Residential Property Loans and Bank Performance during Property Price Booms: Evidence from Europe

Abstract

Understanding the performance of banks is of the utmost importance due to the impact the sector may have on economic growth and financial stability. Residential mortgage loans constitute a large proportion of the portfolio of many banks and are one of the key assets in the determination of performance. Using a dynamic panel model, we analyse the impact of residential mortgage loans on bank profitability and risk, based on 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 in residential mortgage loans display lower credit risk in good market conditions. This result may explain why banks rush to lend on property during booms due to the positive effect it has on credit risk. The results also show that credit risk and profitability are lower during the upturn in the residential property cycle. Furthermore, the results reveal the existence of a non-linear relationship (**U**-shaped marginal effect), as a function of bank's risk, between profitability and residential mortgage exposure. For those banks that have high credit risk, a large exposure to residential loans is associated with increased risk-adjusted profitability, through a reduction in risk. For banks with a moderate to low credit risk, the impact of higher exposure is also positive on risk-adjusted profitability.

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

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1. Introduction

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

There is almost universal agreement that the fundamental cause of the subprime crisis was the combination of credit boom and housing prices bubble. Pezzuto (2008) refers to the low interest rates, high level of leverage, "credit euphoria" of both lenders and borrowers and a more aggressive short-term orientation, as the combined factors which strongly contributed to the subprime crisis. Acharya *et al.* (2011) note 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 have contributed in a major way to the subsequent sovereign credit crisis. This crisis affected financial markets as well as real economies resulting, in drops in productivity growth, increases in unemployment, 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 crisis in both emerging and developed (in this case European) markets. Verick and Islam (2010) find that the Baltic States, Ireland and Spain were the European Countries that suffered the most severe labour market impact and economic contraction as a result of the subprime crisis. In contrast, Germany and Austria were the least affected.

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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 80's), in Mexico and Japan (early 90's) and in 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

Of all the different assets that comprise banks' portfolios, real estate related ones are particularly important for two particular reasons. Firstly, mortgage loans represent one of its largest 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) argue that during an upswing of real estate prices, banks have a tendency 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 an emphasis on size growth, following the liberalisation of the banking sector and by the loss of institutional memory regarding the possibility of property prices collapse, leads to banks taking excessive risks whereas the charged risk premium may be insufficient to cover potential losses[4]. Jimenez *et al.* (2006) state that during booms, riskier borrowers obtain credit more easily 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 to a greater extent in areas that experienced faster credit growth. They also note that the entry of new lenders contributed to the decline in lending standards. With specific reference to the subprime experience in the US, Demyanyk and van Hemert (2011) report that loan quality consistently declined for the six years prior to the crisis in 2007. They note that the high level of house price appreciation observed in the US during this period contributed to the decline in loan quality[5].

Gentle *et al.* (1994) examine the extent of "negative equity"[6] in the United Kingdom in the early 90s, noting that the "property owning democracy" led to a "nation of debtors", after the collapse of property prices. The phenomenon of negative equity has also been observed by White (2010a, 2010b), who states that, in the US, the collapse of property

[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] For specific work on default and foreclosures in the US subprime market in recent years see papers such as Gerardi *et al.* (2007) and Dalglish (2009).

[6] "Negative equity" 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.

prices resulted in an increasing number of defaults, since the property market prices fell below the original mortgage advance used to buy the property[7].

Despite extensive literature on the relationship between bank loans and real estate prices at a macroeconomic level, only a 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 banks. Furthermore results may be biased given that most studies separately examine 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 consider, the specific risks associated with banks' real estate loan portfolios (see Salas and Saurina, 2002)[8]. 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 find that the performance of banks and bank loans are strongly correlated with asset price changes, particularly real estate asset, 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 instead of commercial real estate assets and of the changes in real estate prices on banks' risk and return~~,~~. Secondly, our sample includes EU-15 banks 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 taking in 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

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

[8] 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*".

mortgage loans on the balance sheet is associated with lower credit risk for banks in good times. The results obtained further show a reduction in both credit risk and profitability for banks during the upturn in the price cycle pertaining to the residential property sector. We also observe a non-linear relationship (U-shaped), function of bank's risk, between profitability and the balance-sheet exposure to residential 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 facilitate 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, at least marginally so.

The paper is structured as follows. 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 summarize the research questions and present 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), among others authors, state that there are significant differences between the EU countries with regard to the characteristics of the mortgage market[9]. These institutional differences may aid in explaining the differences observed in the volatility of prices and influence differential bank's 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% share of the entire European mortgage bond market. In Germany "*Hypotheken Pfandbriefe*"

[9] 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; accepted property valuation methods and the availability of asset securitization.

represented 44% of all the mortgage bonds issued in the EU, followed by Denmark (29%) and Sweden (15%)[10].

Coles and Hardt (2000) highlight a number of institutional factors which help in explaining the relative small size of Mortgage Backed Securities' (MBS) in Europe, in contrast to the situation in the USA[11]. These factors include the existence of other types of competitive funding resources on the balance sheet, which is the case with Mortgage-Backed Bonds.

It is difficult to measure the total exposure to residential mortgage loans for those banks with extensive securitisation operations, as 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 bank's decisions, in a macroeconomic perspective, others evaluate the role of real estate exposures in bank's profitability and risk.

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 and credit cycles: decreased economic activity leads to a feedback cycle of falling asset prices, deteriorating balance sheets, tightening financing conditions and constrained external financing 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

[10] Acharya *et al.* (2011) identify the existence of three major funding models for mortgage credit in developed economies: the classic deposit-based system; the MBS – based system (used extensively in the US) and the mortgage or covered bond system (popular in continental Europe). 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 not only a general claim on the issuing bank but also on the underlying mortgage collateral in the event that banks default.

[11] Amongst the reasons that Coles and Hardt (2000) identified are: higher capital requirements; the existence of other competitive funding instruments on the balance sheet; the lack of permission for state guarantees; the lack of consistent statistics (hindering the valuation of securitised products); and legal complexity and lack of standardisation.

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) depends 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 bank capitalisation. On the other hand, the real estate sector may further affect the banking sector indirectly via, its overall economic impact. If property market fundamentals are sufficiently strong then developers will initiate new projects. This construction activity generates new demand for other sectors and thus tends to cause an expansion in the general economy and may stimulate general demand for bank credit.

Although the theory and empirical evidence predicts that the increase in property prices leads to a rise loan approval, the impact of real estate prices on bank risk and profitability is less obvious (Herring and Wachter, 1999). In an efficient market, the interest rate charged by a bank should reflect the true default risk for the underlying assets, and therefore, bank profitability should only depend on whether they are more or less risk-averse. However, the profitability of the banking sector might not increase throughout a property cycle if the mortgage credit risk premium component stays low from the start of the cycle. This may result in banks changing their attitudes towards risk throughout the 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) argue that banks may underestimate the default risk on mortgages loans during strong property market conditions. Specifically, banks have a tendency 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 a changing tolerance for risk. Furthermore, this myopia can in part 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).

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[12]. A further element in this regard is that participants in residential property markets frequently display extrapolative or adaptive expectations (Case and Shiller, 1989, Poterba, 1991). This can contribute to the presence of myopic expectations in that participants may fail to account for potential reversals in price trends (Malpezzi and Wachter, 2005, Stevenson, 2008).

Once a shock occurs, disaster myopia tends to become disaster magnification. 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). The net result of this is that the disaster myopia phenomenon might lead to banks taking excessive risks, while the risk premium required may not be sufficient to compensate for potential losses.

Another related issue is concerned with the *diversification versus focus* debate (e.g. 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[13].

2.2.2. Other Determinants of Bank Risk and Profitability

Previous studies identify other risk and profitability determinants used that we briefly review below.

Credit Risk

a. Macroeconomic Factors

The empirical evidence suggests that there is a close relationship between bank 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

[12]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.

[13] For evidence regarding this see, for example, the works of Acharya *et al.* (2006), Elyasiani and Deng (2004) and Guttentag and Herring (1985, 1986).

on payments to banks. In this paper we use the GDP growth rate to proxy economic activity as 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 aggregate economic activity may have different effects on credit risk. Moreover, such effects may vary from country to country due to differences in the 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 a company's indebtedness increases the likelihood of bankruptcy. In contrast, in Japan the opposite effect is observed. 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 the financial situation of firms. 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].

b. Microeconomic Factors

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

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 for the composition of banks' loans portfolio, show evidence that past loan growth aids in explaining current levels 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, a bank will probably try to keep its best customers and will let go its lowest-quality customers. Consequently, if 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.

[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.

Credit monitoring is also another key element in ensuring 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 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 different credit categories have different levels of risk, and that the real estate and construction sectors come out on top as the riskiest 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 highest interest rates are those which previously had higher 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 relying 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 for this slow but steady decrease by adopting riskier credit policies that could eventually lead to an increase in bad loans.

Profitability

a. 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

[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.

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 system (in which bank balance-sheet activities are comparatively high in relation to bank credit activities) or a market-based system (in which capital markets activities are comparatively high in relation to bank credit activities).

b. 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, namely 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 rate 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 explaining the interest margins, capturing the influence of institutional, regulatory and quality of management aspects, which could potentially distort the "pure" interest margin. Saunders and Schumacher (2000) also argue that regulation, in the form of

[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.*"

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 effects can emerge in the deterioration of the banks' loan portfolio and simultaneously in reduced profitability (possibly driven by deterioration in the effectiveness of banking monitoring, adverse selection, increased general expenditure, or a combination of these factors).

3. Sample and Methodology

3.1. Research Questions

The paper considers three core research 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:

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

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 growth rate in real residential property prices.

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 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:

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

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 real residential property growth rate or the accumulated growth rate of real housing prices.

The results will allow an evaluation of whether 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}).

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 the overall credit quality in the portfolio declines. In a context of asymmetric information, Marquez (2002) notes that an increase in the number of banks in a market leads to a dispersion of borrower-specific information and will result in not only higher funding costs for low-quality borrowers but also in easier 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 also borrow more in terms of LTV. This leads to a combined impact. Firstly, they are purchasing properties at higher prices due to buying later in the cycle. This together with higher borrowing, in terms of LTV, leads to such borrowers being more vulnerable to negative equity[17]. Thus it is

[17] This impact was particularly evident during the subprime crisis. Default and foreclosure rates for the loans originated in 2006 and 2007 were substantially higher than those originated prior to 2005.

likely that the impact of residential mortgage loans on bank profitability will 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 to diversify as much as possible, Elyasiani and Deng (2004) and Acharya *et al.* (2006), in turn, suggest the possible existence of diseconomies of diversification. They state that the relationship between profitability and the degree of concentration of banking activity could be a nonlinear function of bank risk.

Another additional factor reinforcing the non-linear relationship between bank returns and the weight of residential mortgage loans in total assets are the conflicts of interests between bank owners and bank creditors. More specifically, an increase in the probability of insolvency reduces the incentive for 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 thus 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, may lead to lower returns for the bank.

Given the above arguments, the relationship between residential mortgage loans and profitability could be a 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 can be described as:

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

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:

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

where *RISK* is the proxy for bank *i* credit risk as measured by the ratio between loan loss provisions to net loans in period *t*[18]; *RMSHARE* is the weight of residential mortgage loans on total assets of the bank; *RPPRICE* is the rate of growth in real terms of the residential housing prices (in the country or region, for those banks whose exposure to the real estate market is at a regional level). Table 1 presents the residential housing price series used in this study.

INSERT TABLE 1

We use the following control variables. *GDP* is 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* is the ratio between the bank's total credit and total assets; *INEF* 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* is the *proxy* for bank profitability measured by net interest margin (gross margin); *EQUITY* is the ratio between equity capital and total assets; *PREM* is the difference between interest income over total assets and the interbank interest rate; The η_i captures the unobservable effects of

[18] 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 intrinsic characteristics of bank *i* (such as managers' risk-aversion and preferences). ε_{it} is the error term. The detailed definition of the variables and the expected relationships are shown in table 2[19].

INSERT TABLE 2

3.2.2. Profitability Model

We estimate the following linear regression:

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

We use the *Net Interest Margin* as a proxy for bank profitability (*MARGIN*)[20]. *RMSHARE* and *RPPRICE* are defined as above. The following control variables are used. *BBMB* 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* is defined as above and lagged two and three periods. *LIQ* 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*are Implicit Interest Payments given by the ratio of [*Non-Interest Expenses – Non-Interest Revenues*] to *Total Assets*. The other variables

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

[20] 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.

are defined as above. The detailed definition of these variables and the expected relationships are shown in table 3.

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:

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

We also consider the impact of mortgage credit market 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 to equations (4) to (6).

3.3. Dynamic Panel Data Models

Salas and Saurina (2002) and Valverde and Fernández (2007) suggest using 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).

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 variables 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 linear GMM estimation. 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)[21]. 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.

Jimenez *et al.* (2012) show that changes in EU monetary policy affect bank lending and bank risk-taking in all EU countries. They analyze the effects of monetary conditions and economic activity on the granting of loans with individual loan applications records depending on the strength of bank balance sheets measured by bank capital and liquidity ratios. To capture omitted variables, that vary across time (and affect all banks in EU), they control for time-varying observed and unobserved firms heterogeneity with firm-month fixed effects (i.e. there is a dummy for every-year or month combination). As in Jimenez *et al.* (2012) to analyze and quantify the effects of residential property loans on bank performance, we include observable bank characteristics and bank fixed effects in the specifications, thereby inevitably weakening performance identification. Therefore, we report estimations with and without time fixed effects.

3.4. Sample

The sample is composed of an unbalanced panel of annual data, obtained from the financial reports and accounts of 555 banks within the EU-15 countries for the period

[21] 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. 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. Under the null hypothesis of no second-order serial correlation, this test has a standard-normal distribution.

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 data was obtained from BANKSCOPE. Banks with less than three consecutive years of observations, or missing information in terms of the explanatory variables, were excluded. 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 annual reports and accounts[22].

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

The data relating to the concentration index, interbank market interest rates; residential housing prices; 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

Preliminary analysis per country shows that Spain, United Kingdom, and Ireland are the countries with the highest weights of residential mortgage loans in terms of total bank assets. This is not particularly surprising given the high house price appreciation observed prior to 2007 in these countries. Additionally, banks in these countries operated

[22] 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.

under less conservative credit policies (Martins *et al.* 2012). Further, these markets have some of the highest owner-occupancy rates in the EU-15. It is therefore not surprising that these three countries are the countries with the highest weight in residential mortgage loans. In contrast, markets such as Germany and Austria not only have more conservative lending practices (Martins *et al.* 2012) but also experienced far lower rates of house price appreciation and the weight of residential mortgage loans in terms of total assets is substantially 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). Panel B shows the estimated coefficients for relevant subsamples of banks.

The results suggest that banks that increase their exposure to 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 lending leads to a decrease in bank credit risk.

INSERT TABLE 7

Martins *et al.* (2011) argue that due to the accentuated process of bank internationalisation and integration at a regional and international level, real estate assets tend to be related with regional or international residential prices. The authors therefore suggest the use of 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 residential property prices in the case of banks whose exposure to real estate is at a regional or international scale[23]. The results reveal that an increase in the weight of residential mortgage loans in total assets leads to a greater decrease in credit risk.

[23] 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

Despite the possibility of the "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 residential mortgage loans and credit risk tends to be only recognized in bank balance sheets *a posteriori*, namely during a collapse in property prices. Therefore, these results must be taken with caution and in this context.

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 not at a statistically significant degree. The weight of credit in bank assets and banks' relative size also affects the level of loans provision, as expected. The results illustrate 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 at conventional levels. This may be the result of multicolinearity issues. 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. Therefore, a negative sign is to be expected. However, capital ratios that are too-low may lead to banks to "*gamble for resurrection*". This may lead to having the opposite impact on banks' lending decisions.

Banks' interest margins are statistically significant. As for the proxy for the risk premium, it is not statistically significant in the specifications for all the banks (panels A and C), but statistically significant in 3 of the 4 specifications (panel B) and in 2 of the 4 regressions (panel D) for the subsamples. 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 the specifications IV, V, XIV and XV shown in table 7 (panels A and C) is to analyse the impact of institutional factors on bank credit risk. We use the "*Loan-to-Value*" (LTV) ratio, obtained from the ECB, which corresponds to the average loan-to-

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and accounts, namely the primary and secondary segment reporting, which banks are obliged to disclose in accordance with IAS 14 and IFRS 8.

value ratio in the country where the bank operates. The LTV ratios are used due to the absence of information set out individually by banks regarding these ratios. Specification IV, V, XIV and XV show that countries with higher LTV ratios observe higher level of loan losses provisions.

In panels C and D (table 7) we add time fixed effects to the bank fixed effects in all previous specifications. Time fixed effects capture the changes in economy wide conditions, such as current and future expectations of GDP growth, inflation, and interest rates and general shocks affecting the economy. The results obtained are in line with those obtained in panel A.

We repeat the regressions based on subsamples of banks (panel B). Specifications 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. This reduction is more notorious in estimations with time fixed effects (specification XVII on panel D). Moreover, the specification XVIII (with time fixed effects) shows that in the cluster of Spain, Ireland and United Kingdom, the impact of increasing residential mortgage loans on total assets leads to an increase in credit risk. Specifications 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. Identical conclusions, but more pronounced, are also found in specifications XIX and XX estimated with time fixed effects.

The empirical models were estimated by making some changes in order to assess the robustness of the results. Firstly, to avoid some of the multicolinearity issues, we remove from the model all of the lagged variables where the coefficient was not statistically significant. 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. These results are available upon request.

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

4.2. Profitability Model

Table 8 (panel A) 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 results of the five specifications 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 specification II, we conclude that bank profitability tends to decrease during an upturn in the residential property cycle. This can be at least partly explained by the "disaster myopia" phenomenon. As discussed above, in periods of house prices rises, banks tend to expand credit to riskier customers and collateral requirements tend to decrease. These conclusions are also corroborated by specifications 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 specification V) where a bank operates.

The conclusion that bank profitability decreases during an upturn in the residential property cycle is also corroborated by specifications X to XIV (panel C), estimated with time fixed effects. There is however no statistical evidence in estimations with time fixed effects.

INSERT TABLE 8

Table 8 (panel B) tests the hypothesis of a non-linear relationship between profitability and the weight of residential mortgage loans as specified in equation (6). The results support the hypothesis that there is a U-shaped non-linear relationship. 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 at conventional levels. This conclusion is also corroborated by r specifications XV to XVIII in panel D (with time fixed effects). The results of the *F*-statistic to test for the 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.

As for the control variables, the lagged *MARGIN* variable reveals a statistically significant positive sign. In the majority of the specifications, 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 (e.g. Angbazo, 1997). The results also illustrate that inefficient banks tend to have lower profitability margins, in line with studies such as Maudos and Guevara (2004). The positive statistically significant sign associated with the solvency ratio, in majority of specifications, 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) and supported by the findings of Valverde and Fernandéz (2007). 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 results 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 a bank-based system tends to produce larger gross margins than countries that operate a market-based financial system.

The coefficient associated with the country's average LTV ratio, which is acting as a proxy for the institutional characteristics of the mortgage market, is positive and statistical significant. This would suggest that banks in countries where credit-granting practices are less conservative (high leverage ratios) tend to require a higher profitability margins. Specifications VIII, IX, XVII and XVIII 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 (specification without time fixed effects) or no profitability impact (specification with time fixed effects) and a decrease in credit risk, then the final effect is an improvement in risk-adjusted profitability. When both bank profitability and credit risk 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 bank profitability and risk during property booms are summarised in table 9, based on the empirical evidence reported in tables 7 and 8:

INSERT TABLE 9

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

1) Increased weight of residential mortgage loans in total assets results in an efficient trade-off between risk and profitability. More specifically, bank profitability does not seem to be affected or even tends to be slightly reduced by increasing the weight in the case of banks with low to moderate insolvency risk. For high insolvency risk banks an increase in the proportion of residential mortgage lending leads to an increase in profitability. Since credit risk tends to decrease with residential lending, banks with high insolvency risk show an improvement in their risk-adjusted profitability.
2) The effects of increased weight 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.

5. Conclusion

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

The results suggest that banks that increase the weight of residential mortgage loans in total assets a decrease in 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 lending practices. This result may help to explain 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 increase in the weight of residential mortgage loans in total assets raises the bank's risk-adjusted profitability. For banks with a moderate credit risk, the effects of increased weight of residential mortgage loans on bank's risk-adjusted profitability is also positive or marginally positive.

The results highlight the need to develop indicators of bank's individual exposure to the real estate market to calibrate the potential impact of changes in weights and prices of residential housing assets on bank risk and profitability.

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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.	Simple 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
$\boldsymbol{PREM_{it-3}}$	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
$\boldsymbol{RMShare_{it}}$	The weight of residential mortgage loans in the bank's assets.	?
$\boldsymbol{RPPRICE_{t-1}}$	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
$\boldsymbol{\Delta LOAN_{it}}$	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) refer 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
$\boldsymbol{EQUITY_{it-h}}$	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
$\boldsymbol{IPP_{it}}$	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
$\boldsymbol{RPPRICE_{it-1}}$	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.	?
$\boldsymbol{RMShare_{it}}$	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 Country

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] (0,00)	-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)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No

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)
Bank Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No

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

Panel C: Total Sample and Time Fixed Effects

This table reports the estimation results of six regressions based on equation (4) with time fixed effects. 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	XI	XII	XIII	XIV	XV	XVI
$RISK_{it-1}$	0,0768[c]	0,0765[c]	0,0801[c]	0,1915[a]	0,2229[a]	0,1063[c]
	(1,75)	(1,73)	(1,81)	(3,06)	(3,89)	(1,98)
GDP_t	-0,0464[a]	-0,0463[a]	-0,0624[a]	-0,0311[a]	-0,0582[a]	-0,0526[a]
	(-4,27)	(-4,25)	(-5,11)	(-3,30)	(-8,73)	(-4,46)
GDP_{t-1}	-0,0373[a]	-0,0373[a]	-0,0371[a]	-0,0280[a]	-0,0335[a]	-0,0425[a]
	(-3,60)	(-3,59)	(-3,38)	(-3,01)	(-6,29)	(-4,02)
$DFAM_t$	0,0066[b]	0,0066[b]	0,0091[a]	0,0107[a]	0,0103[a]	0,0068[b]
	(2,04)	(2,02)	(2,86)	(3,66)	(3,45)	(1,99)
$DEMP_t$	0,0006	0,0006	0,0006	-0,0010[a]	-0,0008[a]	0,0006
	(1,08)	(1,04)	(1,03)	(-2,88)	(-4,17)	(0,98)
$LOAN\_TO\_ASSETS_{it-1}$	0,1099[b]	0,1058[b]	0,1285[a]	0,3573[a]	0,3992[a]	0,1049[c]
	(2,63)	(2,52)	(2,88)	(2,91)	(2,87)	(1,87)
$LOAN\_TO\_ASSETS_{it-2}$	0,0790	0,0782	0,0637	-0,3213[b]	-0,3235[b]	-0,0285
	(0,68)	(0,68)	(0,47)	(-2,26)	(-2,17)	(-0,29)
$LOAN\_TO\_ASSETS_{it-3}$	0,1001	0,1001	0,0777	0,1009	0,0743	0,0468
	(0,63)	(0,64)	(0,45)	(0,99)	(0,72)	(0,31)
$INEF_{it}$	0,0006	0,0006	0,0008	0,0006	0,0003	0,0006
	(1,13)	(1,13)	(1,57)	(1,24)	(0,82)	(1,02)
$SIZE_{it}$	-2,7257[a]	-2,7249[a]	-3,1320[a]	-2,2740[a]	-2,2731[a]	-2,4447[a]
	(-3,63)	(-3,62)	(-4,92)	(-3,07)	(-3,08)	(-3,89)
$MARGIN_{it-2}$	0,0019[b]	0,0019[b]	0,0017[c]	0,0020[a]	0,0017[a]	0,0017[c]
	(2,46)	(2,46)	(1,80)	(3,78)	(3,18)	(1,87)
$MARGIN_{it-3}$	-0,0055	-0,0055	-0,0053	-0,0014	-0,0011	-0,0062
	(-1,36)	(-1,35)	(-1,21)	(-1,01)	(-0,90)	(-1,39)
$EQUITY_{it-2}$	0,3347	0,3324	0,4216	-0,1399	-0,1755	0,2768
	(0,80)	(0,79)	(0,99)	(-0,46)	(-0,54)	(0,64)
$EQUITY_{it-3}$	0,4914	0,4939	0,6149	-0,0878	-0,1335	0,4805
	(1,24)	(1,24)	(1,43)	(-0,32)	(-0,46)	(1,19)
$PREM_{it-3}$	0,0347	0,0347	0,0326	0,0096	0,0036	0,0357
	(1,52)	(1,51)	(1,28)	(0,52)	(0,58)	(1,54)
$RMSHARE_{it}$	-1,4450[a]	-1,4388[a]		-0,8446[a]		-1,5299[a]
	(-5,45)	(-5,41)		(-5,38)		(-5,85)
$RPPRICE_{t-1}$			-0,0524[c]		-0,0041[c]	
			(-1,90)		(-1,86)	
$RMSHARE_{it}$*$RPPRICE_{t-1}$		-0,0086[a]	-0,0094[a]	-0,0093[a]	-0,0156[a]	-0,0067[a]
		(-2,86)	(-1,94)	(-3,58)	(-3,31)	(-2,75)
LTV_t				0,1028[b]	0,1022[c]	
				(1,99)	(1,74)	
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*)	0,270	0,265	0,291	0,273	0,268	0,271
AR (1) and *p-value*	-3,0[a] (0,00)	-2,8[a] (0,00)	-2,9[a] (0,00)	-2,8[a] (0,00)	-2,0[b] (0,04)	-2,0[b] (0,04)
AR (2) and *p-value*	-0,4 (0,77)	0,4 (0,79)	-1,2 (0,25)	-0,6 (0,61)	-1,1 (0,29)	-1,0 (0,26)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

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

Panel D: Subsamples and Time Fixed Effects

This table reports the estimation results of four regressions based on equation (4), for subsamples with time fixed effects. 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	XVII	XVIII	XIX	XX
$RISK_{it-1}$	0,0382[b]	0,2002[a]	0,1481[b]	0,3947[a]
	(2,35)	(8,33)	(2,27)	(16,30)
GDP_t	-0,0363[c]	-0,1561[a]	-0,0469[a]	-0,0212[b]
	(-1,87)	(-2,78)	(-2,63)	(-2,54)
GDP_{t-1}	-0,0382[b]	-0,0042	-0,0576[a]	-0,0067
	(-2,47)	(-0,28)	(-3,03)	(-0,84)
$DFAM_t$	0,0180[a]	0,0098[b]	0,0131[c]	0,0045[b]
	(3,56)	(2,42)	(1,89)	(2,10)
$DEMP_t$	-0,0015	-0,0003	-0,0006	-0,0011[c]
	(-0,55)	(-0,27)	(-0,60)	(-1,77)
$LOAN\_TO\_ASSETS_{it-1}$	0,2559[c]	0,8617[a]	0,4921[c]	0,5146[a]
	(1,70)	(4,44)	(1,97)	(3,54)
$LOAN\_TO\_ASSETS_{it-2}$	-0,2329[c]	0,0513	-0,1375	0,1755
	(-1,69)	(0,32)	(-0,87)	(0,93)
$LOAN\_TO\_ASSETS_{it-3}$	-0,0506	0,0314	0,0425	0,3257[c]
	(-0,32)	(0,14)	(0,16)	(1,72)
$INEF_{it}$	0,0023[a]	0,0002	0,0011	0,0031[b]
	(3,63)	(0,24)	(1,56)	(2,30)
$SIZE_{it}$	-7,9962[a]	-3,1020[b]	-4,8550[c]	-8,3614[c]
	(-4,69)	(-2,02)	(-1,68)	(-1,67)
$MARGIN_{it-2}$	0,0007	0,0700[b]	0,0013[c]	0,0458
	(1,54)	(2,23)	(1,67)	(1,31)
$MARGIN_{it-3}$	-0,0011	0,0647[a]	-0,0031	-0,0068
	(-1,48)	(3,05)	(-1,36)	(-0,18)
$EQUITY_{it-2}$	0,8039[c]	0,4614	0,2544	-0,7931
	(1,98)	(0,59)	(0,57)	(-1,55)
$EQUITY_{it-3}$	-0,6370[a]	-1,1641	0,2221	-0,8719
	(-2,94)	(-1,57)	(0,52)	(-1,52)
$PREM_{it-3}$	0,0078[c]	-0,0045	0,0249[c]	0,0129
	(1,77)	(-0,34)	(1,86)	(1,26)
$\mathbf{RMSHARE_{it}}$	-9,7012[a]	3,0927[b]	-15,4566[a]	0,7686
	(-3,35)	(2,11)	(-2,59)	(0,45)
$\mathbf{RMSHARE_{it} * RPPRICE_{t-1}}$	0,0309[c]	-0,0120[a]	-0,0385[b]	-0,0041[b]
	(1,84)	(-3,78)	(-2,03)	(-2,04)
Time Period	1999-2008	1999-2008	1999-2008	1999-2008
# Observations	688	1273	1011	1081
Sargan Test (*p-value*)	0,185	0,144	0,370	0,188
AR (1) and *p-value*	-5,0[a] (0,00)	-2,6[a] (0,00)	-2,8[a] (0,00)	-3,3[a] (0,00)
AR (2) and *p-value*	-0,3 (0,74)	0,2 (0,81)	0,3 (0,73)	-0,2 (0,83)
Bank Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes

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)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No

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[b]	(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)
Bank Fixed Effects	Yes		Yes		Yes		Yes	
Time Fixed Effects	No		No		No		No	

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

Panel C: Linear Regressions and Time Fixed Effects

This table reports the estimation results of 5 regressions on the profitability of banks based on equation (5) with time fixed effects. 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	X	XI	XII	XIII	XIV
$MARGIN_{it-1}$	5,921[a] (42,69)	5,935[a] (40,05)	5,924[a] (42,69)	5,918[a] (41,53)	5,918[a] (41,45)
GDP_t	0,080[c] (1,75)	0,066[a] (2,71)	0,079[c] (1,73)	0,084[c] (1,84)	0,085[c] (1,84)
GDP_{t-1}	-0,014 (-0,28)	-0,017 (-0,26)	-0,015 (-0,28)	-0,008 (-0,15)	-0,007 (-0,14)
$BBMB_t$	0,105[c] (1,97)	0,122[c] (1,81)	0,107[c] (1,98)	0,150[c] (1,83)	0,147[c] (1,90)
$RISK_{it-2}$	0,495[a] (15,93)	0,499[a] (16,67)	0,494[a] (16,11)	0,491[a] (15,66)	0,491[a] (15,65)
$RISK_{it-3}$	0,832[a] (19,52)	0,839[a] (20,88)	0,833[a] (19,68)	0,829[a] (19,08)	0,829[a] (19,06)
LIQ_{it-1}	0,013[a] (3,20)	0,014[b] (2,55)	0,013[a] (3,00)	0,013[a] (3,18)	0,013[a] (3,17)
LIQ_{it-2}	0,011[a] (2,61)	0,011[a] (2,65)	0,012[a] (2,71)	0,012[a] (2,98)	0,012[a] (2,97)
$SDR3M_{it-1}$	0,185[c] (1,72)	0,190[b] (2,01)	0,108[c] (1,73)	0,103[c] (1,69)	0,103[c] (1,70)
$SDR3M_{it-2}$	0,181[c] (1,92)	0,156[c] (1,65)	0,212[b] (2,20)	0,209[b] (2,19)	0,208[b] (2,19)
HH_t	-0,001 (-1,14)	-0,001 (-1,32)	-0,001 (-1,28)	-0,001 (-1,22)	-0,001 (-1,21)
$INEF_{it}$	-0,005[b] (-2,12)	-0,005[b] (-2,22)	-0,005[b] (-2,10)	-0,005[b] (-2,07)	-0,005[b] (-2,07)
$\Delta LOAN_{it}$	-0,011[a] (-5,11)	-0,010[a] (-5,48)	-0,011[a] (-5,23)	-0,011[a] (-5,00)	-0,011[a] (-4,99)
$EQUITY_{it-2}$	7,138[b] (2,15)	7,810[b] (2,27)	7,164[b] (2,16)	7,019[b] (-2,12)	6,993[b] (2,12)
$EQUITY_{it-3}$	1,922 (0,63)	1,772 (0,56)	1,938 (0,64)	1,780 (0,58)	1,796 (0,59)
IPP_{it}	2,544[c] (1,77)	2,062[c] (1,84)	2,473 (1,05)	2,648 (1,09)	2,650 (1,09)
$RMSHARE_{it}$	0,696 (0,66)	0,842 (0,78)	1,005 (0,93)	0,961 (0,89)	0,976 (0,91)
$RMSHARE_{it}$*$RPPRICE_{t-1}$		-0,023[b] (-2,32)	-0,029[b] (-2,42)	-0,017[b] (-2,27)	-0,016[b] (-2,22)
Time Period	2002-2008	2002-2008	2002-2008	2002-2008	2002-2008
# Observations	3555	3555	3555	3555	3555
Sargan Test (*p-value*)	0,179	0,169	0,130	0,126	0,158
AR (1) and *p-value*	-4,7[a] (0,00)	-3,9[a] (0,00)	-3,3[a] (0,00)	-3,4[a] (0,00)	-3,9[a] (0,00)
AR (2) and *p-value*	-0,5 (0,29)	-0,3 (0,73)	-0,5 (0,22)	0,2 (0,66)	-0,2 (0,60)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes

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

Panel D: Quadratic Regressions and Time Fixed Effects

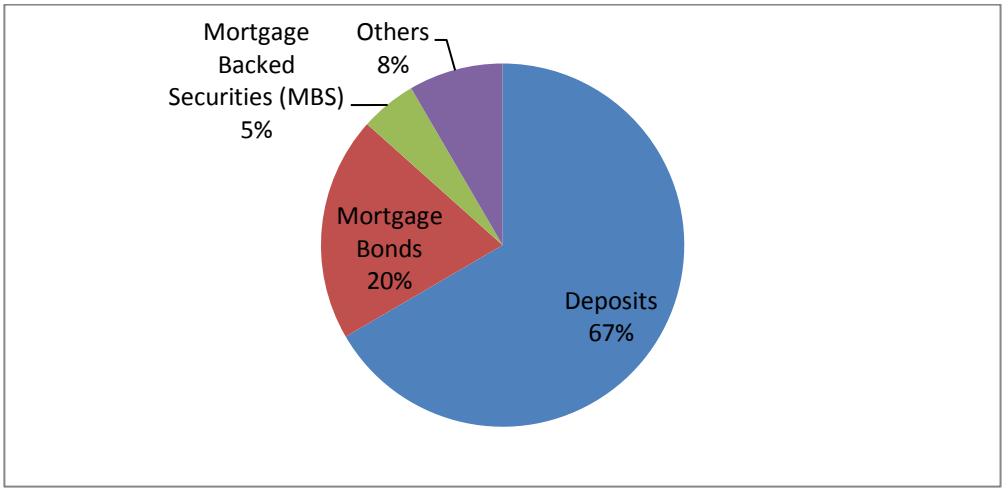
This table reports the estimation results of 4 regressions on the profitability of banks based on equation (6) with time fixed effects. We use the Dynamic Panel Analysis (Arellano e Bond, 1991) and GMM procedure. The dependent variable **MARGIN** is measured by net interest margin (gross margin) and 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	XV		XVI		XVII		XVIII	
$MARGIN_{it-1}$	5,525[a]	(19,44)	5,514[a]	(22,32)	1,092[a]	(12,46)	0,744[a]	(13,93)
GDP_t	0,069[c]	(1,68)	0,078[c]	(1,85)	0,078[b]	(2,47)	0,038[b]	(2,44)
GDP_{t-1}	-0,062	(-1,20)	0,026	(0,53)	0,075	(1,38)	0,041[a]	(3,22)
$BBMB_t$	0,157[b]	(2,52)	0,156[b]	(2,52)	0,007	(0,10)	-0,042[a]	(-2,99)
$RISK_{it-2}$	4,214[c]	(1,70)	10,168[c]	(1,99)	-0,542	(-0,31)	-4,910	(-0,80)
$RISK_{it-3}$	-7,164	(-1,22)	-5,189	(-0,98)	-2,893[b]	(-2,18)	-5,509[a]	(-5,09)
LIQ_{it-1}	0,183[a]	(3,41)	0,161[a]	(3,30)	0,086[b]	(2,34)	0,012	(0,84)
LIQ_{it-2}	0,071	(1,45)	0,056	(1,01)	0,032	(0,23)	0,014[b]	(2,18)
$SDR3M_{it-1}$	0,125[c]	(1,86)	0,118[c]	(1,79)	0,022	(0,12)	0,092[a]	(5,78)
$SDR3M_{it-2}$	0,192[b]	(2,10)	0,204[b]	(2,22)	0,112	(0,29)	0,239[a]	(7,46)
HH_t	-0,096[c]	(1,79)	-0,125[b]	(-2,43)	-0,101[c]	(-1,78)	0,010	(0,86)
$INEF_{it}$	-0,007[a]	(-2,85)	-0,008[a]	(-3,12)	-0,025[a]	(-5,69)	-0,004[a]	(-3,70)
$\Delta LOAN_{it}$	-0,030[b]	(-2,15)	-0,035[a]	(-2,91)	0,001	(0,10)	-0,135[b]	(-2,59)
$EQUITY_{it-2}$	6,222[b]	(2,12)	7,619[b]	(2,50)	-1,608	(-0,86)	-1,385[c]	(-1,69)
$EQUITY_{it-3}$	0,959	(0,24)	1,607	(0,43)	-3,876[b]	(-2,02)	1,489[b]	(2,40)
IPP_{it}	9,667[b]	(2,01)	10,790[b]	(2,57)	89,093[a]	(4,49)	0,182[a]	(7,08)
$RMSHARE_{it}$	3,084[c]	(1,85)	3,879[b]	(2,26)	2,405[c]	(1,72)	1,034[a]	(5,94)
$RMSHARE_{it}$* $RISK_{it-1}$	-182,122[a]	(-2,74)	-213,578[a]	(-2,93)	-566,589[a]	(-4,55)	-32,482[a]	(-3,05)
$RMSHARE_{it}$* $(RISK_{it-1})^2$	1582,752[c]	(1,89)	1982,967[b]	(2,56)	1464,371[c]	(1,68)	1669,768[a]	(3,83)
LTV_t			0,531[a]	(5,60)				
Time Period	2002-2008		2002-2008		2002-2008		2002-2008	
# Observations	3554		3554		637		644	
Sargan Test (*p-value*)	0,166		0,171		0,119		0,133	
AR (1) and *p-value*	-4,2[a]	(0,00)	-3,9[a]	(0,00)	-3,7[a]	(0,00)	-5,4[a]	(0,00)
AR (2) and *p-value*	0,4	(0,48)	-0,4	(0,51)	-0,3	(0,59)	0,6	(0,24)
Bank Fixed Effects	Yes		Yes		Yes		Yes	
Time Fixed Effects	Yes		Yes		Yes		Yes	

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)