>**</sup> (0.3148582)	-0.7937394 (0.1504316)
<i>Bank profitability</i>	8.390679 <sup>**</sup> (3.306159)	11.54423 (1.602447)
<i>Bank NPL</i>	4.030568 <sup>***</sup> (0.5443879)	3.743886 <sup>***</sup> (0.2776973)
Firm Fixed Effects	Yes	Yes
Number of observations	46.355	174.481
Adjusted R2	0.0177	0.0231

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 9: Credit Supply during the European Sovereign Debt Crisis / Baseline Model**

	(1)	(2)	(3)
<i>Sov. Debt Exposure</i>	0.0003015 (0.0033583)	0.0143644*** (0.0044474)	-0.0545068*** (0.0138206)
<i>Bank size</i>			0.0889383*** (0.0264452)
<i>Bank liquidity</i>			-12.08496*** (2.112461)
<i>Bank capital</i>			0.0961255 (0.7041308)
<i>Bank leverage</i>			-2.48E-06** (1.26E-06)
<i>Bank profitability</i>			12.4222** ( 5.549773)
<i>Bank NPL</i>			-2.071088*** (0.7371937)
Firm Fixed Effects	No	Yes	Yes
Number of observations	72.157	72.157	72.157
Adjusted R2	0.0000	0.0000	0.0064

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively

**Table 10: Credit Supply during the European Sovereign Debt Crisis / 5 Largest Banks vs Other Banks**

	<i>All banks</i>	<i>5 Largest Banks</i>	<i>Domestic Banks</i>
<i>Sov. Debt Exposure</i>	-0.0545068 <sup>***</sup> (0.0138206)	-.0570334 <sup>***</sup> (0.0142597)	-0.2352569 <sup>***</sup> (0.0186682)
<i>Bank size</i>	0.0889383 <sup>***</sup> (0.0264452)	0.0922203 <sup>***</sup> (0.0278347)	0.3143488 <sup>***</sup> (0.0336926)
<i>Bank liquidity</i>	-12.08496 <sup>***</sup> (2.112461)	-12.28438 <sup>***</sup> (2.203326)	-7.474185 <sup>***</sup> (2.40635)
<i>Bank capital</i>	0.0961255 (0.7041308)	-0.0993336 (0.7353858)	-5.200277 (0.840139)
<i>Bank leverage</i>	-2.48E-06 <sup>**</sup> (1.26E-06)	-2.43E-06 <sup>*</sup> (1.29E-06)	-6.65E-06 <sup>**</sup> (1.26E-06)
<i>Bank profitability</i>	12.4222 <sup>**</sup> (5.549773)	11.73163 <sup>**</sup> (5.707363)	61.26688 <sup>**</sup> (7.126328)
<i>Bank NPL</i>	-2.071088 <sup>***</sup> (0.7371937)	-1.987082 <sup>***</sup> (0.7675512)	-3.310345 <sup>***</sup> (0.7754462)
Firm Fixed Effects	Yes	Yes	Yes
Number of observations	72.157	69.625	59.201
Adjusted R2	0.0064	0.0064	0.0152

\*\*\*, \*\* and \* indicate that the variable is significant at 1%, 5% and 10%, respectively