Residential Property Loans and Performance during Property Price Booms: Evidence from European Banks

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Abstract

Understanding the performance of banks is of the utmost relevance, because of the impact of this sector on economic growth and financial stability. Of all the different assets that make up a bank portfolio, the residential mortgage loans constitute one of its main. Using the dynamic panel data method, we analyse the influence of residential mortgage loans on bank profitability and risk, using a sample of 555 banks in the European Union (EU-15), over the period from 1995 to 2008.

We find that banks with larger weights of residential mortgage loans show lower credit risk in good times. This result explains why banks rush to lend on property during booms due to the positive effects it has on credit risk. The results show further that credit risk and profitability are lower during the upturn in the residential property price cycle. The results also reveal the existence of a non-linear relationship (**U**-shaped marginal effect), as a function of bank's risk, between profitability and the residential mortgage loans exposure. For those banks that have high credit risk, a large exposure of residential mortgage loans is associated with higher risk-adjusted profitability, through lower risk. For banks with a moderate/low credit risk, the effects of higher residential mortgage loan exposure on its risk-adjusted profitability are also positive or marginally positive.

Keywords: Residential Property Prices; Mortgage Loans; Bank Performance; Dynamic Panel Estimation

1. Introduction

The recent turmoil in the world's financial system, which began in the US mortgage credit markets, shows the very close relationship between property price changes and the financial sector health. Slumps in the property market tend to follow and exacerbate, or spur banking crises[1], as demonstrated by Allen and Gale (2000) and proven by several historical crises[2], the most recent example of which is the subprime crisis.

There is almost universal agreement that the fundamental cause of the subprime crisis was the combination of credit boom and housing bubble. Pezzuto (2008) refers the low interest rates, high level of leverage, "credit euphoria" of both mortgage lenders and borrowers and a more aggressive short-term orientation as the combined factors which have probably strongly contributed to the subprime crisis. Acharya *et al.* (2011) refer that when the "bubble" burst, a severe economic crisis was bound to come. These events resulted in a collapse of the banking industry[3], stock market crashes, a large decrease in liquidity on the credit market, economic recession and furthermore they have engulfed sovereign insolvency in almost all countries. Moreover, this crisis affected real economies as well as financial markets, resulting for example, in drops in productivity growth, increases in unemployment rate, and a decrease in international trade. Horta *et al.* (2008) and Hwang *et al.* (2010) examined the contagion effects of US subprime crisis on international stock markets. Hwang *et al.* (2010) found evidence of financial contagion during the US subprime crisis not only in emerging markets but also in developed markets (the case of European countries). Horta *et al.* (2008) using copula models found that markets in Canada, Japan, Italy, France and UK display significant levels of contagion. For other two countries analyzed (Germany and Portugal) the null hypothesis of absence of contagion could not be rejected. Finally, Verick and Islam (2010) refer the Baltic States, Ireland and Spain as the European Countries that suffered a severe labour market impact and economic contraction as a result of the subprime crisis. Germany and Austria appear in the opposite situation.

Of all the different assets that comprise banks' portfolios, real estate assets are particularly important for two reasons. Firstly, mortgage loans represent one of its most

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1 Herring and Wachter (1999) state that "*Real Estate Cycles may occur without banking crises and banking crises may occur without real estate cycles. But the two phenomena are correlated in remarkable number of instances ranging over a wide variety of institutional arrangements, in both advanced industrial nations and emerging economies*".

2 For example, in the US and Scandinavia (late 80s), Mexico and Japan (early 90s) and Southeast Asia (1998). Please refer to Hilbers *et al.*, 2001.

3 The list of banks that have been affected by the 2007-2012 global financial crisis can be seen in http://en.wikipedia.org/wiki/List_of_bankrupt_or_acquired_banks_during_the_subprime_mortgage_crisis

important asset categories. Within the EU-15, for the period from 2001 to 2008, the weight of residential property loans in total loans varied from a maximum value of 33% in 2003 to a minimum of 21% in 2008 (ECB, 2005 and 2010). Secondly, the banks' exposure to the real estate sector is even larger owing to the widespread use of these assets as collateral for other types of loans.

Herring and Wachter (1999) state that during an upswing of real estate price movements, banks tend to underestimate the default risk of loans directly or indirectly related to real estate. The existence of moral hazard and disaster myopia, caused by high competition and size growth, following the liberalisation of the banking sector and by the loss of institutional memory regarding the possibility of property prices collapse, tends to induce banks to take excessive risks whereas the risk premium may be insufficient to cover potential losses[4]. Jimenez *et al.* (2006) state that during booms riskier borrowers obtain credit and collateral requirements decreases. Dell'Ariccia *et al.* (2008) also found evidence of a decrease in lending standards associated with substantial increases in the number of loan applications. The authors show that lending standards declined more in areas that experienced faster credit growth. They also found that the entry of new lenders contributed to the decline in lending standards.

Gentle *et al.* (1994) studied the reasons for the high number of families with debts in the United Kingdom in the early 90s. The authors report a constantly expanding mortgage-financed policy that they called the "property owning democracy" which, after the collapse of property prices, led to a "nation of debtors". This phenomenon of "negative equity"[5] has also been observed by White (2010a, 2010b), who states that in the US, the collapse of property prices resulted in an increasing number of defaults, since the property market prices fell below the original mortgage advance used to buy the property[6].

Despite extensive literature on the relationship between bank loans and real estate prices at a macroeconomic level, few studies have been undertaken on the impact of real estate prices on bank profitability and credit risk. Davis and Zhu (2009) argue specifically that most studies fail to highlight the role that real estate may play in the performance of

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[4] The Economist, 2003, reveals that the "*six countries where houses appear to be overvalued (America, Britain, Australia, Ireland, the Netherlands and Spain) also share another bubble-like symptom: an explosion in mortgage borrowing in recent years. ... In the Netherlands the average new mortgage there is 110% of the value of a home, because lenders are happy to finance all the purchasing costs, including stamp duty and fees. ... This means that if prices were to drop, more households would be left with debts exceeding the value of their home than were a decade ago*."

[5] This refers to the situation whereby the market value of the property on the mortgage completion date is lower than the value of the capital owing to the bank.

[6] The author calls this decision "*strategic default*".

the banking sector. Furthermore results may be biased given that most studies examine separately the factors that determine either bank profitability or risk.

Studies on bank profitability (see, for example, Maudos and Guevara, 2004 and Valverde and Fernández, 2007) or bank credit risk (see, for example, Salas and Saurina, 2002), examine the role of macroeconomic factors (such as GDP growth and level of indebtedness) or microeconomic factors (such as market competition conditions, interest rate risk, credit risk, liquidity risk, default risk and operating costs), but ignore or inadequately portray the specific risks associated with the banks' real estate loan portfolio (see Salas and Saurina, 2002)[7].

One of the exceptions in the literature is the study by Davis and Zhu (2009) which analyses the effect of commercial property price changes on the risk and profitability of a group of banks from industrialised economies. The authors state that performance of banks and bank loans are strongly correlated with asset price changes, and particularly with real estate asset prices, owing to banks' large direct and indirect exposure to the real estate sector.

The present study differs from the study undertaken by Davis and Zhu (2009) on three key points. Firstly, it differs with regard to the category of real estate assets analysed. We analyse the importance of the exposure to residential mortgage loans and changes in real estate prices on bank risk and return, instead of commercial real estate assets. Secondly, the sample of banks analysed relates to the EU-15 markets whilst Davis and Zhu (2009) analyse a sample of 904 banks from several industrialised counties (including 8 EU-15 countries). Thirdly, we propose a model of bank profitability vis a vis bank exposure to residential mortgage loans that takes into account the level of bank credit risk.

We use dynamic panel data methods to estimate the influence of residential mortgage loans on bank profitability and risk, using a sample of 555 banks in the EU-15, over the period from 1995 to 2008. The results suggest that a higher exposure to residential mortgage loans on the balance sheet means lower credit risk for banks in good times. The results obtained show further a reduction in both credit risk and profitability for banks, during the upturn in the price cycle pertaining to the residential property sector. Furthermore, we observe a non-linear relationship (U-shaped marginal effect), function of bank's risk, between profitability and the balance-sheet exposure to residential mortgage

[7] Salas and Saurina (2002) state that "*within the loan category there are different levels of risk, with the riskiest loans being those to the real estate and construction sectors, followed by commercial and industrial loans and, finally, household mortgage*".

loans. For those banks that have high credit risk, higher exposure to residential mortgage loans results in higher risk-adjusted profitability, since residential mortgage loans allow to lower credit risk. For banks with a moderate/low credit risk, the effects of higher exposure to residential mortgage loans on profitability are also positive or marginally positive.

In the next section, we briefly characterise the European residential mortgage markets and provide a brief review of the factors determining bank profitability and credit risk, with a special emphasis on those pertaining to the real estate market. In section 3 we present the research questions and the specification of the empirical models proposed. Section 4 sets out the results of the empirical analysis. Conclusions are presented in Section 5.

2. Determinants of Bank Profitability and Credit Risk

2.1. The European Residential Mortgage Markets

Tsatsaronis and Zhu (2004) state that there are significant differences between the EU countries with regard to the characteristics of the mortgage market[8]. These institutional differences might explain the differences in the volatility of prices and influence differential banks' risk-taking across countries.

INSERT FIGURE 1

In Europe, retail deposits are the main source of funding for residential mortgage loans, representing 2/3 of the residential mortgage loans. Mortgage bond issues are the second most important funding resource, after deposits. Data obtained from the European Mortgage Federation (EMF) show that in 2009, three countries accounted for an 88% slice of the entire European mortgage bond market. In Germany "*Hypotheken Pfandbriefe*" represented 44% of all the mortgage bonds issued in the EU, followed by Denmark (29%) and Sweden (15%)[9].

[8] Those aspects relate to several aspects such as the prevailing interest rate in the mortgage market; the possibility of Equity withdrawal; the level of LTV (Loan-to-Value) ratios; the accepted property evaluation methods and the possibility of asset securitization.

[9] Acharya *et al.* (2011) identify the existence of three major funding models for mortgage credit in developed economies. "*The first one is the deposit-based system, where banks originate mortgages funded by deposits and hold the mortgages on their books. This "old model of banking" is still the dominant type of mortgage finance in most countries outside the US. The second type is the "new model of banking" where loans are no longer held on banks' balance sheets, but are originated*

Coles and Hardt (2000) point out a series of institutional factors which explain the unimportance of Mortgage Backed Securities (MBS) in Europe unlike the situation in the USA[10]. These factors include the existence of other types of competitive funding resources on the balance sheet, which is the case with Mortgage-Backed Bonds. With the mortgage bond, the originating institution keeps the assets on its balance sheet and assumes ultimate responsibility for the bonds' credit risk, whilst with the MBS, the mortgage credit is sold and completely removed from the originating bank's balance sheet[11] (Hardt, 2000).

Therefore, it is difficult to measure the total exposure to residential mortgage loans for those banks which extensively perform securitisation operations, as a result of the fact that these operations are not accounted for on the balance sheet. Nevertheless, as this form of funding is not commonly used in Europe, the effects on banks' financial standing should be negligible.

2.2. Bank Risk and Profitability and Real Estate Prices

The review of the literature presented below looks into the relationship between property prices and bank risk and profitability. While some studies examine how property prices impact banks' decisions, through a macroeconomic perspective, others evaluate the role of real estate exposures in bank's profitability and risk.

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to distribute in the form of MBS. They document that the US had the largest securitization share (higher than 50% of all originations), while no other country exceeded 25%. Only Australia and Canada have sizable MBS markets. The third major form of mortgage finance is the "mortgage or covered bond", popular in continental Europe, especially in Denmark, Germany and France. Covered bonds are issued by banks and share many features with MBS, but they also differ in important ways. Most importantly, investors in covered bonds have a general claim on the issuing bank; but in the event that the issuing bank defaults, the investor can claim the underlying mortgage collateral. This structure provides two layers of protection for the covered bond investor: the bank's equity and the housing collateral."

[10] Amongst the reasons that Coles and Hardt (2000) identified for the lower amount of securitisation in Europe appear the higher capital requirements; the existence of other competitive funding instruments on the balance sheet (as it is the case with Mortgage-Backed Bonds); the lack of permission for state guarantees; the lack of consistent statistics (hinders evaluation of securitised products); and legal complexity and lack of standardisation.

[11] As Hardt (2000) states on page 17 "*In the case of mortgage bonds, the originating institution keeps the assets on its balance sheet and maintains ultimate responsibility for the credit risk of the bond. The mortgage loans and the bonds remain on the on the balance sheet of the originating mortgage credit institution. The use of MBS, by contrast, involves the sale of mortgage loans and their complete removal from balance sheet. The institution retains any excess interest from the loans over the all-in cost of the securitisation in the form of servicing commissions or other types of income, but removes the loans and any associated capital requirement or risk provision from the balance sheet*".

2.2.1. The Impact of Residential Property Prices on the Banking Sector: the Macroeconomic Perspective

Several studies point out that there is a strong financial and economic relationship between real estate price cycles and credit cycles: decreased economic activity leads to a feedback cycle of falling asset prices, deteriorating balance sheets, tightening financing conditions and limiting external finance to fund profitable investment opportunities, and so forth. The most influential argument refers to the "financial accelerator" mechanism proposed by Bernanke *et al.* (1994) and Kiyotaki and Moore (1997). In their models, credit market imperfections exist because borrowers have informational advantages over lenders regarding the true value of the underlying projects. To mitigate the potential problems of adverse selection and moral hazard, banks require clients to provide collateral assets. The price of bank loans (the risk premium) will depend upon the value and quality (in terms of liquidity, price volatility, etc.) of the collateral. The financial accelerator mechanism together with the fact that real estate assets are often used as collateral, explains why real estate price cycles tend to have a significant impact on the bank lending behaviour and on bank risk and profitability.

Furthermore, there are potentially other channels through which real estate price cycles could affect bank lending behaviour and bank risk and profitability. On one hand, an increase in the price of real estate tends to increase the value of banks' fixed assets (if the bank owns property) and boost the bank capitalisation. On the other hand, the real estate sector may further affect the banking sector indirectly, via, for example, its overall economic impact. When property prices increase above their fundamental values, constructors and developers will start new construction. This new construction activity generates new demand for other sectors and thus tends to cause an expansion in the general economy and may stimulate the demand for bank credit.

Although the theory and empirical evidence predicts that the increase in property prices increases bank loans, the impact of real estate sector prices on bank risk and profitability is less obvious (Herring and Wachter, 1999). In an efficient market, the bank loan interest rates should reflect the true default risk for the underlying assets, and bank profitability should depend only on whether they are more or less risk-averse. Nevertheless, the profitability of the bank sector might not increase throughout a property price growth cycle if the mortgage credit risk premium component stays low from the start of the cycle. This may result if banks change attitudes towards risk throughout the property price cycle or when there are distortions in the loan decision process (e.g. Jimenez *et al.* 2006 and

Dell'Ariccia *et al.* 2008). Herring and Wachter (1999) state that during the property price growth cycle, banks may underestimate the default risk on mortgages loans. Banks tend to disregard the danger of adverse selection when they expand lending within a short space of time. This tendency towards "disaster myopia" can arise as a result of poor risk management or changing tolerance for risk[12]. In particular, it can be attributable inter alia to inadequate data, measurement bias (Borio *et al.*, 2001), pervasive incentives linked to the safety net, intensified competition following the liberalisation of the banking sector (e.g., Chan *et al.* 1986, Hellman *et al.* 2000 and Marquez 2002) or institutional memory loss over time regarding the possibility of property prices collapsing (Berger and Udell, 2004).

Tversky and Kahneman (1982) state that decision-makers tend to formulate subjective probabilities on the basis of the "availability heuristic", i.e., based on how easily decision-makers can imagine that the event will occur. Since the ease with which an event can be imagined is highly correlated with the frequency that the event occurs, this rule of thumb provides a reasonably accurate estimate of high-frequency events. But the ease of recall is also affected by other factors such as the time elapsed since the last occurrence. Simon (1978) states that this tendency to underestimate shock probabilities is exacerbated by the "threshold heuristic". When the subjective probability falls below some threshold amount (π^* in figure 2) it is disregard and treated as if it were zero.

INSERT FIGURE 2

Put together, these two factors tend to cause "disaster myopia", in other words, the tendency, over time, to underestimate the probability of low-frequency shocks. Bank managers have a tendency to consider the existence of a positive probability of a collapse of property prices, albeit a limited one, since they are *a priori* unaware of such probability and do not have sufficient information to extrapolate it. During the upturn in the property price cycle, this subjective probability of a price collapse tends to decrease, leading banks to expand loans to a larger number of borrowers. Furthermore, borrowers deemed to be very risky during the previous stage of the cycle, tend to obtain loans more easily during the

[12] Other authors also argue that participants in housing markets display myopic and extrapolative expectations. Stevenson (2008) argues "*that while it is generally accepted that investors in capital markets operate under rational expectations, this is no so in illiquid markets such as housing. A common view is that housing market participants generally display a form of extrapolative or adaptive expectations. Malpezzi and Wachter (2005) report that myopic expectations also play a role in that participants may fail to anticipate or account for potential reversals in price trends. Given the reliance on recent history, the role played by adaptive expectations can be linked to myopic behavior (Case and Shiller 1989)*".

expansion phase. Consequently, the quality of the loans portfolios is likely to deteriorate and the portfolio of loans become much riskier during the maturity phase of the cycle[13]. Once a shock occurs, disaster myopia tends to become disaster magnification. The availability heuristic may exacerbate financial conditions because, just after a shock (such as *t+n'* in figure 2), it is easy for all agents to imagine another sharp decline in real estate prices and the subjective shock probability will rise well above the true shock probability. As Guttentag and Herring (1984) show, this will result in sharply increases in interest rates as banks try to reduce exposure and increase risk premiums in response to sharply higher shock probabilities. The extent of credit rationing is likely to expand for borrowers who cannot offer a credible contractual rate that will compensate for the increase in the perceived risk of default. Regulators and supervisors also tend to suffer from disaster magnification, and in response to the greatly increased subjective probability of a disaster they may seek to protect the banking system by insisting on higher capital ratios and more aggressive provisioning against potential losses.

This phenomenon is further worsened by the fact that many banks delay provisioning for loan losses to the recession phases of the property price cycle, thereby leading the economic cycle to have a greater impact on bank capital and profitability (Laeven and Majnoni, 2003).

In sum, the disaster myopia phenomenon might induce banks to take excessive risks while the risk premium required may not be enough to compensate for potential losses.

Another related question has to do with the *diversification versus focus* debate (please refer to Diamond 1984, Winton 1999, Stomper 2006). Financial intermediation theory suggests that banks should diversify to reduce risks or focus their lending on industries about which they have superior expertise to increase risk-adjusted returns. Acharya *et al.* (2006) and Elyasiani and Deng (2004) provide empirical evidence that loan portfolio policy should not be driven by diversification but by a bank's specific monitoring abilities in industries or sectors. Yet Guttentag and Herring (1985, 1986) state that the decision to concentrate credit in a given sector depends mostly, amongst other factors, on the increase in expected returns, on the decreased probability of default and on the expected value of the assets.

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[13] Hellman *et al.* (2000) express the view that Japanese financial-market liberalization in the 1990 increased competition and reduced the profitability and franchise value of domestic banks, which, jointly with others factors, lead to the East Asian financial crisis and a weaker financial system in Japan.

2.2.2. Other Determinants of Bank Risk and Profitability

Our goal here is to identify the risk and profitability determinants used in the previous studies to ensure that the results obtained for the variables associated with the real estate sector are not biased by omitted factors.

2.2.2.1. Credit Risk

Macroeconomic Factors

The empirical evidence suggests that there is a close relationship between bank's credit risk and the economic cycle. When economic growth is low or even negative, companies and households reduce their cash inflows (sales, wages), which in turn leads to increased default on payments to banks. In this paper we use the GDP growth rate to proxy economic activity, because GDP is considered to be a more informative measurement than other macroeconomic variables, such as changes in unemployment, real wages and real interest rates (Salas and Saurina, 2002).

Depending on the level of indebtedness of companies and households, changes in aggregated economic activity may have different effects on credit risk. Moreover, such effects may vary from country to country, due to differences in debt composition of households and companies (short versus long-term debt), and differences in the relationship between banks and companies. Davis (1992) finds that in countries such as the US, the UK, Canada and France, a rise in the companies' indebtedness increases its bankruptcy probability. In Japan, the effect is the opposite. Germany appears to be an intermediate case (non-significant relationship). In the Japanese financial system, there is a close relationship between banks and companies which means that banks are highly informed about companies' financial situation. Therefore, banks tend to be less reluctant to finance companies during periods of economic recession, even if the companies' debt ratio may be already high[14].

Microeconomic Factors

Salas and Saurina (2002) refer the rate of credit growth, the composition of the loan portfolio and the incentives to take riskier credit policies as the three main microeconomic variables which could explain the banks' risk decision-making.

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[14] Petersen and Rajan (1994) show that the existence of a close relationship between the bank and the company increases the availability of funds for the latter.

A rapid credit growth is considered to be one of the main causes of increased bank risk. Clair (1992) and Solttila and Vihriälä (1994), after controlling the composition of banks' loans portfolio, show evidence that past loan growth explains the current level of bad debt. Kwan and Eisenbeis (1997) empirically demonstrate that banks with rapid credit expansion are riskier. Salas and Saurina (2002) state that banks that focus on increasing market share tend to register lower levels of quality required of their customers. Therefore, if another bank tries to steal its market share, the bank will probably try to keep its best customers and will let go its lowest-quality customers. Consequently, if the credit expansion is made in a new geographical area or sector in which the bank has no earlier experience, it is more likely to be affected by problems of adverse selection.

Credit monitoring is also another key element to ensure a good credit policy. To this end, an effective risk analysis and internal control structure needs to be in place. The shortage and misuse of resources allocated to this task may affect the bank's solvency. Berger and DeYoung (1997) find that decreases in costs efficiency are related to increases in bad debt. Kwan and Eisenbeis (1997) further state that inefficient banks are more prone to risk taking.

Another factor which may affect credit risk is the portfolio composition. Different types of loans have different credit risks. The structure of the balance sheet, particularly the loan portfolio, reflects the credit risk accepted by managers. Pensala and Solttila (1993), Randall (1993), Murto (1994), Domowitz and Sartain (1999), amongst others, state that the different credit categories have different levels of risk, and the real estate and construction sectors come out on top as the most risky sectors, followed by commercial and industrial loans, and finally, household mortgages.

Keeton and Morris (1988) consider whether the high level of bad debt of some banks is the result of a deliberately riskier credit policy, though anticipated by charging higher interest rates (a higher risk premium). The authors conclude that banks which charge the highest interest rates are those which previously had high levels of bad debt.

The existence of incentives by managers to follow policies of taking high risks may be another factor determining bank credit risk. Banks with solvency problems can try to solve them by betting on a rapid credit expansion in sectors with high profitability but also with high risk. Contributing towards this situation is the fact that shareholders and managers have little to lose, given their limited liability and due to the fact that these banks have a low level of capital. A subtler case appears when bank margins decrease continuously. Managers can attempt to compensate this slow but steady decrease by adopting riskier credit policies that could eventually cause increases bad loans.

Petersen and Rajan (1995) find that a higher percentage of young companies are financed in a concentrated banking market rather than in a competitive one. According to the authors, if the bank has monopoly power, the possibility of charging the company higher interest rates in the future means that a bank can finance a higher number of lower quality customers, or that these customers could receive funds from the bank even in periods of financial distress. This situation will tend not to happen in competitive markets, where it is not possible to recover in the future the losses of the present because the company, after solving its difficulties, would not pay an interest rate above the market rate.

2.2.2.2. Profitability

Macroeconomic Factors

Valverde and Fernández (2007) use real GDP when analysing the factors determining the interest margins of European banks[15]. The authors posit that the relationship between banks' gross margin and economic growth depends upon the correlation between prices, costs and the economic cycle. Economic growth tends to be negatively related to bank prices and costs, however, the extent to which these variables are affected is varied. Carbó *et al.* (2003) state that the net effect of economic growth on bank margins is not clearly determined.

In their analysis of the factors determining the gross margin in European terms, Valverde and Fernández (2007) include a dummy which indicates whether the bank operates under a bank-based systems (in which bank balance-sheet activities are comparatively high in relation to bank credit activities) or a market-based systems (in which capital markets activities are comparatively high in relation to bank credit activities). The aim of this variable is to show the potential effects on margins in accordance with the structure of the financial system. The authors use a composite indicator - a weighted average of bank and capital market activities relative to GDP, developed by Levine (2002) - to classify the countries in each of the different financial systems.

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[15] Maudos and Guevara (2004), Valverde and Fernández (2007) and Lepetit *et al.* (2008b), amongst others, use the *Net Interest Margin* (NIM) variable as a proxy for bank profitability. The variable measures the difference, in terms of yield, between the active interest and passive interest from banking operations undertaken by banks, given the asset total. It is similar to the gross margin of non-financial companies.

Microeconomic Factors

A large part of the literature on the banking sector focuses on the determinants of interest margins. In their pioneering study, Ho and Saunders (1981) adopt the concept of banks as mere intermediaries between depositors and customers, and state that the interest margins have two basic components: the degree of competition of the markets and the interest rate risk to which the bank is exposed. This model has been extended by several studies: Allen (1988) widens it to permit the existence of different types of credits and deposits. McShane and Sharpe (1985) change the source of the interest rate risk, situating it in the uncertainty of the money market instead of the interest rates on credits and deposits. Angbanzo (1997) extends the model to take into account credit risk as well as interest rate risk.

According to the theoretical model developed by Maudos and Guevara (2004), the factors determining the "pure" interest margins are as follows: the competitive structure of the markets, average operating costs[16], risk aversion, the volatility of money market interest rates and the credit risk. Maudos and Guevara (2004) also state that, in practice, there may be other variables which explain the interest margins, capturing the influence of institutional, regulatory, quality of management aspects, which could potentially distort the "pure" interest margin and which are difficult to incorporate into theoretical models. Saunders and Schumacher (2000) also argue that regulation on the form of interest rate restrictions on deposits or minimum reserves and solvency ratios might have a significant impact on banks' interest margins.

Acharya *et al.* (2006) find that a U-shape relationship between bank returns and the degree of concentration, as a function the level of bank risk. Their results suggest that there are some diseconomies of diversification in banks which expand their business activities into highly competitive sectors or sectors in which they have no prior experience. The results reveal that these diseconomies show up in the deterioration of their loan portfolio and simultaneously in banks' decreased profitability (possibly driven by deterioration in the effectiveness of banking monitoring, adverse selection, increased general expenditure, or a combination of these factors).

[16] Maudos and Guevara (2004) state that "*the extension of the model realized in this paper yield the inclusion of an additional term, the average operating costs, in the explanatory equation of the interest margin. Consequently, firms that incur high unit costs will logically need to work with higher margins to enable them to cover their higher operating costs. Observe that, even in the absence of market power and of any kind of risk, a positive margin will be necessary in order to cover operating costs*."

3. Sample and Methodology

3.1. Research Questions

We address the following questions:

I. What is the expected impact of the relative expansion of residential mortgage loans on bank credit risk? Does the impact vary over the property price cycle and is it influenced by the institutional characteristics of the country where the bank operates?

The marginal effect of increase in residential mortgage loans on bank credit risk can be written as:

$$\frac{d(RISK_t)}{d(RMShare_t)} = \alpha_{11} + \alpha_{12} * RPPRICE_{t-1} \quad (1)$$

where *RISK* is the *proxy* for credit risk; *RMShare* is the weight of residential mortgage loans in the bank's total assets and *RPPRICE* is the residential housing real prices growth rate.

The results will shed light on whether residential mortgage loans have a positive or negative impact on bank credit risk and whether the effect on bank credit risk increases or decreases with the rise in residential property market prices (given by parameter α_{12}).

Tsatsaronis and Zhu (2004), Acharya *et. al.* (2011) and Martins *et al.* (2012) state that there are significant differences across countries in terms of the characteristics of the mortgage credit markets. They show that markets with higher growth rates and less conservative lending practises (with for example, high leverage ratios and possibility of extracting capital) also tend to have higher owner occupancy rates. By influencing the level of risk-taking by banks, the institutional differences pertaining to the mortgage market may help to explain some differences of the impact of residential mortgage loans on bank credit risk. It is expected that banks in countries whose credit policy characteristics are less conservative have a greater propensity to take risks.

II. What is the expected impact of the relative expansion of residential mortgage loans on bank profitability? Does the impact vary over the residential property price cycle?

The marginal effect of increase in residential mortgage loans on bank profitability can be written as:

$$\frac{d(MARGIN_t)}{d(RMShare_t)} = \alpha_{12} + \alpha_{13} * RPPRICE_{t-1} \quad (2)$$

where *MARGIN* is the proxy for bank profitability; *RMShare* is the weight of residential mortgage loans in the bank's total assets and *RPPRICE* is the residential housing real prices growth rate or the accumulated growth rate of residential housing real prices.

The results will allow evaluating if the residential mortgage loans have a positive or negative impact on bank profitability and if the effect on bank profitability increases or decreases with the rise in residential property prices (given by parameter α_{13}).

Herring and Wachter (1999) state that during the property price growth cycle, banks may underestimate the default risk on mortgages loans. This may result if bank change attitudes towards risk throughout the property price cycle or when there are distortions in loan decision process. Chan *et al.* (1986) show that increased competition erodes the surplus that banks can earn by identifying high-quality borrowers. The reduction in value leads banks to reduce their screening of potential borrowers and, thus overall portfolio credit quality declines. In a context of asymmetric information, Marquez (2002) refers that an increase in the number of the banks in a market disperses the borrower-specific information and will result in higher funding costs for low-quality borrowers but also in a higher access to credit for low-quality borrowers. The customers to whom banks lend later in the cycle may not only be of lower credit quality but in addition, they may have borrowed more in terms of LTV and due to both buying more and at a higher price are more vulnerable to negative equity. Thus it is likely that the impact of residential mortgage loans on bank profitability vary over the residential property price cycle.

As mentioned above, while traditional banking theory, based on the delegated monitoring argument, recommends that the optimal bank loan policy is one that is as diversified as much as possible into various different sectors of business activity or projects, Elyasiani and Deng (2004) and Acharya *et al.* (2006), in turn, suggest the possible existence of diseconomies of diversification for a bank that expands to other sectors of business activity or assets. They state that the relationship between profitability and the degree of concentration of banking activity could be a nonlinear function of bank risk. From traditional portfolio theory, we know that diversification increases the central tendency of the distribution of loan portfolio returns. However, when debt is risky and the level of debt is above the central tendency of the distribution, diversification can in fact increase the probability of bank insolvency (Winton, 1999). This would occur, for example, if the *downside risk* of bank loans is substantial.

Another additional impact reinforcing the non-linear relationship between bank returns and the weight of residential mortgage loans in total assets is the conflict of interests between bank owners and bank creditors. More specifically, an increase in the probability of insolvency reduces the incentives of bank owners to monitor their loans. If the loan portfolio has high downside risk (i.e., a high probability of asset returns falling below deposits, making the bank insolvent), then an improvement in loan monitoring and, in turn, in loan quality produces greater benefits to the creditors than to the bank owners. Since the cost of monitoring is borne by the bank owners (the residual claimants), an increase in diversification weakens the incentives for bank owners to monitor loans. This, in turn, leads to lower bank returns.

Given the above arguments, the relationship between residential mortgage loans and profitability could be non-linear, U-shaped, function of the level of risk. This is the last question we address:

III. Is the relationship between bank profitability and residential mortgage loans a non-linear function? Is the relationship between bank profitability and residential mortgage loans a function of the level of risk?

The marginal effect of the increase residential mortgage loans (*RMShare*) on bank profitability could be described as:

$$\frac{d(MARGIN_t)}{d(RMShare_t)} = \alpha_{12} + \alpha_{13} * RISK_t + \propto_{14} * RISK_t^2 \quad (3)$$

where *MARGIN* is the proxy for bank profitability; *RMSHARE* is the weight of residential mortgage loans in the bank's total assets and *RISK* is the proxy for bank credit risk.

If the marginal effect of the concentration on residential mortgage loans on bank profitability is a **U**-shaped function of the level of risk, then $\alpha_{13} < 0$ and $\alpha_{14} > 0$.

3.2. Variables and Model Specifications

3.2.1. Bank Credit Risk Model

In order to study the effects of residential mortgage loans on bank credit risk, we estimate following model:

$$
\begin{aligned}
\boldsymbol{RISK_{it}} = & \propto_1 RISK_{it-1} + \sum_{h=0}^{1} \propto_2 GDP_{t-h} + \propto_3 DFAM_t + \propto_4 DEMP_t \\
& + \sum_{h=1}^{3} \propto_5 LOAN\_TO\_ASSETS_{it-h} + \propto_6 INEF_{it} + \propto_7 SIZE_{it} \\
& + \sum_{h=2}^{3} \propto_8 MARGIN_{it-h} + \sum_{h=2}^{3} \propto_9 EQUITY_{it-h} + \propto_{10} PREM_{it-3} \\
& + \propto_{\boldsymbol{11}} \boldsymbol{RMShare_{it}} + \propto_{12} \boldsymbol{RMShare_{it}} * \boldsymbol{RPPrice_{t-1}} + \eta_i \\
& + \varepsilon_{it} \qquad (4)
\end{aligned}
$$

where *RISK* is the proxy for bank *i* credit risk measured by the ratio between loan loss provisions to net loans in period *t*[17]; $RMSHARE_i$ is the weight of residential mortgage loans in the total bank assets; *RPPRICE* is the rate of growth in real terms of the residential housing prices (in the country or in the region, for those banks whose exposure to the real estate market is at a regional level). Table 1 presents the residential housing price series.

INSERT TABLE 1

We use the following control variables. *GDP* is the real GDP growth; *DFAM* is the ratio between the liabilities of families and GDP; *DEMP* is the ratio between the liabilities of companies and GDP; $LOAN\_TO\_ASSETS_i$ is the ratio between the bank's total credit and total assets; $INEF_i$ is the ratio of operating costs to gross income; $SIZE_i$ is the ratio between the bank's assets and banking industry aggregate assets; $MARGIN_i$ is the *proxy* for bank profitability measured by net interest margin (gross margin); $EQUITY_i$ is the ratio between equity capital and total assets; $PREM_i$ *is* the difference between interest income over total assets and the interbank interest rate; The η_i captures the unobservable effects of the intrinsic characteristics of bank *i* (such as managers' risk-aversion and preferences). ε_{it} is

[17] Angbazo (1997), Salas and Saurina (2002), Maudos and Guevara (2004), Acharya *et al.* (2006) and Lepetit *et al.* (2008a, 2008b), amongst others, also use this ratio as a measurement of bank credit risk.

the error term The detailed definition of the variables and the expected relationships are shown in table 2[18].

INSERT TABLE 2

3.2.2. Profitability Model

We estimate the following linear regression:

$$\boldsymbol{MARGIN_{it}} = \propto_1 MARGIN_{it-1} + \sum_{h=0}^{1} \propto_2 GDP_{t-h} + \propto_3 BBMB_{it} + \sum_{h=2}^{3} \propto_4 RISK_{it-h} + \propto_5 \sum_{h=1}^{2} LIQ_{it-h} + \propto_6 \sum_{h=1}^{2} SDR3M_{it-h} + \propto_7 HHI_t + \propto_8 INEF_{it} + \propto_9 \Delta LOAN_{it} + \sum_{h=2}^{3} \propto_{10} EQUITY_{it-h} + \propto_{11} IPP_{it} + \propto_{12} \boldsymbol{RMShare_{it}} + \propto_{\mathbf{13}} \boldsymbol{RMShare_{it}} * \boldsymbol{RPPRICE_{t-1}} + \eta_i + \varepsilon_{it} \quad (5)$$

As above, we use the *Net Interest Margin* as a proxy for bank profitability (*MARGIN*)[19]. $RMSHARE_i$ and *RPPRICE* are defined as above.

We use the following control variables. $BBMB_i$ is a dummy variable that takes the value 1 if the bank operates in a bank-based system and the value 0 if bank operates in a market-based system. $RISK_i$ is defined as above lagged two and three periods. LIQ_i is the ratio of Liquid Assets to Short Term Funding. *SDR3M* is a proxy for interest rate risk and is given by lagged annual standard deviation of daily interbank 3 month interest rates. *HHI* is the Herfindahl and Hirschman Index. $\Delta LOAN_i$ is the rate of growth of credit loans. IPP_i are Implicit Interest Payments given by the ratio of *Non-Interest Expenses – Non-Interest Revenues* to *Total Assets*. The other variables are defined as above. The detailed definition of these variables and the expected relationships are shown in table 3.

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18 For a more depth explanation of risk management importance and determinants of credit risk, please refer to Freixas and Rochet (2008).

19 Angbazo (1997), Saunders and Schumacher (2000), Maudos and Guevara (2004), Valverde and Fernández (2007) and Lepetit et al. (2008b) amongst others, also use this proxy.

INSERT TABLE 3

In order to assess if the relationship between bank profitability and residential mortgage loans credit is a **U**-shaped function of the level of risk we estimate the following regression:

$$\boldsymbol{MARGIN_{it}} = \propto_1 MARGIN_{it-1} + \sum_{h=0}^{1} \propto_2 GDP_{t-h} + \propto_3 BBMB_{it} + \sum_{h=2}^{3} \propto_4 RISK_{it-h} + \propto_5 \sum_{h=1}^{2} LIQ_{it-h} + \propto_6 \sum_{h=1}^{2} SDR3M_{it-h} + \propto_7 HHI_t + \propto_8 INEF_{it} + \propto_9 \Delta LOAN_{it} + \sum_{h=2}^{3} \propto_{10} EQUITY_{it-h} + \propto_{11} IPP_{it} + \propto_{12} \boldsymbol{RMShare_{it}} + \propto_{13} \boldsymbol{RMShare_{it}} * \boldsymbol{RISK_{it-1}} + \propto_{14} \boldsymbol{RMShare_{it}} * \boldsymbol{RISK^2_{it-1}} + \eta_i + \varepsilon_{it} \quad (6)$$

We also analyze the impact of mortgage credit markets characteristics on bank credit risk and profitability. For this purpose, the variable *LTV* (the average loan to value ratio in the country where the bank operates) is added in equations (4) to (6).

3.3. Dynamic Panel Data Models

Salas and Saurina (2002) and Valverde and Fernández (2007) suggest to use first-differences of the equations above in the estimation of the dynamic panel data models, in order to eliminate bank-specific effects (see Arellano and Bond, 1988 and 1991).

In the appendix, we present the dynamic panel data model with detail. The unobservable individual effects (η_i) in equations (4) to (6) tend to be correlated with other explanatory variables. For example, in the credit risk model, η_i tends to be correlated with the managers' (unobservable) risk preferences and with the lagged loan provision ratio. If equations (4), (5) and (6) are expressed in first differences from the variables, the individual effects will be eliminated. Yet, by using static panel data estimation, estimates would be biased given that the transformed lagged dependent variable will still be correlated with the transformed error terms. Furthermore, the explanatory variable weight *RMShare* is endogenous, and should therefore be defined with adequate instrumental variables. In particular, three variables are treated as endogenous in the estimation. These are the *proxies* for credit risk (*RISK*), profitability (*MARGIN*) and the weight of residential mortgage loans in bank's total assets (*RMShare*).

To overcome the aforementioned biases, we use the linear GMM estimation procedure. The instrumental variables for the endogenous variables are the same variables lagged throughout a number of periods (*h*) sufficient to prevent the second-order autocorrelation of residuals (Salas and Saurina, 2002). In equation (4) the dependent variable is transformed, since the ratio of loans provisions to loans is a truncated variable (between zero and one) and is therefore not suitable for the GMM procedure.

3.4. Sample

The sample is composed of annual unbalanced panel data, obtained from the annual reports and accounts of 555 banks within the EU-15 countries for the period from 1995 to 2008. The use of lagged variables reduces the time period of the estimations: bank credit risk regressions and profitability regressions are estimated, respectively, between 1999 to 2008 and 2002 to 2008. The following table presents the distribution of banks analyzed by country and by specialisation.

INSERT TABLE 4

The sample was obtained via BANKSCOPE. Banks with less than three consecutive years of observations or missing information in terms of the explanatory variables were eliminated. With regard to some banks, there is no information available in BANKSCOPE regarding the amount of residential mortgage loans. In these situations, the information was collected from banks' annual reports and accounts[20].

[20] IAS14 (substituted by IFRS 8 on 1st January 2008) "Operating Segments" require companies to disclose the main operating segments. Given the importance of residential mortgage loans in the activity of the banks analysed, it is possible – by looking at the annual report and accounts – to calculate the amount of residential mortgage loans.

We chose residential mortgage loans rather than full mortgage loans due to the absence and poor quality of prices data in the other segments of the real estate market, and the lack of detailed segmentation of the non-residential mortgage loans.

The data related to concentration index, interbank market interest rates; residential housing prices and families' and companies' indebtedness ratios and GDP were obtained from the European Central Bank, DATASTREAM, BIS *House Prices* and EUROSTAT, respectively.

Tables 5 and 6 present the descriptive statistics of the variables employed in the estimation of the credit risk and profitability models.

INSERT TABLES 5 and 6

An analysis per country shows us that Spain, United Kingdom, and Ireland are the countries with the highest weights of residential mortgage loans on bank total assets. The high house price growth rates and the fact that banks in these countries have less conservative credit policies (Martins *et al.* 2012) might explain these figures. These markets with higher growth rates and less conservative lending practises also tend to have higher owner occupancy rates. It is therefore not surprising that three countries are the countries with the highest residential mortgage loans weight on bank total assets. They are also among the countries with highest average house price growth rates. In contrast, in Germany and in Austria, that have rather conservative lending practices (Martins *et al.* 2012) and experienced average house price growth rates close to zero in recent years, residential mortgage loans weight on bank total assets is much lower.

4. Results

4.1. Credit Risk Model

Table 7 (panel A) shows the results for the estimates of the credit risk model regression (4). The panel B shows the estimated coefficients for subsamples of banks.

INSERT TABLE 7

Results suggest that banks that increase residential mortgage loans decrease credit risk. The results are in line with Pensala and Solttila (1993), Randall (1993), Murto (1994), Domowitz and Sartain (1999). The results also show that during the upturn in residential market prices cycle, a rise in residential mortgage loans leads to a decrease in bank credit risk.

Martins *et al.* (2011) state that due to the accentuated process of bank internationalisation and integration at regional and international level, the real estate assets tend to be related with regional or international residential prices, and they therefore suggest the use of a regional or international indices of residential housing prices as a proxy for the real estate risk factor. Regression VI in table 7 assesses the effects of altering the proxy associated with the residential property prices, for banks whose exposure to the real estate market is at a regional or international scale[21]. The results reveal that an increase in the weight of residential mortgage loans in total assets leads to a greater decrease in credit risk.

Despite the possibility of a "disaster myopia" phenomenon, whereby the quality of bank assets may deteriorate without the banks being aware that they are accepting a higher risk level, Laeven and Majnoni (2003) state that there tends to be a policy of delaying the recognition of loan losses provisions until the phase when property prices collapse. This being the case, the relationship between the residential mortgage loans and credit risk tends to be only recognized in bank balance sheets *a posteriori*, during the property price collapse cycle. Therefore, the results found must be taken with caution.

[21] Martins *et al.* (2011) consider that a bank is exposed to the real estate market at a regional level when its assets portfolio associated with the real estate sector on the international market represents 40% or more. In order to measure the geographical exposure to the real estate sector, they analyze the banks' annual reports and accounts, namely the primary and secondary segment reporting, which banks are obliged to disclose in accordance with IAS 14 and IFRS 8.

Most of the control variables coefficients show the expected sign, although some are not statistically significant. The GDP growth rate (current and lagged one-year) has a negative effect on credit risk, as predicted by the theory. For the other two macroeconomic variables, families and companies' indebtedness, the coefficient is, respectively positive and significant, as expected, and negative but statistical insignificant sign. The weight of credit in bank assets and banks' relative size also affect the level of loans provision, as expected. The results show further that larger banks seem to account for a lower relative weight of loan provisions in their balance sheets.

The variables associated with the inefficiency level and solvency ratio are not statistically significant in the estimated models. This may result because of multicolinearity problems. With regard to the solvency ratio, Davis and Zhu (2009) state that its effect on credit risk is unclear. The authors state that when the solvency ratio is high the incentives for taking risks are lower, and a negative sign is thus to be expected for the coefficient associated with that variable. However, too-low capital ratios may induce banks to "*gamble for resurrection*", which may have the opposite impacts on banks' lending decisions.

Banks' interest margins are statistically significant. As for the proxy for the risk premium, it is statistically insignificant in the regressions for all the banks (panel A), and statistically significant in 3 of the 4 regressions for banks subsamples (panel B). Salas and Saurina (2002) state that it might be possible not to find a positive impact if strong competition introduces cross-subsidization of products inside banks.

The aim of regressions IV and V shown in tables 7 (panel A) is to analyse the impact of institutional factors on bank credit risk. We use "*Loan-to-Value*" (LTV) ratio, obtained from the ECB, which correspond to the average loan to value ratio in the country where the bank operates. The LTV ratios are used owing to the absence of information set out individually by bank regarding LTV ratios. Regressions IV and V show that countries with higher LTV ratios observe higher level of loan losses provisions.

We repeat the regressions based on subsamples of banks (panel B). Regressions VII and VIII refer, respectively, to the clusters of Germany and Austria, and Spain, Ireland and the United Kingdom. Results suggest that the impact of increasing residential mortgage loans on total assets leads to a greater credit risk reduction in the cluster formed by Germany and Austria. Regressions IX and X analyze the effects of increasing residential mortgage loans on bank credit risk in the 1st and 4th quartiles of banks, divided on the basis of the weight of residential mortgage loans on total credit. The results reveal that an increase in residential mortgage loans results in a decrease in credit risk, which is greater in those banks with less residential mortgage loans.

The empirical models were estimated by making some alterations in order to assess the robustness of the results. First, to avoid some of the multicolinearity problems, we remove from the model all the lagged variables with no statistical significant coefficients. Our conclusions remain unchanged. Second, all the results (signs and significance of parameters) hold if the risk premium does not appear in regressions or if another proxy is used. Results are available upon request.

Finally, the hypotheses of the absence of a time series second order correlation (the regressions were estimated to the first difference) and of the validity of the instruments used (Sargan test) are not rejected.

4.2. Profitability Model

Table 8 presents the results of the linear regressions between bank profitability and the weight of residential mortgage loans in total assets, specified by equation (5). The five regressions reveal that those banks increasing their weight of residential mortgage loans in total assets saw their profitability rise during the period analyzed: the coefficient associated with the variable *RMSHARE* is positive and statistically significant. By looking at regression II, we conclude that bank profitability tends to decrease during the upturn in the residential property price cycle. This fact can be explained by the "disaster myopia" phenomenon. As explained above, during the upwards property price cycle, banks tend to expand credit to riskier customers and collateral requirements tend to decrease (see Jimenez *et al.* 2006 and Dell'Ariccia *et al.* 2008). Accordingly, both the credit portfolio quality and the profitability are damaged by increasing competition (e.g. Chan *et al.* 1986, Hellman *et al.* 2000 and Marquez 2002). These conclusions are also corroborated by regressions IV and V, where the residential property prices variable is replaced by the cumulative real growth of residential property prices in the country (or region, in the case of regression V) where a bank operates.

INSERT TABLE 8

Table 8 (panel B) tests the hypothesis of non-linear, relationship between profitability and the weight of residential mortgage loans in total assets, function of the level of credit risk, in accordance with equation (6). The results support the hypothesis that there is a **U**-shaped non-linear relationship between profitability and weight of residential mortgage loans in total assets, function of the level of risk. The coefficients of the interaction variables, $RMSHARE_{it}* RISK_{it-1}$ and $RMSHARE_{it}* (RISK_{it-1})^2$, are negative and positive, respectively, and statistically significant. The results of the statistic *F* to test the statistical significance of the linear and quadratic terms, separately and together, reveal that the coefficients of these variables are statistically significant, contributing towards increasing the explanatory power of the regression.

By analysing the coefficients of the control variables, it can be seen that the lagged *MARGIN* variable reveals a statistically significant positive sign. In majority of regressions, credit risk, liquidity risk, interest rate risk and the concentration index are also statistically significant with a positive effect on banks' profitability. This is consistent with previous findings (see, for example, Angbazo, 1997). The results show further that inefficient banks tend to have lower profitability margins in line with other studies, such as Maudos and Guevara (2004). The positive statistically significant sign associated with the solvency ratio, in majority of regressions, could suggest that banks require a premium in their margins, due to the pressures of ensuring solvency by regulators. The negative and statistically significant coefficient of the $\Delta LOAN$ variable (loan growth rate) suggests that banks that register high loan growth may be required to work with lower banking margins (as suggested by Petersen and Rajan, 1995). Valverde and Fernandéz (2007) find an identical result. The *IPP* variable (implicit interest payments) has a positive coefficient and is statistically significant, for the majority of regressions. This variable reflects extra payments to depositors through service charge remission or other types of transfers due to competition in the market for deposits. These extra payments tend to cause an increase in the banks gross margins consistent with the findings of Angbazo (1997). The GDP growth rate also shows a positive and statistically significant effect on banks' gross margins. Finally, the dummy associated with the structure of financial systems, reveals that bank-based system tend to present larger gross margins than market-based financial systems countries.

The coefficient associated with the country's average LTV ratio (proxy for the institutional characteristics of the mortgage market), is positive and statistical significant, suggesting that banks in countries where credit practices are less conservative (high leverage ratios) tend to require a higher profitability margins. Equations VIII and IX are estimated for banks' 1st quartile and 4th quartile, in line with the weight of residential mortgage loans to total loans, respectively.

Finally, the non-rejection of the null hypotheses of the Sargan test and the second-order autocorrelation test allow us to conclude drawn from the estimated models appear supported.

4.3. Effects of Residential Mortgage Loans on Banks' Risk-Adjusted Profitability

The effects of residential mortgage loans should be studied both in terms of the profitability and credit risk. If the increased weight of residential mortgage loans on total assets produces an increase in profitability and a decrease in credit risk, then the final effect is an improvement in bank's risk-adjusted profitability. When bank profitability and credit risk either increase or decrease, the overall effect on the bank's risk-adjusted profitability is ambiguous and cannot be ascertained without taking a stance on what constitutes an "efficient" risk-profitability trade-off.

The effects of residential mortgage loans on total assets on bank profitability and risk during property booms are summarised in the table below, based on the empirical evidence of tables 7 and 8:

INSERT TABLE 9

From table 9, we can draw the following two conclusions for the sample of banks and period analyzed:

1) Increasing weight of residential mortgage loans on total assets results in an efficient trade-off between risk and profitability. More specifically, bank profitability tends not to be affected or tend to be slightly reduced by increasing weight of residential mortgage loans on total assets for low to moderate insolvency risk banks, and to increase with weight of residential mortgage loans

on total assets for high insolvency risk banks. Since credit risk tends to decrease with an increasing weight of residential mortgage loans on total assets, banks with high insolvency risk improve risk-adjusted profitability.

2) The effect of an increasing weight of residential mortgage loans on total assets on banks with moderate insolvency risks cannot be correctly ascertained without reference to how much the bank's profitability should increase via a unitary increase in bank risk[22].

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[22] In practice, many banks use a risk-adjusted return on capital framework to determine whether such loans are beneficial. Commonly the return per unit of risk of the loan should exceed some cost of capital benchmark specified by the bank such as the after-tax ROE of the bank.

5. Conclusion

The paper evaluates the effects of increasing the weight of residential mortgage loans on bank risk and profitability for a sample of 555 banks within the EU-15, for the period from 1995 to 2008. The results indicate that residential mortgage loans have a significant impact on bank profitability and risk.

The results suggest that increasing the weight of residential mortgage loans tends to result into a decrease in bank credit risk. This is explained by the fact that this asset is used as collateral to obtain other loans and is perceived by banks as contributing towards reducing credit risk. The results obtained show that the decrease in credit risk as result of an increase in the weight of residential mortgage loans is higher during the upturn in the residential property price cycle and in countries with more conservative loans practices. This result explains why banks rush to lend on property during booms due to the positive effects it has on credit risk. The results also show that bank profitability tends to decrease during the upturn in the residential property price cycle.

The results also reveal the existence of a non-linear relationship (**U**-shaped marginal effect), function of the level of bank's risk, between profitability and the weight of residential mortgage loans on total assets. For those banks with high credit risk, an increasing weight of residential mortgage loans on total assets tends to raise the bank's risk-adjusted profitability. For banks with a moderate credit risk, the effects of increasing weight of residential mortgage loans on banks' risk-adjusted profitability are also positive or marginally positive.

The results highlight the need to develop indicators of the bank's individual exposure to the real estate market, which could help to calibrate the potential impact of changes in the weight and price of residential housing assets on bank risk and profitability.

Appendix

The Dynamic Panel Data Model

This appendix presents the Dynamic Panel Data Model used in this study. We use the first-difference of the equations to estimate in order to eliminate the bank-specific effects (see Arellano and Bond, 1988 and 1991). Yet, this procedure introduces a new error term which is correlated to the lagged dependent variable introduced among the set of explanatory variables. Arellano and Bond (1991) address this correlation and possible endogeneity problems by proposing the use of lagged variables of the explanatory variables in levels as instruments variables and the two-step GMM estimator. In the first step, the error terms are assumed to be both independent and homoskedastic, across banks and over time. In the second step, residuals obtained in the first step are used to construct a consistent estimate of the variance-covariance matrix, thus relaxing the assumptions of independence and homoskedasticity. Griliches and Hausman (1986) reveal that the "*difference estimator*" has been found to exacerbate measurement error biases. An alternative method is used in this paper to estimate the regression in differences jointly with the regression level, as proposed by Arellano and Bover (1995). As show by Blundell and Bond (1998), this system estimator reduces the potential biases in finite samples and asymptotic imprecision associated with the difference estimator. The estimator uses the lagged differences of the explanatory variables as instruments. They are valid instruments under the assumption that the correlation between the bank-specific effect and the levels of the explanatory variables is constant over the time. The consistency of the GMM estimator depends both on the validity of the assumption of absence of serial correlation of the error term and on the validity of the instruments. Arellano and Bond (1991) suggest two tests to validate these assumptions. The first is the Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analysing the sample analogue of the moment conditions used in the estimation procedure. The Sargan test is based on the observation that the residuals should be uncorrelated with the set of exogenous variables when the instruments are truly exogenous. This statistic will be asymptotically chi-squared under the null hypothesis that the error term is uncorrelated with the instruments. The second test, examines the assumption of no serial correlation in the error terms. We test if the differenced error term is first-order serially correlated. Under the null hypothesis of no second-order serial correlation, this test has a standard-normal distribution.

The general model, which closely follows the Arellano and Bond (1988) model, is a single equation with individual effects. The equation takes the form:

$$y_{it} = \sum_{k=1}^{p} \propto_k y_{i(t-k)} + \beta'(L)x_{it} + \lambda_t + \eta_i + v_{it} \quad (t = q+1, \dots, T_i; i = 1, \dots, N), \text{(A-1)}$$

where, η_i and λ_t are respectively, the individual and temporal effects, x_{it} is the vector of the explanatory variables, *B(L)* is the vector of associated polynomials in the lag operator, and q is the maximum lag length in the model ($\beta'(L)$ indicates transpose). The number of time periods available on the *i*th individual is T_i. The v_{it} are assumed to be independently distributed across individuals with a zero mean, but arbitrary forms of heteroskedasticity across units and time are possible. The x_{it} may or may not be correlated with the individual η_i effects and for each of these cases the effects may be strictly exogenous, predetermined, or endogenous variables with respect to v_{it}.

The (T_{i-q}) equations for the individual i can be written conveniently as follows:

$$y_i = W_i\sigma + t_i\eta_i + v_i, \quad \text{(A-2)}$$

where σ is a parameter vector including the a_k's, the β's and the λ's, and W_i is a data matrix containing the time series of the lagged dependent variables and the x's. Finally, t_i is a vector $(T_i - q)*1$ of ones. The dynamic panel data can be used to estimate various linear GMM estimators of σ with the general form:

$$\hat{\sigma} = [(\textstyle\sum_i W_i^* Z_i)A_N(\sum_i Z_i W_i^*)]^{-1} (\sum_i W_i^{*\prime} Z_i)A_N(\sum_i Z_i' y_i^*), \quad \text{(A-3)}$$

where $$A_N = (\tfrac{1}{N}\textstyle\sum_i Z_i' H_i Z_i)^{-1} \quad \text{(A-4)}$$

and W_i^* and y_i^* refer to transformations of W_i and y_i (example, levels, first differences, orthogonal deviations, deviations from individual means). Z_i is the matrix of instrumental variables. H_i is a possible individual specific weighting matrix.

When estimating dynamic models, transformations that allow the use of lagged (and pre-determined) endogenous variables as instruments in transformed equations should be used. Where there are no instruments available that are uncorrelated with the individual effects η_i, the transformation should eliminate this component of the error term. The first difference transformation is one example of a transformation that eliminates η_i from the transformed error term without entering all the lagged values of the perturbation term v_{it} in the transformed error term. Hence, this transformation allows the use of suitably lagged (and pre-determined) endogenous variables as instruments.

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Table 1: Residential Housing Prices Series

The table presents the sources of residential house price series with its description, source, prices type, dwelling type, geographical coverage and first observation. All these series were deflated using CPI. All series were obtained from Bank International Settlements (BIS): BIS *House Prices*.

Country	Dwelling	Dwelling Type	Geographical Coverage	Prices	Description of Index	Period	Source
Germany	Second Hand Dwellings.	Property offering a good quality of life in average to good locations. Terraced houses and flats.	Western Germany: Before 1989: 50 towns/cities. From 1990 onwards: 100 towns/cities. From 1995 onwards: 125 towns/cities (100 towns/cities in Western Germany and 25 towns/cities in Eastern Germany)	Typical values quantified by real estate experts who refer to price data of various types, including non-transaction prices.	Prices weighted through population. Aggregation based on the share of terraced houses and flats in the total living área.	1975 -	Central Bank of Germany. Figures are based on data from BulwienGesa AG. (www.bundesbank.de)
Austria	New and Second Hand Dwellings.	Houses and apartments.	Vienna	Transaction Prices.	Weighted average price	1976 -	Central Bank of Austria (www.oenb.at)
Belgium	New and Second Hand Dwellings.	Small and medium sized dwellings for sale by mutual agreement.	Nationwide	Transaction Prices.	Average price index weighted by the number of transactions for each type of housing.	1988 -	STADIM (private consultancy) (www.stadim.be)
Denmark	New and Second Hand Dwellings.	Houses, flats and holiday homes.	Nationwide (data collected at municipal level).	Transaction Prices.	Average price per square meter for municipalities weighted with the dwelling stock.	1971 -	Danish Mortgage Association (www.realkreditraadet.dk)
Spain	New and Second Hand Dwellings.	All dwellings excluding those that have a market value over €1.050.000.	Nationwide (data collected for provinces and municipalities with more than 25.000 inhabitants.	Price is calculated by using official valuations: "*Open market appraised housing*"	Average price per square meter weighted with the number of valuations.	1987 -	Ministry of Housing (www.fomento.gob.es)
Finland	New and Second Hand Dwellings.	Houses and apartments.	Large Cities (with more than 100.000 inhabitants).	Transaction Prices.	Average price index weighted by the number of transactions for each type of housing.	1978 -	Central Bank of Finland (www.suomenpankki.fi)
France	Second Hand Dwellings.	Second-hand dwellings: more than 5 years old or sold a second time within the 1st 5 years.	Paris. Nationwide.	Transaction Prices.	Paris: Average price per square meter observed in sales. Country: Hedonic regression.	1980 - 1994 -	Notaires – INSEE (www.insee.fr)
Greece	New and Second Hand Dwellings.	N/A	Athens and 17 major cities.	Transaction Prices.	Prices weighted with the dwelling stock (in square meters) in Athens and 17 major cities.	1994 -	Central Bank of Greece (www.bankofgreece.gr)
Netherlands	Second Hand Dwellings.	Detached house, corner house, terraced house, apartment, semi-detached house.	Nationwide.	Transaction Prices.	Weighted repeat sales.	1976 -	National Land Register (Kadaster) (www.kadaster.org)
Ireland	New and Second Hand Dwellings.	All newly mortgaged residential property.	Nationwide.	Price at mortgage approval.	Weighted average of house price for new and second hand dwellings in the period in question.	1971 -	Department of the Environment (www.environ.ie)
Italy	New and Second Hand Dwellings.	N/A	13 large urban areas.	Transaction Prices.	Weighted average price	1988 -	NOMISMA (www.nomisma.it)
Luxemburg	New and Second Hand Dwellings.	Flats and Houses.	Nationwide.	Transaction Prices.	Laspeyere price indices.	1974 -	Central Bank of Luxembourg (www.bcl.lu)
Portugal	New and Second Hand Dwellings.	Flats and Houses.	Nationwide (exclude islands)	Price is calculated by using official valuations.	Weighted price indices by hedonic regression and by housing type.	1988 -	Imométrica (www1.ipd.com)
UK	New and Second Hand Dwellings.	Detached house, semi-detached house, bungalow, terraced house and flats.	Nationwide.	Transaction Prices.	Mixed Adjusted	1969 -	Department of Communities and Local Government (www.communities.gov.uk)
Sweden	New and Second Hand Dwellings.	One and two dwelling buildings.	Nacional	N/A	Weighted average of the price indices of owner-occupied adjusted for ratable values and based on the legal registration.	1986 -	Statistics Sweden (www.scb.se/)

Table 2: Determinants of Bank Credit Risk: Variable Definition and Expected Relationships

Variable	Variable Definition	Coefficient Sign
***RISK**$_{it-1}$*	Ratio of loan loss provision to net loans from the previous period (*RISK*). The current ratio is closely related to that of the previous period, since loan loss provisions are not immediately written down in the bank balance sheet.	Positive
***GDP**$_{t-h}$*	Real GDP Growth Rate. Measures the impact of aggregated economic activity. The larger the economic growth the lower the degree of default by economic agents.	Negative
***DFAM**$_t$*	Ratio Between the Liabilities of Families and the GDP. This ratio measures the families' indebtedness level.	Positive
***DEMP**$_t$*	Ratio Between the Liabilities of Company and GDP. This ratio measures the company's indebtedness level.	Positive
***LOAN_TO_ASSETS**$_{it-h}$*	Ratio between Total Credit and Total Assets lagged one, two and three periods. A target of rapid increase in market share can force the bank to reduce the quality of its borrowers. However, since the loan is granted till it becomes a provision loans, there is a lag unknown and variable. In order to measure the temporal effects, we allow three lags, starting at *t*-1. If it were lagged less are than one period, it could be spuriously correlated with the dependent variable through the denominator.	Positive
***INEF**$_{it}$*	Level of Bank Inefficiencies provided by the ratio "*Operating Costs to Gross Income*". A higher value for the ratio indicates that there are management inefficiencies. It is expected that banks with better management in place have a lower level of loan provisions.	Positive
***SIZE**$_{it}$*	Bank's Relative Dimension provided by the ratio between bank assets *i* and total bank assets, during the period *t*. As we noted in section 2.2.2.1, some authors use this variable to measure risk diversification policies. A big balance sheet allows the managers to invest in different geographical or business segments to deal with asymmetric shocks. If the relative size is a good proxy for risk diversification, we should find a negative coefficient. On the other hand, this variable may capture the bank's market power. In this situation, we should expected a positive sign for the coefficient, because when the bank increases the market power, increase the probability of granting credit to companies with a higher credit risk.	Positive or Negative
***MARGIN**$_{it-h}$*	Bank Interest Margin obtained by the variable "*Net Interest Margin*", lagged two and three periods. This variable is a measure of the difference between the interest income generated by banks and the amount of interest paid to their lenders (for example, deposits), relative to the amount of their (interest-earning) assets. It is similar to the gross margin of non-financial companies. The present variable not only reflects the profitability of bank credit, but also incorporates a risk premium. The increased risk will tend to provoke an increase in the gross margin, for which reason the variables are lagged.	Positive
***EQUITY**$_{it-h}$*	Solvency Ratio is provided by the ratio between Capital and Total Assets, lagged two and three periods. The impact of solvency difficulties is not straightforward. The loans provisions will appear later because it takes time to change credit policy. The higher the solvency ratio, the lower the incentives to take more risks. Therefore, a negative coefficient is expected for the coefficient. Nevertheless, lower capital ratios may induce banks to "*gamble for resurrection*", thereby causing the opposite impacts on bank decisions.	Positive or Negative

Table 2: Determinants of Bank Credit Risk: Variable Definition and Expected Relationships (cont.)

Variable	Variable Definition	Coefficient Sign
$PREM_{it-3}$	Credit Risk Premium. The higher *ex post* credit risk may be anticipated by the bank charging an *ex ante* risk premium in the interest of the loans. To control for this effect, we include $PREM_{it-3}$ (the difference between interest income over total assets and the interbank interest rate) as a proxy for the risk premium. The tree-year lags is designed to catch the *ex ante* component of risk premium. If the riskier loans are properly priced, the coefficient associated to the variable should be positive and statistically significant. However, it is possible that a positive impact may not be found if strong competition induces cross-subsidization of products inside banks.	Positive
$RMShare_{it}$	The weight of residential mortgage loans in the bank's assets.	?
$RPPRICE_{t-1}$	The rate of growth in real terms of the residential housing prices in the country (or in the region, for those banks whose exposure to the real estate market is at a regional level). Detailed information about residential housing price series appears in table 1.	?

Table 3: Determinants of Bank Profitability: Variable Definition and Expected Relationships

Variable	Variable Definition	Coefficient Sign
$MARGIN_{It-1}$	Bank Interest Margin from the previous period.	Positive
GDP_{t-h}	Real GDP growth rate. The relationship between the bank margins and growth will depend on the correlation between prices, costs and the business cycle. Economic growth is negatively related to bank prices and costs, although the extent to which these variables are affected may be significantly different, meaning that the net effect on margin may not be clearly determined (Carbó *et al.*, 2003).	Positive or Negative
$BBMB_t$	Bank-Based or Market-Based System. A *dummy* variable is used in order to show the potential effects of the differences in the bank margins according to the structure of the financial system. The *dummy* take the value 1 if the bank operates in a bank-based system and the value 0 if bank operates in a market-based system. Valverde and Fernández (2007) found positive and negative signs, statistically significant, for this *proxy*.	Positive or Negative
$RISK_{it-h}$	Credit Risk defined by the value of the ratio "*Loan Loss Provisions to Net Loans*" lagged into two and three periods. The values of this ratio are lagged since risk parameters are not expected to affect margins contemporaneously. A greater risk premium should be required by the bank when the credit risk increases.	Positive
LIQ_{it-h}	Liquidity risk provided by the ratio *"Liquid Assets to Short Term Funding"*. The risk of insufficient liquidity may force banks to request emergency funds at excessive cost. Angbazo (1997) states that the liquidity risk tends to affect bank margin positively.	Positive
$SDR3M_{it-h}$	Volatility of the Market Interest Rate is used as the *proxy* for the interest rate risk. The uncertainty in the money market is reflected in the theoretical model by the variance of the market interest rate. The empirical proxy for this variable is consequently based on a measurement of volatility of the market interest rate, such as the annual standard deviation of the daily interbank interest rate at 3 months. The variable is lagged since the volatility of the market interest rate is not expected to affect the gross margin contemporaneously. It is expected that the interest rate risk increases banks' gross margin (Saunders and Schumacher, 2000).	Positive
HHI_t	Herfindahl and Hirschman Index computed from banks total assets on the domestic market. In theory, the level of concentration of banking activity and banks' gross margins tend to be positively related. However, this relationship may be influenced by third variables and the gross margins can be negatively affected by market concentration (see for example, Cetorelli and Gambera, 2002). The *HHI* variable was obtained from two reports from the European Central Bank (ECB, 2005 and 2010).	Positive or Negative
$INEF_{it}$	Level of Bank Inefficiencies provided by the "*Cost to Income Ratio*". The existence of high operating costs implies increased operating inefficiency. Therefore, we expect those banks experiencing higher costs to increase prices to a greater extent (if they enjoy market power), so that inefficiency will result in higher margins (Altunbas *et al.*, 2001). Maudos and Guevara (2004) state that this proxy may, alternatively, indicate the quality or efficiency of the management. There tends to be higher quality management when there is a lucrative composition of assets and a low cost composition of liabilities. Thus a higher ratio would imply lesser management efficiency or quality, which would reflect lower gross margins.	Positive or Negative

Table 3: Determinants of Bank Profitability: Variable Definition and Expected Relationships (cont.)

Variable	Variable Definition	Coefficient Sign
$\Delta LOAN_{it}$	Average Dimension of Operations or Credit Volume. In the estimation we use the loans growth rate as *proxy*. In the model developed by Maudos and Guevara (2004), the gross margins are a growing function of the average dimension of the operations realized. The reason for this is that for a certain risk value and market risk, a large operation will tend to involve greater risk of potential loss, so the bank will tend to require a greater margin. Thus, the potential loss will tend to be greater for banks with a high volume of credit volume. Davis and Zhu (2009) refers that if the bank's risk attitude remains the same across the credit cycle, its profitability should be higher as a compensation for the higher credit risk. Nevertheless, if the risk-taking behaviour is associated with distorted incentives, such as the "disaster myopia" tendency mentioned before, its linkage with bank profitability is more ambiguous.	Positive or Negative
$EQUITY_{it-h}$	Solvency Ratio provided by "*Capital to Assets Ratio*". Valverde and Fernández (2007) state that debt substitution for capital, lower the bank's insolvency risk and possibly decrease the funding costs for the bank. But as the capital is becoming a more costly source of funding, an increase in equity tends to increase the average cost of the capital. Thus, a higher gross margin will tend to be required *ex-ante*. Davis and Zhu (2009) state that the solvency ratio may have two opposite effects on bank profitability. If the cost-of-funding effect dominates, a higher equity ratio leads to higher bank profitability. If the "*gamble for resurrection*" effect dominates instead, banks with lower capitalisation will invest more on high-risk assets and the loan quality is impaired.	Positive or Negative
IPP_{it}	Implicit Interest Payments. Following Ho and Saunders (1981), Angbazo (1997) and Saunders and Schumacher (2000), the proxy "*(Non-Interest Expenses – Non-Interest Revenues)/Total Assets*" is used to measure the implicit interest payments. This variable reflects extra payments to depositors through service charge remission or other types of transfers due to competition in the market for deposits. These extra interest expenses should be mirrored in higher interest margins.	Positive
$RPPRICE_{it-1}$	Rate of growth in real terms of the residential housing prices in the country (or in the region, for those banks whose exposure to the real estate market is at a regional level) or the accumulated rate of growth in real terms of residential housing prices. Detailed information about residential housing price series appears in table 1.	?
$RMShare_{it}$	The weight of residential mortgage loans in the bank's assets.	?

Table 4: Distribution of Banks by Country and Specialization

This table shows the banks distribution by country and specialization. The sample was obtained from the database BANKSCOPE. We only consider banks with more than three consecutive years of observations between 1995 and 2008. The banks' specialization is in agreement with the classification used by database BANKSCOPE. The specialization category "Others" includes: "Bank Holdings & Holding Companies", "Savings Banks" and "Investment Banks".

Country	Number of Banks				
	Commercial	Cooperative	Real Estate & Mortgage	Others	Total
Germany	28	6	3	10	47
Austria	16	9	5	10	40
Belgium	8	1	0	5	14
Denmark	40	0	2	12	54
Spain[1]	22	5	0	43	70
Finland	5	0	0	1	6
France	37	50	3	5	95
Greece	13	0	0	1	14
Netherlands	18	1	1	6	26
Ireland	11	0	3	1	15
Italy	27	16	0	17	60
Luxemburg	11	1	0	2	14
Portugal	7	1	1	9	18
United Kingdom	24	0	34	8	66
Sweden	5	0	4	7	16
Total	272	90	56	137	555

[1] The column relating to "Others" has only Saving Banks given the importance of the *Cajas de Ahorros* in Spain.

Table 5: Descriptive Statistics

This table shows the descriptive statistics of the 555 European Banks in the period between 1999 and 2008. **RISK** is the ratio of provisions for loan losses and the total net loans; **GDP** is the real GDP growth; **DFAM** is the ratio between the liabilities of families and the GDP; **DEMP** is the ratio between the liabilities of firms and GDP; **LOAN_TO_ASSETS** is the ratio of total loans to total assets; **INEF** is the ratio of operating costs to gross income; **SIZE** is the ratio between bank assets *i* and the total bank assets; **MARGIN** is the proxy for bank profitability measured by net interest margin (gross margin); **EQUITY** is the ratio between the capital and total assets; **PREM** is obtained from the difference between interest income over total assets and the interbank interest rate; **LIQ** is the ratio net loans to short term funding; **SDR3M** is the annual standard deviation of the daily interbank 3 month interest rate; **HH** is the Herfindahl e Hirschman Index obtained via total assets on the domestic market (the ratio was obtained from the ECB and range between 0 and 10.000); **IPP** is the ratio non-interest expenses – non-interest revenues)/total assets; **ΔLOAN** is the loans growth rate; **RMSHARE** is the weight of residential mortgage loans in the total bank assets; **RPPRICE** is the rate of growth in real terms of the residential housing market prices.

Variable	Mean	Standard Deviation	Minimum	Maximum
RISK (%)	0,662	2,834	-2,297	35,353
GDP (%)	2,001	1,469	-3,000	6,500
DFAM (%)	72,871	27,989	24,240	148,280
DEMP (%)	201,861	49,795	90,230	379,400
LOAN_TO_ASSETS	59,055	22,824	0,523	99,130
INEF (%)	62,783	30,818	0,000	254,050
SIZE (%)	2,281	6,472	0,000	58,183
MARGIN (%)	2,613	10,533	-2,870	13,230
EQUITY (%)	8,317	6,745	-0,465	99,591
PREM (%)	1,890	13,444	-5,269	12,992
LIQ (%)	84,894	5,400	0,000	320,084
SDR3M	0,411	0,527	0,888	0,023
HH	685,148	489,445	158,00	3160,00
IPP (%)	1,187	15,862	-6,972	2,820
ΔLOAN (%)	14,612	13,044	-37,672	54,000
RMSHARE (%)	30,943	21,234	0,000	99,443
RPPRICE (%)	4,841	6,590	-14,742	23,222

Table 6: Descriptive Statistics by Countries

This table shows the descriptive statistics: mean and standard deviation by countries, in the period between 1999 and 2008. **RISK** is the ratio of provisions for loan losses and the total net loans; **GDP** is the real GDP growth; **DFAM** is the ratio between the liabilities of families and the GDP; **DEMP** is the ratio between the liabilities of firms and GDP; **LOAN_TO_ASSETS** is the ratio of total loans to total assets; **INEF** is the ratio of operating costs to gross income; **SIZE** is the ratio between bank assets *i* and the total bank assets; **MARGIN** is the proxy for bank profitability measured by net interest margin (gross margin); **EQUITY** is the ratio between the capital and total assets; **PREM** is obtained from the difference between interest income over total assets and the interbank interest rate; **LIQ** is the ratio net loans to short term funding; **SDR3M** is the annual standard deviation of the daily interbank 3 month interest rate; **HH** is the Herfindahl e Hirschman Index obtained via total assets on the domestic market (the ratio was obtained from the ECB and range between 0 and 10.000); **IPP** is the ratio non-interest expenses – non-interest revenues)/total assets; **ΔLOAN** is the loans growth rate; **RMSHARE** is the weight of residential mortgage loans in the total bank assets; **RPPRICE** is the rate of growth in real terms of the residential housing market prices. The table reports the mean and standard deviation for each variable and country. The standard deviation comes in brackets.

	GER	AUT	BEL	DEN	SPA	FIN	FRA	GRE	NET	IRL	ITA	LUX	POR	UK	SWE
RISK (%)	0,441 (3,30)	0,853 (6,04)	0,210 (0,62)	0,657 (0,99)	0,494 (0,28)	0,093 (0,21)	0,467 (2,00)	1,317 (1,90)	1,760 (7,14)	0,244 (0,57)	0,686 (1,06)	0,123 (0,038)	0,750 (0,90)	0,384 (1,40)	0,549 (5,26)
GDP (%)	1,172 (1,03)	2,095 (1,06)	1,927 (0,95)	1,270 (1,30)	3,107 (0,91)	3,175 (1,24)	1,647 (0,69)	3,764 (1,35)	1,991 (1,17)	4,509 (3,02)	0,824 (1,02)	3,927 (2,18)	0,879 (0,90)	2,329 (0,75)	2,320 (1,44)
DFAM (%)	69,159 (3,89)	51,522 (2,58)	43,030 (4,01)	125,740 (13,42)	74,136 (12,19)	46,452 (9,15)	55,712 (5,80)	40,782 (12,13)	109,062 (11,06)	82,717 (21,04)	38,852 (5,66))	55,554 (5,84)	93,025 (9,41)	97,738 (10,08)	68,591 (6,58)
DEMP (%)	169,207 (9,50)	153,853 (24,34)	240,480 (31,89)	172,505 (23,11)	200,300 (29,65)	213,366 (19,22)	205,644 (25,19)	107,190 (13,67)	239,409 (15,10)	278,896 (26,49)	146,100 (8,47)	317,992 (34,70)	241,243 (9,30)	253,201 (19,79)	264,141 (26,80)
LOAN_TO_ASSETS	0,479 (0,235)	0,554 (0,194)	0,420 (0,201)	0,650 (0,107)	0,679 (0,150)	0,563 (0,262)	0,586 (0,259)	0,612 (0,150)	0,495 (0,278)	0,527 (0,249)	0,611 (0,225)	0,308 (0,163)	0,583 (0,229)	0,662 (0,203)	0,672 (0,277)
INEF (%)	72,971 (32,29)	66,592 (31,87)	64,568 (18,93)	58,308 (16,53)	60,184 (31,06)	67,547 (18,66)	63,525 (28,63)	71,475 (36,21)	63,553 (34,44)	63,505 (18,39)	45,31 (44,18)	54,415 (23,10)	61,305 (13,80)	62,985 (17,88)	55,020 (29,26)
SIZE (%)	0,893 (2,42)	2,897 (5,02)	11,991 (17,98)	1,519 (5,20)	1,413 (4,01)	16,002 (27,90)	1,203 (3,59)	5,929 (6,74)	2,672 (6,24)	2,584 (3,24)	0,975 (3,25)	4,723 (4,38)	4,184 (5,75)	0,682 (1,71)	7,054 (10,84)
MARGIN (%)	6,573 (35,66)	1,892 (1,31)	1,749 (1,56)	3,763 (1,66)	2,305 (0,81)	2,035 (1,18)	1,950 (1,37)	2,921 (1,03)	1,478 (0,99)	1,256 (0,77)	2,769 (1,33)	0,959 (0,53)	2,477 (1,30)	1,997 (1,82)	1,563 (1,05)
EQUITY (%)	6,581 (8,92)	7,525 (9,93)	5,279 (2,59)	11,917 (4,99)	7,907 (3,56)	7,158 (2,89)	8,907 (4,76)	8,715 (6,51)	6,476 (3,55)	5,184 (2,89)	9,978 (6,24)	5,253 (2,36)	8,417 (8,21)	7,859 (9,18)	8,460 (8,69)
PREM (%)	2,350 (5,29)	1,798 (2,17)	2,132 (3,61)	2,021 (1,52)	1,175 (1,11)	0,245 (1,34)	1,810 (1,66)	2,303 (1,47)	1,765 (3,39)	1,006 (1,61)	1,823 (3,36)	3,930 (3,82)	2,216 (1,97)	2,413 (37,99)	0,951 (1,35)
LIQ (%)	70,603 (5,45)	100,21 (8,24)	59,634 (2,93)	133,24 (2,90)	92,96 (3,13)	80,64 (3,84)	132,55 (4,92)	72,56 (2,46)	135,11 (2,35)	84,65 (4,06)	120,23 (9,46)	41,58 (2,57)	85,69 (3,47)	93,97 (7,94)	179,31 (2,14)
SDR3M	0,295 (0,17)	0,304 (0,18)	0,299 (0,17)	0,301 (0,17)	1,100 (1,18)	0,299 (0,18)	0,304 (0,18)	0,296 (0,17)	0,285 (0,16)	0,295 (0,17)	0,295 (0,17)	0,289 (0,18)	0,296 (0,17)	0,384 (0,24)	0,346 (0,16)
HH	174,75 (9,85)	545,37 (42,97)	1971,00 (167,74)	1132,37 (42,50)	496,00 (34,12)	2547,50 (316,47)	648,75 (60,00)	1117,75 (33,24)	1841,75 (136,60)	597,87 (81,96)	265,25 (43,86)	293,75 (15,10)	1073,75 (64,16)	370,75 (52,12)	845,25 (67,58)
IPP (%)	2,423 (36,1)	0,912 (2,3)	0,423 (1,1)	1,422 (1,2)	1,323 (5,2)	0,523 (1,2)	0,323 (3,2)	1,623 (2,2)	0,523 (1,2)	0,223 (1,6)	1,723 (13,1)	0,156 (1,4)	0,934 (1,6)	0,534 (30,4)	0,223 (3,2)
ΔLOAN (%)	7,221 (57,8)	11,767 (20,85)	9,208 (31,7)	16,101 (15,93)	31,239 (29,53)	15,329 (51,7)	12,719 (65,0)	38,086 (23,5)	36,167 (54,8)	23,905 (69,9)	25,373 (63,3)	12,651 (25,7)	22,206 (46,4)	6,254 (22,8)	23,940 (62,2)
RMSHARE (%)	20,032 (17,0)	20,902 (11,1)	16,932 (10,8)	27,923 (14,2)	35,623 (15,2)	29,734 (21,2)	29,821 (18,3)	23,523 (11,2)	24,232 (23,2)	32,321 (26,2)	26,823 (15,2)	11,012 (8,3)	26,121 (15,2)	34,523 (28,2)	31,623 (26,9)
RPPRICE (%)	0,318 (0,70)	1,903 (4,93)	7,373 (3,09)	5,271 (8,11)	7,472 (6,14)	5,510 (8,20)	7,296 (6,60)	4,536 (4,76)	2,568 (1,05)	4,210 (6,90)	5,188 (2,01)	6,316 (4,55)	-2,255 (2,16)	4,791 (10,12)	5,618 (4,11)

Table 7: Determinants of Banks' Risk: Dynamic Panel Analysis

Panel A: Total Sample

This table reports the estimation results of six regressions based on equation (4). The dependent variable **RISK** is the ratio of provisions for loan losses and the total net loans and is used as a proxy of the bank's credit risk. This variable appears transformed (dependent variable $\ln(RISK_{it}/(1-RISK_{it}))$). **GDP** is the real GDP growth; **DFAM** is the ratio between the liabilities of families and the GDP; **DEMP** is the ratio between the liabilities of firms and GDP; **LOAN_TO_ASSETS** is the ratio of total loans to total assets; **INEF** is the ratio of operating costs to gross income; **SIZE** is the ratio between bank assets *i* and the total bank assets; **MARGIN** is the proxy for bank profitability measured by net interest margin (gross margin); **EQUITY** is the ratio between the capital and total assets; **PREM** is obtained from the difference between interest income over total assets and the interbank interest rate; **RMSHARE** is the weight of residential mortgage loans in the total bank assets; **RPPRICE** is the rate of growth in real terms of the residential housing market prices (or region, in the case of regression VI, for banks with regional or international exposure to the housing market). **LTV** is the average loan to value ratio in the country where the bank operates. We use the Dynamic Panel Analysis (Arellano e Bond, 1991) and GMM estimation procedure. *t* statistics are presented in brackets. [a], [b] and [c] denote statistical significance at 1%, 5% and 10%, respectively.

Variables	I	II	III	IV	V	VI
$RISK_{it-1}$	0,3165[a]	0,3333[a]	0,3354[a]	0,2205[a]	0,2258[a]	0,1224[b]
	(10,63)	(10,95)	(10,57)	(7,94)	(7,89)	(2,02)
GDP_t	-0,0495[a]	-0,0468[a]	-0,0459[a]	-0,0303[a]	-0,0297[a]	-0,0637[a]
	(-9,77)	(-9,24)	(-8,84)	(-5,82)	(-5,66)	(-6,88)
GDP_{t-1}	-0,0327[a]	-0,0354[a]	-0,0347[a]	-0,0295[a]	-0,0292[a]	-0,0417[a]
	(-6,97)	(-7,36)	(-7,21)	(-6,04)	(-5,96)	(-4,84)
$DFAM_t$	0,0067[a]	0,0058[a]	0,0049[a]	0,0121[a]	0,0121[a]	0,0053[b]
	(4,93)	(4,32)	(3,67)	(5,02)	(5,01)	(2,24)
$DEMP_t$	-0,0004	-0,0004	-0,0003	-0,0012[a]	-0,0011[a]	-0,0007[c]
	(-1,26)	(-1,20)	(-0,86)	(-3,71)	(-3,33)	(-1,75)
$LOAN\_TO\_ASSETS_{it-1}$	0,7091[a]	0,7279[a]	0,7461[a]	0,6380[a]	0,6371[a]	0,1751[b]
	(4,84)	(4,93)	(4,91)	(4,63)	(4,44)	(2,01)
$LOAN\_TO\_ASSETS_{it-2}$	-0,0244	-0,0379	-0,0653	-0,0021	-0,0233	0,0690
	(-0,26)	(-0,40)	(-0,67)	(-0,02)	(-0,24)	(1,49)
$LOAN\_TO\_ASSETS_{it-3}$	-0,0643	-0,0701	-0,1030	0,0143	-0,0168	0,1370[c]
	(-0,62)	(-0,67)	(-0,96)	(0,12)	(-0,14)	(1,71)
$INEF_{it}$	0,0006	0,0005	0,0005	0,0000	0,0000	0,0007
	(1,31)	(1,03)	(1,02)	(0,97)	(0,91)	(1,37)
$SIZE_{it}$	-2,4212[a]	-2,4531[a]	-2,4623[a]	-2,6112[a]	-2,6558[a]	-2,5698[a]
	(-3,93)	(-3,88)	(-4,38)	(-3,91)	(-4,25)	(-4,09)
$MARGIN_{it-2}$	0,0721[c]	0,0697[c]	0,0636[c]	0,1007[b]	0,0966[b]	0,0017[b]
	(1,89)	(1,80)	(1,77)	(2,22)	(2,01)	(2,18)
$MARGIN_{it-3}$	0,0698	0,0740	0,1158	-0,0468	-0,0425	-0,0043
	(0,71)	(0,74)	(1,11)	(-0,40)	(-0,34)	(-1,17)
$EQUITY_{it-2}$	0,0620	0,0741	0,0125	-0,0943	-0,1372	0,2099
	(0,20)	(0,24)	(0,04)	(-0,33)	(-0,46)	(0,50)
$EQUITY_{it-3}$	0,2368	0,1576	0,0303	-0,0995	-0,2562	0,3654
	(0,86)	(0,56)	(0,10)	(-0,31)	(-0,76)	(0,37)
$PREM_{it-3}$	-0,2104	-0,2395	-0,4852	0,2245	0,1056	0,0278
	(-0,36)	(-0,41)	(-0,79)	(0,41)	(0,18)	(1,33)
$\mathbf{RMSHARE_{it}}$	-1,0151[a]	-0,9584[a]		-0,8733[a]		-1,2310[a]
	(-4,73)	(-4,52)		(-4,22)		(-4,80)
$\mathbf{RPPRICE_{t-1}}$			-0,0015[c]		-0,0016[c]	
			(-1,71)		(-1,80)	
$\mathbf{RMSHARE_{it}*RPPRICE_{t-1}}$		-0,0072[a]	-0,0098[a]	-0,0067[a]	-0,0082[a]	-0,0069[a]
		(-3,53)	(-4,69)	(-3,40)	(-4,04)	(-2,82)
$\mathbf{LTV_t}$				0,0876[a]	0,0842[a]	
				(8,36)	(7,90)	
Time Period	1999-2008	1999-2008	1999-2008	1999-2008	1999-2008	1999-2008
# Observations	4540	4540	4540	4540	4540	4540
Sargan Test (*p-value*)	0,235	0,245	0,267	0,289	0,278	0,253
AR (1) and *p-value*	-3,3[a] (0,01)	-2,9[a] (0,00)	-2,7[a] (0,00)	-2,8[a] (0,00)	-2,1[b] (0,03)	-2,0[b] (0,04)
AR (2) and *p-value*	-0,4 (0,75)	0,4 (0,80)	-1,3 (0,20)	-0,5 (0,67)	-1,1 (0,29)	-0,9 (0,21)

Table 7: Determinants of Banks' Risk: Dynamic Panel Analysis (cont.)

Panel B: Subsamples

This table reports the estimation results of four regressions based on equation (4), for subsamples. We use the Dynamic Panel Analysis (Arellano e Bond, 1991) and GMM procedure. The dependent variable **RISK** is the ratio of provisions for loan losses and the total net loans and is used as a proxy of the bank's credit risk. This variable appears transformed (dependent variable $\ln(RISK_{it}/(1-RISK_{it}))$). **GDP** is the real GDP growth; **DFAM** is the ratio between the liabilities of families and the GDP; **DEMP** is the ratio between the liabilities of firms and GDP; **LOAN_TO_ASSETS** is the ratio of total loans to total assets; **INEF** is the ratio of operating costs to gross income; **SIZE** is the ratio between bank assets *i* and the total bank assets; **MARGIN** is the proxy for bank profitability measured by net interest margin (gross margin); **EQUITY** is the ratio between the capital and total assets; **PREM** is obtained from the difference between interest income over total assets and the interbank interest rate; **RMSHARE** is the weight of residential mortgage loans in the total bank assets; **RPPRICE** is the rate of growth in real terms of the domestic residential housing market prices.

Regression VII includes the banks of Germany and Austria. Regression VIII includes de banks of Spain, Ireland and UK. Regressions IX and X are estimated for the first quartile and fourth quartile, according to the weight of residential mortgage loans in total loans, respectively. *t* statistics are presented in brackets. [a], [b] and [c] denote statistical significance at 1%, 5% and 10%, respectively.

Variables	VII	VIII	IX	X
$RISK_{it-1}$	0,4341[a]	0,2439[a]	0,1837[a]	0,4509[a]
	(11,60)	(11,75)	(4,27)	(20,00)
GDP_{t}	-0,0875[a]	-0,0778[a]	-0,0543[a]	-0,0512[a]
	(-7,27)	(-9,49)	(-5,10)	(-7,13)
GDP_{t-1}	-0,0874[a]	-0,0152	-0,0340[a]	-0,0020
	(-6,41)	(-1,56)	(-3,01)	(-0,33)
$DFAM_{t}$	0,0492[a]	0,0049[a]	0,0149[a]	0,0044[b]
	(8,54)	(2,96)	(4,37)	(2,31)
$DEMP_{t}$	0,0113	-0,0015[a]	-0,0005	-0,0013[a]
	(1,36)	(-2,96)	(-0,74)	(-3,10)
$LOAN\_TO\_ASSETS_{it-1}$	0,8430[a]	0,8647[a]	0,5518[c]	0,3908[a]
	(4,37)	(5,70)	(1,89)	(2,64)
$LOAN\_TO\_ASSETS_{it-2}$	-0,4459[b]	0,2384[c]	-0,2113	0,0321
	(-2,21)	(1,66)	(-1,60)	(0,16)
$LOAN\_TO\_ASSETS_{it-3}$	-0,1108	0,1291	0,1410	0,3452[b]
	(-0,39)	(0,69)	(0,84)	(2,14)
$INEF_{it}$	0,0013	0,0008	0,0004	0,0028[a]
	(1,15)	(1,06)	(0,64)	(3,17)
$SIZE_{it}$	-4,4392[a]	-4,271[a]	-3,2162	-2,6558[a]
	(-3,36)	(-2,82)	(-1,49)	(-4,25)
$MARGIN_{it-2}$	0,1037	0,0556	0,1401[b]	-0,2973
	(1,18)	(0,27)	(2,53)	(-1,25)
$MARGIN_{it-3}$	0,2212[c]	1,7370[c]	-0,1157	-0,2420
	(1,69)	(1,93)	(-0,69)	(1,19)
$EQUITY_{it-2}$	-0,3141	0,4977	0,6365[c]	-0,6511
	(-0,47)	(0,84)	(1,65)	(-1,15)
$EQUITY_{it-3}$	-0,7999[c]	-0,0146	0,0960	0,3852
	(-1,66)	(-0,02)	(0,23)	(1,029)
$PREM_{it-3}$	0,0129[c]	-0,0207[a]	0,0116	0,0254[a]
	(1,67)	(-3,68)	(1,18)	(4,26)
$RMSHARE_{it}$	-1,5913[a]	-0,6654[b]	-4,1373[a]	-0,3863[b]
	(-3,53)	(-2,37)	(-3,44)	(2,44)
$RMSHARE_{it}$ * $RPPRICE_{t-1}$	0,0557[a]	-0,0125[a]	-0,0385[b]	-0,0106[a]
	(4,44)	(-5,90)	(-2,03)	(-6,50)
Time Period	1999-2008	1999-2008	1999-2008	1999-2008
# Observations	688	1273	1011	1081
Sargan Test (*p-value*)	0,158	0,132	0,395	0,167
AR (1) and *p-value*	-5,5[a] (0,00)	-2,3[b] (0,01)	-2,9[a] (0,00)	-3,1[a] (0,00)
AR (2) and *p-value*	-0,3 (0,78)	0,1 (0,90)	0,3 (0,75)	-0,2 (0,81)

Table 8: Profitability Determinants: Dynamic Panel Analysis

Panel A: Linear Regressions

This table reports the estimation results of 5 regressions on the profitability of banks based on equation (5). We use the Dynamic Panel Analysis (Arellano e Bond, 1991) and GMM procedure. The dependent variable **MARGIN** is measured by net interest margin (gross margin) and is used as the proxy for bank profitability. **GDP** is the real GDP growth; **BBMB** is a dummy that takes the value 1 for banks that operate in financial systems based on the banking sector and the value 0 for systems based on the capital market. The dummy variable takes the value 0 to the Netherlands, UK, Finland, Denmark and Ireland and the value 1 for the remaining countries of the EU-15; **RISK** is the proxy of the bank's credit risk and is measured by the ratio of provisions for loan losses and the total net loans; **LIQ** is the ratio of net loans to short term funding; **SDR3M** is the annual standard deviation of the daily interbank at 3 month interest rate; **HH** is the Herfindahl e Hirschman Index obtained via total assets on the domestic market (the ratio was obtained from the ECB and range between 0 and 10.000); **INEF** is the ratio of operating costs to gross income; **ΔLOAN** is the loans growth rate; **EQUITY** is the ratio between the capital and total assets; **IPP** is the ratio non-interest expenses – non-interest revenues)/total assets; **RMSHARE** is the weight of residential mortgage loans in the total bank assets; **RPPRICE** is the rate of growth in real terms of the domestic residential housing market prices (or region, in the case of regression III, for banks with regional or international exposure to the housing market). In the case of regressions IV and V, RPPRICE is the accumulated growth rate of real market prices of residential housing in the country (or region, in the case of regression V, for banks with regional or international exposure to the housing market). *t* statistics are presented in brackets. [a], [b] and [c] denote statistical significance at 1%, 5% and 10%, respectively.

Variables	I		II		III		IV		V	
$MARGIN_{it-1}$	5,805[a]	(19,65)	5,802[a]	(19,53)	5,807[a]	(29,64)	5,809[a]	(31,16)	5,808[a]	(31,02)
GDP_t	0,134[a]	(4,78)	0,142[a]	(5,00)	0,135[a]	(4,79)	0,132[a]	(4,67)	0,132[a]	(4,66)
GDP_{t-1}	0,035	(1,24)	0,030	(1,06)	0,037	(1,27)	0,044	(1,50)	0,043	(1,49)
$BBMB_t$	0,399[a]	(9,81)	0,389[a]	(9,63)	0,402[a]	(9,64)	0,363[a]	(9,08)	0,363[a]	(9,06)
$RISK_{it-2}$	0,483[a]	(12,57)	0,482[a]	(12,40)	0,484[a]	(12,62)	0,484[a]	(13,11)	0,484[a]	(13,07)
$RISK_{it-3}$	0,793[a]	(14,05)	0,792[a]	(13,84)	0,794[a]	(14,12)	0,796[a]	(14,74)	0,795[a]	(14,69)
LIQ_{it-1}	0,117[b]	(2,46)	0,123[b]	(2,46)	0,001[b]	(2,46)	0,001[b]	(2,27)	0,001[b]	(2,29)
LIQ_{it-2}	0,028	(0,58)	0,067	(1,21)	0,000	(0,65)	0,000	(0,82)	0,000	(0,81)
$SDR3M_{it-1}$	0,207[a]	(3,10)	0,197[a]	(2,96)	0,208[a]	(3,11)	0,212[a]	(3,18)	0,213[a]	(3,18)
$SDR3M_{it-2}$	0,360[a]	(4,34)	0,331[a]	(3,99)	0,364[a]	(4,33)	0,323[a]	(3,94)	0,325[a]	(3,96)
HH_t	-0,042	(-1,05)	-0,043	(-1,06)	0,000	(0,16)	0,000	(0,51)	0,000	(0,47)
$INEF_{it}$	-0,005[c]	(-1,95)	-0,005	(-2,04)	-0,005[b]	(-1,96)	-0,004[c]	(-1,91)	-0,004[c]	(-1,91)
$\Delta LOAN_{it}$	-0,010[a]	(-7,50)	-0,010[a]	(-7,24)	-0,011[a]	(-7,47)	-0,011[a]	(-7,57)	-0,011[a]	(-7,55)
$EQUITY_{it-2}$	9,891[a]	(2,86)	10,011[a]	(2,88)	9,839[a]	(2,86)	9,700[a]	(2,83)	9,700[a]	(2,83)
$EQUITY_{it-3}$	-0,882	(-0,29)	-0,823	(-0,27)	-0,925	(-0,31)	-0,658	(-0,22)	-0,639	(-0,22)
IPP_{it}	4,374[c]	(1,66)	4,448[c]	(1,66)	4,360	(1,23)	4,146	(1,23)	4,165	(1,23)
$RMSHARE_{it}$	1,904[c]	(1,83)	2,104[b]	(2,01)	1,878[c]	(1,82)	2,053[b]	(1,99)	2,078[b]	(2,01)
$RMSHARE_{it}$*$RPPRICE_{t-1}$			-0,024[a]	(-3,61)	0,005	(0,49)	-0,025[a]	(-5,06)	-0,028[a]	(-4,86)
Time Period	2002-2008		2002-2008		2002-2008		2002-2008		2002-2008	
# Observations	3555		3555		3555		3555		3555	
Sargan Test (*p-value*)	0,179		0,145		0,130		0,149		0,158	
AR (1) and *p-value*	-4,5[a]	(0,00)	-3,8[a]	(0,01)	-3,3[a]	(0,00)	-3,6[a]	(0,00)	-4,0[a]	(0,00)
AR (2) and *p-value*	-0,5	(0,38)	-0,2	(0,82)	-0,5	(0,22)	0,1	(0,78)	-0,3	(0,55)

Table 8: Profitability Determinants: Dynamic Panel Analysis: Subsamples (cont.)

Panel B: Quadratic Regressions

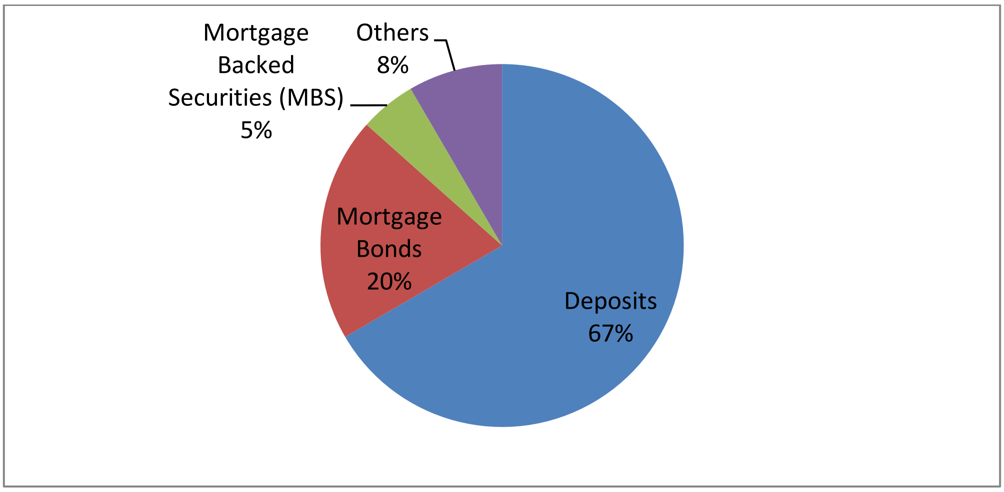
This table reports the estimation results of 4 regressions on the profitability of banks based on equation (6). We use the Dynamic Panel Analysis (Arellano e Bond, 1991) and GMM procedure. The dependent variable **MARGIN** is measured by net interest margin (gross margin) and is used as the proxy for bank profitability. **GDP** is the real GDP growth; **BBMB** is a dummy that takes the value 1 for banks that operate in financial systems based on the banking sector and the value 0 for systems based on the capital market. The dummy variable takes the value 0 to the Netherlands, UK, Finland, Denmark and Ireland and the value 1 for the remaining countries of the EU-15; **RISK** is the proxy of the bank's credit risk and is measured by the ratio of provisions for loan losses and the total net loans; **LIQ** is the ratio of net loans to short term funding; **SDR3M** is the annual standard deviation of the daily interbank at 3 month interest rate; **HH** is the Herfindahl e Hirschman Index obtained via total assets on the domestic market (the ratio was obtained from the ECB and range between 0 and 10.000); **INEF** is the ratio of operating costs to gross income; **ΔLOAN** is the loans growth rate; **EQUITY** is the ratio between the capital and total assets; **IPP** is the ratio non-interest expenses – non-interest revenues)/total assets; **RMSHARE** is the weight of residential mortgage loans in the total bank assets; **LTV** is the average loan to value ratio, by country. Regressions VI and VII include all the banks. Regressions VIII and IX are estimated for the first quartile and fourth quartile, according to the weight of residential mortgage loans in total loans, respectively. *t* statistics are presented in brackets. [a], [b] and [c] denote statistical significance at 1%, 5% and 10%, respectively.

Variables	VI		VII		VIII		IX	
$MARGIN_{it-1}$	4,575[a]	(8,75)	5,220[a]	(13,70)	1,102[a]	(12,99)	0,811[a]	(22,46)
GDP_t	0,071[a]	(2,91)	0,122[a]	(4,71)	0,078[a]	(2,59)	0,026[a]	(4,83)
GDP_{t-1}	0,034[c]	(1,66)	0,099[a]	(3,92)	0,093[b]	(2,27)	-0,004	(-0,47)
$BBMB_t$	0,296[a]	(6,44)	0,137[b]	(2,41)	-0,005	(0,11)	-0,036[a]	(-2,93)
$RISK_{it-2}$	16,643[c]	(1,71)	7,727[c]	(1,86)	-0,462	(-0,23)	-2,277	(0,33)
$RISK_{it-3}$	-9,557[a]	(-2,66)	-3,434	(-0,60)	2,879[b]	(2,05)	4,871[a]	(-4,28)
LIQ_{it-1}	0,197[b]	(2,16)	0,160[a]	(3,49)	0,095[c]	(1,69)	0,003	(0,21)
LIQ_{it-2}	-0,001	(-0,07)	-0,020	(-0,48)	0,035	(0,25)	-0,007	(-1,61)
$SDR3M_{it-1}$	0,223[a]	(3,89)	0,224[a]	(3,79)	-0,034	(-0,24)	0,081[a]	(5,72)
$SDR3M_{it-2}$	0,244[a]	(3,83)	0,294[a]	(4,11)	-0,093	(-0,45)	0,233[a]	(9,10)
HH_t	0,172[a]	(3,33)	0,120[b]	(-2,54)	0,114[b]	(2,33)	0,004	(0,33)
$INEF_{it}$	-0,009[a]	(-2,94)	-0,008[a]	(-3,21)	-0,019[a]	(-4,46)	-0,005[a]	(-4,57)
$\Delta LOAN_{it}$	-0,051[a]	(-4,15)	-0,042[a]	(-2,77)	-0,007	(-0,50)	-0,155[b]	(-2,57)
$EQUITY_{it-2}$	10,634[a]	(3,11)	8,716[a]	(2,78)	-1,551	(-1,00)	-0,431	(-0,66)
$EQUITY_{it-3}$	0,894	(0,25)	1,817	(0,51)	-4,117[b]	(-2,03)	0,674[c]	(1,72)
IPP_{it}	22,915[b]	(2,36)	16,089[b]	(2,39)	88,942[a]	(4,71)	0,161[a]	(6,17)
$RMSHARE_{it}$	3,266[b]	(2,27)	4,937[a]	(3,06)	2,341[c]	(1,68)	1,074[a]	(5,49)
$RMSHARE_{it}$ * $RISK_{it-1}$	-228,108[a]	(-2,76)	-243,904[a]	(-3,00)	-570,271[a]	(-4,41)	-14,775[c]	(-1,70)
$RMSHARE_{it}$ * $(RISK_{it-1})^2$	2921,803[a]	(3,57)	2459,394[a]	(3,23)	1894,734[c]	(1,72)	1058,387[b]	(2,37)
LTV_t			0,563[a]	(7,56)				
Time Period	2002-2008		2002-2008		2002-2008		2002-2008	
# Observations	3554		3554		637		644	
Sargan Test (*p-value*)	0,175		0,157		0,126		0,111	
AR (1) and *p-value*	-4,8[a]	(0,00)	-3,6[a]	(0,01)	-3,9[a]	(0,00)	-5,2[a]	(0,00)
AR (2) and *p-value*	0,2	(0,88)	-0,6	(0,26)	-0,3	(0,62)	0,3	(0,58)

Table 9: Effects of Residential Mortgage Loans on Bank's Risk Adjusted Profitability

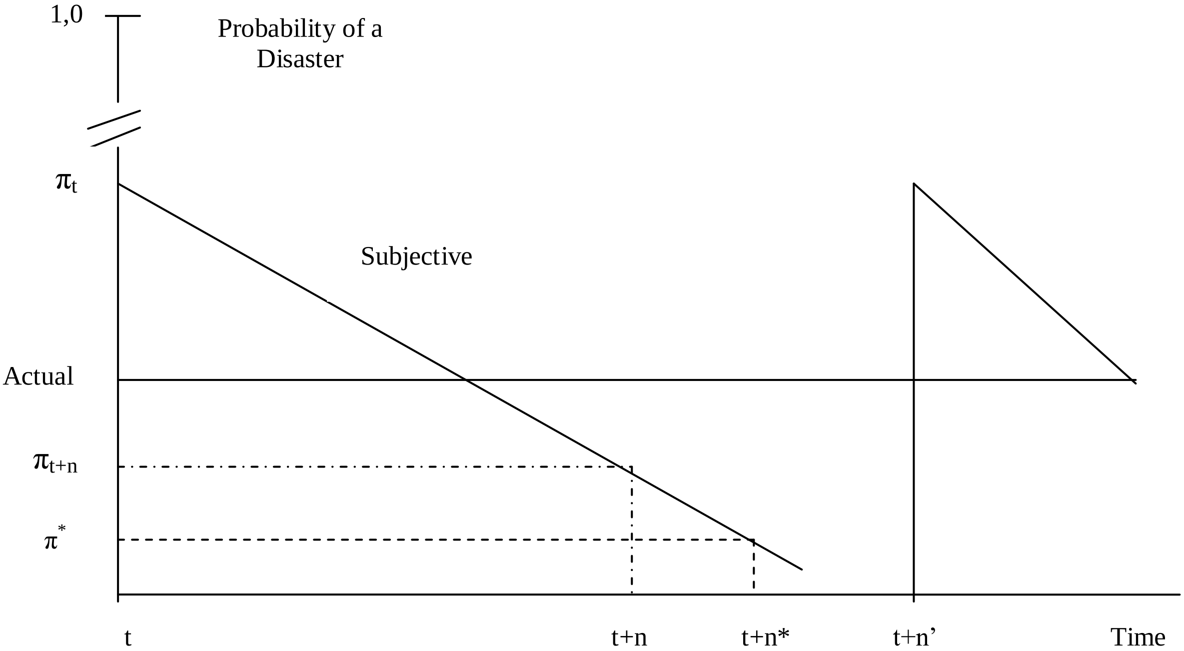
	Banks with Moderate Credit Risk	Banks with High Credit Risk
Effects of the Increase in the Weight of Residential Mortgage Loans on Asset Bank's	- Decrease of Credit Risk - Profitability Unaffected or Marginal Decrease ⇓ Increased Performance OR Effect on Performance Ambiguous	- Decrease of Credit Risk - Profitability Increase ⇓ Increased Performance

Figure 1: The financing of residential mortgage loans in the EU (2009)



Source: European Mortgage Federation (EMF) (www.hypo.org)

Figure 2: *Disaster Myopia*



Source: Herring and Wachter (1999)