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ON THE INTEREST RATE AND THE
DEMAND FOR CREDIT. EMPIRICAL
EVIDENCE FROM SPANISH BANKS**

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Abstract

We examine the consequences of imposing higher capital requirements on banks (as under Basel III or, recently, in the case of large banks in the European context) for bank dynamics in complying with the new standards and for the long-term effects on bank lending rates and the demand for bank credit. The analysis combines econometric estimations of the determinants of equity capital ratios and lending rates with simulations of market equilibrium results for loan interest rates and the demand for bank credit, based on a parameterised model of the Spanish banking industry. We find that the gap between the target and the actual capital ratio is reduced by around 40% every year, mainly with retained earnings. We also find that raising the equity capital ratio by one percentage point increases bank lending rates by 4.2 basis points. Finally, the simulation exercise shows that the estimated increase in the cost of funds for banks associated with a one percentage point increase in the equity capital ratio leads to a fall of 0.8% in the total demand for bank credit. These results suggest that the social costs of higher equity capital requirements for banks are expected to be greater in the transition period, when banks are adjusting to the new standards, than in the steady state of the new industry equilibrium, when all banks comply with the new ratio.

Keywords: Bank capital regulation, Basel III, bank lending rates, demand for credit.

JEL Classification: D24, G21.

Resumen

Este trabajo analiza las consecuencias de un aumento de los requerimientos de capital a los bancos (tal como en Basilea III o en la nueva normativa europea dirigida a los grandes bancos) tanto en el corto plazo, esto es, en la dinámica del ajuste de los bancos para cumplir con los nuevos estándares, como en el largo plazo. El análisis combina las estimaciones econométricas basadas en modelos sobre los determinantes de los ratios de capital y de los tipos de interés del crédito bancario con mediciones del impacto en el equilibrio a largo plazo en los tipos de interés y en la demanda de crédito bancario, obtenidas a partir de simulaciones basadas en las estimaciones de un modelo paramétrico para el sector bancario español. Los resultados indican que la brecha entre los ratios de capital actuales respecto a los nuevos requerimientos se cerrará con una reducción progresiva del 40% anual, principalmente mediante la retención de beneficios. Adicionalmente, el trabajo permite concluir que un aumento de un punto porcentual del ratio de capital se traduce en un aumento de 4.2 puntos básicos en los tipos de interés de los préstamos bancarios. Finalmente, el ejercicio de simulación predice que el aumento estimado en el coste de la financiación bancaria asociado a un aumento de un punto porcentual en el ratio de capital implica, a largo plazo, una disminución de la demanda agregada de crédito bancario del 0,8%. Estos resultados sugieren que el coste social del reforzamiento de los requerimientos de capital sería potencialmente mayor en el corto plazo, durante el periodo de transición, que en el largo plazo, una vez que los bancos han adoptado los nuevos estándares.

Palabras claves: Regulación del capital bancario, Basilea III, tipos de interés del crédito, demanda de crédito.

Códigos JEL: D24, G21.

1 Introduction

The standards on minimum capital ratios play an important role in banking regulation.¹ The financial crisis has evidenced some weaknesses in the existing capital regulation and changes are under way (new regulation of large banks in the EU and under Basel III) aimed at increasing the minimum equity capital ratios for banks². Equity capital is the most effective loss-absorption financial instrument at banks. Thus, the social benefits of higher equity capital are in the form of financial stability and more sustained economic growth. However, higher equity capital requirements can also have social costs if, for example, banks meet the new equity capital requirements by lending less and/or by charging higher interest rates on the loans they do grant. There have been some recent estimates of the optimal (welfare-maximising) regulatory equity capital for banks³, while other research focuses separately on the costs or benefits of the regulatory initiative⁴. This paper addresses the potential costs arising from higher regulatory equity capital and provides empirical evidence from Spanish banks on how cross-bank differences and changes over time in equity capital affect the interest rate and the aggregate demand for bank loans.

The paper is structured following Kashyap et al. (2010) and Hanson et al. (2011), who make the distinction between what they call the *flow* and the *stock* costs of higher equity capital regulation. The flow costs emerge in the transition period, when banks with equity capital ratios complying with the old regulation standards must find ways to move to the higher equity capital ratios set by the new regulation. The stock costs are those occurring in the steady state, when banks already comply with the equity capital standards.

The social component of the flow costs of higher equity capital regulation stems from the possibility that banks decide to meet the new ratio by contracting the volume of credit, in order to reduce the absolute requirements for additional equity, instead of by increasing the volume of equity (Holmstrom and Tirole, 1997). The inclination of banks to reduce the volume of credit in response to the new regulation can be explained by the pecking-order theory of finance; according to this, information asymmetries between the existing and new shareholders make issuing new shares to raise equity capital particularly expensive (Myers and Majluf, 1984). The alternative is to obtain additional equity from retained earnings, but this way it may take some time for the bank to reach the target ratio. In this paper, we model the adjustment of the equity ratio of Spanish banks towards a target ratio to examine whether the adjustment is gradual and to test whether the changes in banks' equity capital will be positively correlated with their profits (retained earnings), as predicted by the pecking-

1. See for example Diamond and Rajan (2000) and Brunnermeier, et al. (2009).

2. Under Basel II, the minimum core equity capital (retained earnings and share issues) is 2% of the risk-weighted assets of the bank. Under Basel III, the minimum ratio is 7% or 8.5% under certain conditions. Regulation sets a timetable of progressive compliance with the new standards; for the new rules in banks' regulatory capital see www.bis.org/press/p100912.pdf?noframes=1.

3. Miles, Yang and Marcheggiano (2011) explicitly calculate the socially optimal ratio of equity capital for banks from the condition of equality between the estimated marginal social benefit and marginal social cost of equity finance. See also BIS (2010a, 2010 b and 2010c).

4. Admati, De Marzo, Hellwig and Pfleiderer (2010) provide a very comprehensive review of the debate surrounding the determinants of the cost of funds for banks. They also revise the arguments about the presumed consequences of higher regulatory equity capital for the cost of capital for banks and for banks' credit decisions. Kashyap, Stein and Hanson (2010) examine in detail the literature on the chain of effects from shocks in the equity capital of banks to the responses of the real sector of the economy; Hanson, Kashyap and Stein (2011) rely on the previous paper to justify reforms in macro-prudential regulation of banks. Elliot (2010) simulates the likely consequences of changes in equity capital ratios for the cost of capital for banks. The results are consistent with those in other referenced papers.

order theory. Support for this hypothesis would justify the regulatory concern over the flow costs of asking banks for more equity capital and finding the best way (i.e. gradually or instantly) of meeting the new standard.

The second piece of empirical evidence focuses on the stock costs and provides estimates of the relationship between bank lending rates and equity capital ratios, relying also on data from Spanish banks. The empirical model is similar to that of Kashyap et al. (2010), which focuses on the US banking industry, drawing on aggregate data. A differential characteristic of our empirical model is that it is estimated using bank-level data. This proves to be relevant since we obtain meaningful results that can be interpreted under the conceptual framework of the Modigliani and Miller (1958) theorem with taxes. Finally, based on a simulation approach, the paper predicts the long-run effect of a permanent increase in the cost of funds for banks on the long-term demand for bank credit. These predictions are based on simulations using a parameterised model of the Spanish banking industry that allows for competition among banks and also between bank credit and other sources of funds to finance investment (Martín-Oliver, 2010).

In recent times, there has been renewed interest in the effects of equity capital on bank credit (Berger et al., 2006; Francis and Osborne, 2009; Berrospide and Edge, 2010; Adrian and Shin, 2010; Gertler and Kiyotaki, 2010; Gertler and Karadia, 2011; Hernando and Villanueva, 2012; Aiyar et al., 2012)⁵. The empirical papers provide estimates of the effect of a marginal change in the equity capital ratio on the growth rate of loans. Our approach is different in two main respects. First, we focus on the permanent, long-term effects of a higher equity capital ratio for all banks, so we estimate the predicted contraction in the equilibrium stock of bank credit, not the effect on the growth rate of bank loans. Second, we obtain the results from the demand side of the credit market, not from the supply of credit by banks.

We find evidence that Spanish banks adjust their equity capital gradually to meet an unobservable target equity capital ratio. We also find that the magnitude of the adjustment in a given period increases with the lagged amount of the bank's profits. These results support the existence of hidden costs of adjustment in the period of transition from the current to the desired levels of the equity capital ratio. Evidence supports the fact that these costs are of the kind anticipated by the pecking-order theory (gradual contributions from retained earnings are preferred to instant compliance by issuing new shares). We also find that, for Spanish banks, higher equity capital ratios entail higher bank lending rates of a magnitude compatible with that expected under the Modigliani and Miller theorem in the presence of market frictions, such as taxes. Finally, the simulation exercise yields results on the effect of the cost of funds on the equilibrium lending rates and on the volume of demand for bank loans that are consistent with those found using the econometric approach. The simulation exercise provides a robustness check of the econometric results and it has the advantage over the latter that the equilibrium values of the demand for bank loans arising from an increase in the cost of bank finance are obtained taking into account that, in addition to the interest on loans, banks can adjust other competitive variables, such as the number of branches and advertising expenditure, in response to the increase in costs.

5. This avenue of research goes back to the early 1990s when there was a debate on whether the adoption of Basel II could create a credit contraction in the US (Hancock and Wilcox 1993, 1994, Berger and Udell, 1994, Bernanke and Lown 1991, Peek and Rosengren 1995).

The rest of the paper is organised as follows. Section 2 presents the basic theory on the costs stemming from increases in the equity capital of banks in the dynamic and the static steady state situations, as well as the empirical models that can be used to test the predictions. Section 3 contains a description of the database and the main variables used in the empirical analysis. Section 4 presents the empirical results drawn from the econometric estimations and the simulation exercise. Finally, the conclusions highlight the main results and their relevance.

2 Theory and empirical models on the potential costs of higher equity capital ratios in banks.

In this section, we briefly discuss the theory behind the determinants of the cost of funds for banks and the links between this cost and the interest rate and volume of bank credit. In the exposition, we first recall the theories on the determinants of the cost of capital for firms as a function of their financial structure and, next, we describe the model of the banking industry used in the simulation exercise.

2.1 Financial structure and cost of equity capital for banks

How does the cost of capital of a firm vary in response to changes in its financial structure? In the case of regulatory equity capital of banks, what is the foreseeable cost of raising the minimum equity capital requirements? Kashyap et al (2010) answer these questions making a distinction between the *flow* and the *stock* costs from higher equity capital requirements. In each case, there are private and social components of the costs. The flow costs emerge in the transition period, associated to the actions taken by banks to close the gap between their actual equity ratio and the new regulatory one, such as issuing new shares or increasing retained earnings. The origin of the flow costs is the information asymmetry between firms and investors, which causes that the markets interpret the issuance of new shares as a negative signal about the situation of the bank and, thus, it will penalize such action with lower stock prices (Myers and Majluf, 1984). The social component of the flow cost would be the contraction in bank credit and the loss of investment opportunities, if banks respond to the higher equity capital requirements by constraining credit growth, and reject funding projects with positive NPV (Holmstrom and Tirole, 1997).

The stock costs of increasing equity capital of banks refer to the costs of operating permanently with an equity capital ratio higher than prior the regulatory change. The new financial structure of the bank includes relatively more equity than the old one. This implies, if the cost of equity is higher than the cost of debt that the weighted cost of all funds will increase. Banks will translate the higher cost of funds into higher interest rates of loans, which will contract the demand of bank credit, and, possibly the investment rate of the economy (social part of the stock costs). The private part of the stock costs, i.e. the effect on banks' profits of higher weighted cost of capital, will depend on the competitive conditions of the market.

The diagnosis of the magnitude and economic relevance of the stock costs of higher equity capital requirements depends very much on whether the Modigliani and Miller (1958) theorem holds for banks or not. This theorem states that in frictionless markets the weighted cost of debt and equity is independent of the proportions of debt and equity in the financial structure. Miller (1995) extends the result to the case of banks.

Debt is less costly than equity because the former is more protected from the economic risks of the business than equity (residual claimant). But the cost of equity increases with leverage because higher leverage implies more financial risk for the shareholders. In the steady state situation of higher equity capital, the same economic risk in the assets of the bank is spread into more units of equity than in the situation of lower equity finance. For this reason, the risk per unit of equity is proportionally reduced with lower debt and, consequently, the risk premium on the cost of equity decreases. At the end, the

increment in cost from the substitution of debt by additional equity (more expensive) in the less leveraged financial structure, is exactly compensated with the reduction in the cost of equity compared with the cost in the more leveraged situation. Nonetheless, the corporate tax advantage of debt and information asymmetries between managers and shareholders broke down the assumption of frictionless markets and favour debt with respect to equity increasing the stock costs of equity finance. Lower expected costs of financial distress, on the other hand, compensate part or all of the debt advantage from market frictions.

The empirical model on adjustment of equity capital by banks

An unanticipated regulatory change asking for an immediately higher equity capital ratio for banks or a negative external shock that causes higher expected present and future losses can take banks to an undercapitalized situation. The valuation of the social costs of undercapitalized banks requires tracing how this situation influences credit availability, investment and economic growth. The complete and detailed examination of this issue is beyond the scope of the present paper. What we will do next, in the empirical section, is to test the hypothesis of the “pecking order theory” of finance (Myers and Majluf, 1984), build under the assumption of information asymmetries between insiders and investors, which results in penalties for firms that try to close the gap between the current and the target equity capital ratio by issuing new shares. This penalty or flow cost of meeting higher equity capital requirements could be minimized by a gradual increase in equity from internal sources of funds, such as retained earnings. We will check whether banks adjust their equity capital ratio instantly or gradually and if the speed of adjustment is positively correlated with the level of profits (as a proxy of earning retentions). We obtain evidence of positive flow costs when asking for higher equity capital.

To find out evidence of flow costs associated to raising equity among Spanish banks, we rely on a partial adjustment model of the equity capital ratio of banks towards the target equity ratio, as in Hancock and Wilcox (1993, 1994), Flannery and Rangan (2008) and Berrospide and Edge (2010). The partial adjustment equation is formulated as:

$$KE_{i,t+1} - KE_{i,t} = \lambda(KE_{i,t+1}^* - KE_{i,t}) + \varepsilon_{i,t+1} \quad (1)$$

where KE_{it} and KE_{it}^* denote the observed and the equilibrium target equity capital ratios of bank i in year t , respectively; $\varepsilon_{i,t+1}$ denotes the error term and parameter λ measure the speed of adjustment to the target level. We assume that the target ratio is a function of a vector of observable characteristics of the bank, X_{it} :

$$KE_{i,t+1}^* = \beta X_{i,t} \quad (2)$$

Substituting in (2), we obtain the empirical formulation of the model on the determinants of the equity capital of banks:

$$KE_{i,t+1} = (1 - \lambda)KE_{i,t} + \lambda\beta X_{i,t} + \varepsilon_{i,t+1} \quad (3)$$

The variables included in vector X_{it} varies across studies but, in general, they will be proxy variables for the costs and benefits of holding different levels of capital ratios, including corporate taxation, costs of financial distress and bankruptcy, transaction costs and

asymmetric information problems, and so on. In this paper, our interest is in testing the prediction of the pecking order theory that the equity ratio of banks varies positively with the level of current profits, as determinants of retained earnings. Therefore, the main explanatory variable of the equity capital ratio will be the return on assets of the bank, *ROA*. The rest of control variables, such as, risk, growth opportunities and size will be described in the empirical section.

The long run effects of higher equity

Once the equity capital ratio reaches the steady state situation, the market frictions that force a departure from the Modigliani and Miller theorem are the deductibility of interests of debt in the corporate tax base, together with the non-deductibility of dividend payments; the agency costs from conflicts of interests between managers and shareholders and the positive cost of bankruptcy. Corporate taxes and bankruptcy costs imply that there is an optimal leverage ratio minimizing the cost of funds that may be different among firms. In the case of banks, the social cost of bankruptcy will be much higher, in general, than the private ones perceived by bank managers and shareholders, if the latter perceive that banks under distress will be rescued by governments. In this case, the leverage decision of bank managers and shareholders pursues to maximize the saving in corporate taxes by issuing debt like financial instruments, instead of equity to meet regulatory capital requirements.

The computation of the banks' corporate tax cost of increasing equity finance to substitute debt is straightforward to calculate. If the interest rate of debt is 10% and the corporate tax rate is 30%, one additional percentage point of equity (and, therefore one percentage point less of debt) will increase the cost of capital in 3 basic points, just the amount of additional taxes paid compared with the taxes before the substitution. Kashyap et al (2010) add to this tax cost of a less leveraged financial structure two other potential sources of cost. One has to do with the difference in cost of long and short term debt due to different liquidity premium. The other source of cost is attributed to undefined frictions in the markets that cause a departure from the ideal environment of the Modigliani and Miller theorem. Overall, for the tax system and the financial market conditions of a country like the USA, Kashyap et al (2010) calibrate the increase in the weighted cost of capital for one additional percentage point of equity capital in the bank's financial structure in a range between 2.5 and 4.5 basis points⁶. We consider this calibration as a reasonable starting point for Spain, too.

If banks with higher equity capital ratios pay a higher weighted average cost for the funds used to finance loans it can be expected that these banks will charge higher interest rates in their loans to compensate for the higher cost. The calibration of the magnitude of the cost of higher equity capital ratios provides a reference value for the expected marginal increase in the interest of bank loans per unit of the equity capital ratio. The empirical model to test for differences in interest rates charged on loans due to differences in the equity capital ratios of banks is formulated as follows⁷:

6. Kashyap et al (2010) and Miles, Yang and Marcheggiano (2011) explicitly test for the hypothesis of risk conservation, which is the basis for the Modigliani and Miller theorem, with data from US and UK banks. The test consists in the regression of the "beta" of the stock market returns of banks' shares against their respective leverage ratios. The data confirms that the risk (beta) is positively correlated with leverage and that, if leverage is reduced to one half, then the beta and the risk premium on shares' expected returns are also reduced to half.

7. Other papers have modelled the relationship between the capital ratio of banks and profit margins (Demirgüç-Kunt, Laeven, and Levine, 2003) or overall economic performance (Berger and Udell, 2006). For the purpose of our paper the relevant result is how equity capital affects the interest of loans since equity capital is part of the cost of funds for the bank.

$$r_{i,t} = \alpha KE_{i,t} + \phi Z_{i,t} + \eta_{i,t} \quad (4)$$

where r_{it} is the interest rate of loans of bank i in year t , KE_{it} is the equity capital ratio of the period, Z_{it} is a vector of control variables (it will be discussed in the empirical section), and η_{it} is the error term. The hypothesis to be tested is that the estimated coefficient of the equity capital ratio will be positive and significant. We take as a reference point the calibration of Kashyap and Stein (2010), which establishes that the estimated value of α will be in the interval [0.025, 0.045], under the assumption that increases in cost of funds are entirely translated to the interest rates fixed banks. In presence of an elastic demand of credit, this interval can be interpreted as an upper limit.

2.2 Cost of funds, interest rates and volume of loans in an equilibrium model

So far, we have explained how we will estimate the likely pace of compliance with the new equity capital requirements and the likely effect of the new regulation on the cost of credit using banks' historical data. However, this is only one part of the overall economic and social consequences of the new capital regulation. What is missing in this approach is the effect of the adjustment process in the volume of aggregate bank credit, investment rate and economic growth. Ceteris paribus, higher cost of equity will be translated into higher interest rates of loans in proportion to the market power of banks, which is inversely related to their respective price elasticity of demand. In a monopolistic competition market for example, a bank i with absolute price elasticity of loans equal to e_{il} and a marginal cost of loans of m_{it} in period t will quote a profit maximizing loan interest rate, r_{it}^l , given by⁸:

$$r_{it}^l = \left(1 - \frac{1}{e_{il}}\right)^{-1} \cdot (m_{it}) \quad (5)$$

The marginal cost of loans is given by the sum of the financial cost of funds for the bank (including the cost of regulatory equity capital), the operating costs incurred in the lending process (borrower screening, borrower monitoring and so on), and the credit risk premium. If equity capital regulation asks for more equity to back up the loans granted by banks and, as a consequence, the financial mix of the portfolio of loans becomes more expensive, the translation of the increment in the cost into increment in the interest of loans will depend on the market power of the banks.

However, the calculation of the interest rate as a mark up on marginal cost has some limitations. First, since the change in regulatory capital is likely to affect the marginal cost of lending for all banks in the economy, then the translation of higher cost to higher interest rates of loans will also be generalized. The effect on the aggregate demand of bank credit in response of a generalized increase in the interest rate of loans across banks will depend now, ceteris paribus, on the price elasticity of the aggregate demand of bank loans, which in turn will reflect the substitutability between bank credit and other sources of finance for firms and households. Of course, the ceteris paribus assumption may not hold if banks respond to the higher cost of funds not only with price increases but with changes in other competition variables, such as advertising, customer services or branch network.

8. The price equation (5) can be easily rearranged to obtain the well-known result: $\frac{r_{it}^l - m_{it}}{r_{it}^l} = \frac{1}{e_{il}}$; that is, the net relative profit margin (the so-called Lerner index) is equal to the inverse of the absolute value of the price elasticity.

This paper evaluates the final consequence for the demand of bank credit resulting from the change in cost of funds after the new capital regulation by simulating the market equilibrium solution in a parameterized model of banking competition for the Spanish banking industry estimated by Martín-Oliver (2010). In this model, the demand of loans and deposits is derived from a multiple choice decision problem using the methodology in Berry (1994) and Berry et al. (1995). Each bank offers a product differentiated from the rest of banks, and buyers choose the offer that maximizes their respective utility. The consumer's choice set includes what is called the "outside good", that is, other financing and investing instruments that are imperfect substitutes of the bank loans and deposits.

The introduction of the outside good acknowledges that the demand of loans and deposits is part of the overall demand of financial products and it enables to jointly estimate the interest elasticity of loans and deposits at the individual-bank level and at the aggregate level for the whole banking system. The supply side of the market consists of banks that deliver loans and deposits produced at the branch level following a Leontief production technology (Martín-Oliver and Salas-Fumás, 2008), whose inputs are the capacity of the branch (quasi-fixed input) and the services from the labour force and the IT capital of the branch. Each bank takes profit-maximizing decisions on a wide set of price and non-price competition variables: interest rates of loans, interest rates of deposits, number of branches, advertising capital, number of employees and information technology (IT); the equilibrium of the market is the Nash competitive equilibrium solution.

The application of the simulation methodology will consist in computing the equilibrium values of the endogenous variables, interest rate and demand of bank loans, for variations in the marginal cost of lending attributed to variations in the equity capital ratio.

3 Database and variables

The database for the empirical analysis performed in the paper is elaborated from the information contained in the balance sheets and income statements, as well as in complementary files, reported by individual banks to Banco de España. The sample period spans from 1992 to 2007. In year 1993, Spanish banks are regulated under the requirements of Basel I (CBE 5/93) for the first time. Basel I regulation remains unchanged for the whole period of study since Basel II was first introduced in 2008. Year 2007 coincides with the year before the start of the recent financial crisis. The information in the database refers to commercial and savings banks. We exclude credit cooperatives because they do not provide all the information that is needed in the analysis, as well as banks whose market share of assets is smaller than 0.1%. The total number of banks with usable information starts with 143 in 1992 and 90 in 2007. When two banks merge, we consider that a new bank brand is created. Banks considered in our paper cover around 90% of the assets in the Spanish banking industry in 2007. This coverage is similar in terms of other variables, such as number of employees, loans and deposits, and remains fairly stable across the studied period.

3.1 Equity capital

The **Equity capital** of the bank is calculated as the sum of capital plus reserves from the retained earnings. We express this figure in current nominal prices at the end of each year applying a permanent inventory model with a zero-depreciation rate and the consumer price index as the price inflation variable, as in Martín-Oliver, Salas-Fumás and Saurina (2007). The reason for doing so is that inflation was relatively high in Spain in the early years of the sample. Thus, one euro of equity coming from retained earnings of a given year was not comparable with one euro of the unadjusted current stock of equity. By the updating of past increments of equity to current units of purchasing power, we have the stock at the end of the year valued at homogeneous “prices”. The exercise is repeated with other items of the liability side of the balance sheet of banks, for example, deposits. Thus, we have both equity and debt of banks at current prices. Then, the equity capital ratio, KE , is calculated dividing absolute equity capital by absolute equity and debt, both at current prices. This is the dependent variable of model (3).

The time evolution of descriptive statistics of the equity capital ratio, KE , for the banks in the sample is shown in Figure 1A. The three statistics, mean, median and weighted average, show a decreasing time trend along the period 1992-2007, although the decline accelerates in the second part of the period when Spain becomes a member of the Euro zone. Notice that the mean is above the median, indicating the asymmetry of the distribution of capital ratios in the population of banks, and that the weighted mean is lower than the un-weighted one, i.e., the equity capital ratio is inversely related to the size of the bank⁹.

Another relevant empirical issue is whether the capital ratios converge or diverge over time. To examine it, we present in Figure 1A.B the standard deviation and the coefficient of variation of the ratio over time. The observation of this figure indicates that the standard deviation of the capital ratio has decreased along the sample period, but the coefficient of variation (standard deviation divided by the mean) remains rather

9. The equity capital ratio calculated with equity and debt at their face values in the balance sheet of banks shows also a decreasing trend over time but not so pronounced as the ratio at current prices. The price adjusted equity ratio is higher than the accounting one during most of the time period but the two ratios converge at the end of the period.

constant over time, with a slight increasing trend beginning at the late 90's. From these results, we conclude that there is no evidence of convergence in the ratio of equity capital over time among Spanish banks.

For comparative purposes, Figure 1B shows the time evolution of descriptive statistics on the solvency ratio or regulatory capital ratio of banks¹⁰. The solvency ratio¹¹ is equal to Tier 1 and Tier 2 capital (that includes debt-like securities in addition to capital raised by issuing shares and retainer earnings) of the bank divided by the risk weighted assets (RWA)¹². The solvency ratio remains much more stable over time than the equity ratio, specially the median and the weighted average values of the distribution that remain around values of 11.5% from 2000 to 2007 (Figure 1B.A). The simple mean of individual banks' ratios is above the weighted mean and above the median values of the distribution, indicating that small banks keep on average higher solvency ratios than large banks. However the differences are reduced over time, indicating the convergence of solvency ratios among large and small banks (Figure 2B).

3.2 Interest rate of loans

The other dependent variable in our analysis is the average **interest rate** on bank loans, model (4). The interest rate is calculated as the ratio between the interests from loans charged by the bank i in year t and the average of the outstanding loans at the end of year $t-1$ and t . The descriptive statistics of this variable are presented in Figure 2. The interest rate of loans starts at a level around 14% in the early nineties and goes down to 5%, just before Spain joined the Euro zone. In the years 2000's, the interest continued to decline with a lower value slightly above 3%, in year 2005, and rose again in 2006 and 2007. The introduction of the Euro sharply decreased the official interest rate for all banks in the Monetary Union (from 8%, which was the stable official interest rate of Bank of Spain in years 1993-1997, to 4.15% in 1998. After 1998, the average official interest rate in the Euro-system decreased to 3.01%).

The linear and the weighted averages of interest rates across banks are very close along the whole period, and also close the median of the year distribution (Figure 2A). However, there is evidence that small banks charge higher interest rate on loans than large banks, since the linear mean is slightly higher than the weighted one.

The coefficient of variation of the interest rates of loans shows a time increasing trend, suggesting a relative divergence in the interest rates of loans among banks over time (Figure 2B). The divergence across interest rates increases to a level above the trend in the years of lower average interest rates (end of the period), maybe because banks change their commercial policy increasing product differentiation as a way of softening competition and maintaining relative profit margins.

10. Figure 1B does not include foreign branches, since they are not obliged to provide information on regulatory capital to the Bank of Spain, since the capital requirements must be fulfilled by the consolidated group they belong to at their corresponding home country. Also, and in order to avoid the effect of outliers, the computation of the average of the solvency ratios has been carried out winsorizing the variable at 5%.

11. Gropp and Heider (2010) specifically focused to answer whether capital requirements are a first determinant of banks' capital structure.

12. Regulatory requirements on the solvency ratio for the Spanish banks do not have to be fulfilled by individual banks but by the consolidated financial group they belong to. However, we are able to construct and use the individual (i.e. non-consolidated) solvency ratios because individual banks provide information on their risk weighted assets and on their capital instruments (which is latter aggregated to determine the consolidated capital ratio). We choose to use these individual ratios since they may contain more information of the behavior of individual banks than the common consolidated solvency ratio, if individual banks were relatively autonomous in their operating activity.

3.3 Explanatory and control variables

One of the hypotheses to be tested is that the equity capital of banks is sensitive to the evolution of profits as a source of retained earnings (equation (3)). We measure the **Profitability** of banks with the variable return on assets, **ROA**, calculated as the ratio of net profits over total assets (lagged one period).

Below, we briefly describe the control variables included in model (3) on the determinants of the equity capital ratio. Descriptive statistics are shown in Table 1.

Growth opportunities. It can be expected that banks with higher growth opportunities will tend to be less leveraged than non-growing banks because higher levels of equity capital put high growing banks in a better position to grasp the opportunities as they appear (Flannery and Rangan, 2006). The variable commonly used in the literature to capture growth opportunities has been the market-to-book ratio, but many banks in our sample are not listed in the stock market and, thus, there is no information of this variable (in particular, none of the saving banks is listed¹³). As an alternative, we propose to capture the bank's growth opportunities with a **productivity** measure. The bank-level productivity measure is taken from Martin-Oliver, Ruano and Salas-Fumás (2011). It is estimated as the total factor productivity parameter of the bank in year $t-1$. Banks with higher productivity parameter can be considered in a better position to invest and growth (Hopenhayn, 1992).

Loan Loss provisions (LLP). Regulation obliges banks in Spain to set provisions in periods of high credit growth to compensate for expected future losses in periods of low growth (anti-cyclical provisions). We use the variable **LLP/Assets** as explanatory of the capital ratio to account for the cyclical conditions of the economy and the possibility of banks using provisions to smooth profits and dividends over time. The expected sign of the coefficient of this variable is undetermined.

Business Risk. In general, it can be expected that equity capital will be higher in riskier than in safer banks, as a way of reducing the expected cost of bankruptcy or financial distress. A commonly used variable to measure the risk of the firm is the volatility of the stock price returns (Gropp and Heider, 2006; Flannery and Rangan, 2008). Since many of our banks are not listed, this measure of risk is not available for us. As an alternative, we consider the ratio of the risk-weighted assets over total assets, **RWA/Assets**. Riskier banks will have to increase regulatory capital to meet the minimum requirements in the capital ratio. However, they can do so increasing equity or increasing debt-like capital instruments. For this reason, it is recommendable to add the solvency ratio of the bank as an additional control variable.

Solvency. The solvency of the bank is measured by its regulatory capital relative to the risk weighted assets, referred to as **solvency ratio**. Both, the regulatory capital and the risk-weighted assets are computed according to Basel I. Banks with lower values of the solvency coefficient in $t-1$ might be eager to raise the weight of their regulatory capital. If the response consists on issuing new capital or retain more profits (more core capital), we should expect a positive sign between solvency and capital ratios. However, if they were to boost the Tier 2 capital (limited in Basel III) that consists in debt like capital (subordinated debt, general provisions and revaluation reserves), the increment in this supplementary capital could

13. Savings banks represent half of the number banks in the sample in 2007.

decrease the equity capital ratio. Therefore, the sign of the coefficient for this explanatory variable can inform about the preferred choice of banks to fulfil the capital regulation, equity or debt like capital.

Size. The size of the bank is measured by the total assets in $t-1$ (at constant prices of 1992), expressed in logs, **In Assets**. Larger banks can have better (and cheaper) access to financial markets and they could operate with lower capital ratios since, if more capital was needed, they could respond issuing new shares. Alternatively, the larger size could be tied to more complex balance sheets, which are optimally financed with a larger proportion of equity capital. Therefore, we do not have any expectation for the sign of the coefficient.

The second hypothesis to be tested is that the interest rate of bank loans is sensitive to the level of equity capital in the steady state situation. Therefore, the main explanatory variable of interest in model (4) is the equity capital ratio, *KE*.

The interest rate of loans will be determined by a mark up on the marginal cost of lending. The marginal cost includes the operating and the financial cost of the bank. Interest rates of loans will evolve over time as a result of changes in the official interest rate, the same for all banks, so we will use time dummy variables to control for it. The cost of funds is also expected to vary with the risk of the bank, so we use the variables **Loan Loss provisions (LLP)**, **RWA/Assets** and **Solvency ratio**, as control variables in model (4). We assume that the marginal operating cost of banks can be different for banks with different productive efficiency and/or costs of inputs. Thus, we include as additional control variables in the interest rate equation **Productivity** and **Salary**. The measure of banks' productivity was defined above. The variable salary is calculated as the ratio of personal expenses over the total number of bank employees. It can be expected that more efficient banks will have lower marginal operating costs and, therefore, will charge lower interest rates on loans than less efficient ones. The effect of salaries in the interest rate is undetermined, since higher salaries can be interpreted as higher operating costs or as higher quality of the labour services.

The average interest of loans can also vary across banks due to differences in the composition effects of the loan portfolio and / or differences in the sources of funds with which loans are financed. One relevant feature of the Spanish banking industry during the period of study has been the extraordinary expansion on mortgage loans, financed with the issue of mortgage-backed securities. So, we add as control variables of the interest rate equation either the proportion of mortgages over total loans, **Mortgages**, or **Securitization**, equal to the ratio of mortgage-backed securities over total assets of the bank.

4 Empirical results

4.1 Regression approach

Equity capital

The empirical formulation of model (3) with all the explanatory variables, including the control ones is formulated as follows:

$$KE_{i,t} = \alpha_i + (1 - \lambda)KE_{i,t-1} + \gamma_1 ROA_{i,t-1} + \gamma_2 \ln Productivity_{i,t-1} + \gamma_3 LLP / Assets_{i,t-1} + \gamma_4 Solvency_{i,t-1} + \gamma_5 RWA / Assets_{i,t-1} + \gamma_6 \ln Assets_{i,t-1} + \eta_i + \varepsilon_{i,t} \quad (6)$$

We include time dummy variables (α_i) and banks' fixed effects (η_i), the latter to control for unobservable heterogeneity that might bias the estimate of lambda (underestimate speed of adjustment (Lemmon et al. 2008, Gropp and Heider, 2010)).

The estimation is performed considering the variables *Productivity* and (equity) *capital ratio* as endogenous so, their values are instrumented. The instruments used are, for a bank *i*, the average productivity and the average capital ratios of the rest of banks different to *i*. This kind of instruments is used in Berry et al (1995) to estimate demand functions. Productivity studies have shown that the amount of intermediate inputs consumed by firms is also expected to be correlated with the level of productivity (Levinsohn and Petrin, 2003). Thus, we use the expenditures in office supplies by each bank as an instrument of the productivity variable. The model has been estimated using the two-step instrumental variables. Table 2 reports the results of the estimation.

Column I of Table 2 shows the results of the estimation for the basic model. The other columns present robustness and complementary results. The lagged equity capital variable has a positive and significant estimated coefficient. This supports that banks gradually approach to the target equity capital ratio. The estimated coefficient of this variable is close to 0.6, which implies a speed of adjustment, λ , in the capital ratio equal to 0.4 (1-0.6), from (3) and (6). Therefore, on average Spanish banks contribute every year in 40% to close the gap between the current and the target capital ratio. This estimation is line with the speed of adjustment obtained in empirical studies with data from US banks (Berrospide and Edge, 2011).

The coefficient associated to the lagged profitability variable (*ROA*), as a proxy of retained earnings, is also positive and significant. This result is consistent with the prediction of the pecking order theory, which predicts that retained earnings are preferred to new shares issues as a source of equity capital. The long term marginal contribution of *ROA* to the target equity capital ratio is 0.375 (0.15/0.40). This means that a bank with a *ROA* one standard deviation above the average *ROA* of the industry will have a permanent equity capital ratio higher than banks with the average industry *ROA*. The estimated coefficient of the variable *RWA/Assets* is negative and marginally statistically significant, that is, there is no evidence that the equity capital ratio increases with the risk profile of the bank. The coefficient of the *Assets* of the bank is not statistically significant, which means

that the size of the bank does not affect the choice of the target equity capital ratio¹⁴. The estimated coefficient for the rest of explanatory variables, *Productivity*, *Solvency* and *LLP/Assets* are all not statistically significant.

The banks' fixed effects variables have an important contribution to the explanatory power of the model indicating that there are unobserved bank-specific variables that determine in an important way the target equity capital ratio of banks. The estimated coefficients for the time dummy variables (not reported) are positive and significant in 1994 and 1995 and negative and significant from 2005 onwards. This result suggests that the Euro brought conditions (financial stability, lower expected costs of financial distress) for a lower target in the equity capital ratio of banks, compared with the pre Euro period¹⁵.

The estimations of Column II and Column III are for robustness purposes. In column II, we change the instruments of the lagged equity capital ratio. Here, we consider the lagged values of the *Solvency* ratio and the *RWA/Assets* ratio and we exclude them from list of the explanatory variables. The basic results remain unchanged. The estimated coefficient of the lagged *ROA* variable continues positive and significant (although now only at 10%). In column III, the robustness exercise consists in lagging the explanatory variables *Solvency* and *RWA/Assets* variables two periods (instead of one) so that they are not contemporary with the lagged equity ratio. In this estimation, the estimated coefficient of the lagged *ROA* is no longer statistically significant, but the coefficient of lagged *Productivity* turns out to be statistically significant. This result might be explained by the high correlation that is expected between productivity and profits¹⁶.

Finally, the estimation reported in column IV is the same than the estimation in column I but the bank dummy variables are replaced by another group of dummy variables that capture a list characteristics of the banks, such as size¹⁷ (small, medium and large (omitted)), ownership (saving banks, foreign branches and commercial banks (omitted)) and geographic market scope¹⁸ (local, regional and national (omitted)). The estimated coefficient for the lagged equity capital ratio is much larger than in the estimations with banks' fixed effects, confirming the bias in the estimation of the cost of adjustment coefficient of the model when not controlling for unobservable characteristics of the banks. Foreign branches of banks and small banks have a lower target equity capital ratio than national banks and lower than large banks, respectively.

Interest rates of loans

This section presents the results of the econometric estimation of model (4) on the determinants of the interest rate of loans charged by banks. Our main interest is in testing

14. The results on the relationship between size of the bank and capital ratios are mixed in the literature. Berrospide and Edge (2011) find a positive and significant effect of size on capital ratios. Contrarily, Flannery and Rangan (2008) and Berger et al (2008) find a negative and significant effect.

15. Kashyap et al (2010) report an increase in the capital ratio of US banks from 6% to 11% in the period 1990-2009.

16. Another robustness result, not reported is the estimation of the models with equity capital ratios calculated at book values instead of the capital ratios at constant prices used in the estimations of Table 2. With accounting values the speed of adjustment in the capital ratio is slightly lower, 0.38, and the estimated coefficient of the *ROA* variable larger, 0.21, and more statistically significant. Therefore the main conclusions about the relevance of the pecking order theory in the capital adjustment decision of banks remain unchanged.

17. Banks are defined as *Large* banks if they are between the 66th and 100th percentiles of the distribution of total assets, *Small* banks if they are between 1th and 33th percentiles and the rest of banks are classified as *Medium* banks.

18. Banks are classified according to the geographical scope of their business as *National* (37% of deposit share in 2002), when they have branches in 90% of the 50 Spanish provinces. *Local* (16% of deposit share in 2002), when the bank concentrates 90% of the branches in a single province, and *Regional*, all the rest.

whether banks with higher equity capital charge higher interest to their granted loans and if the magnitude of the effect is in line with the predictions from the Modigliani-Miller theorem.

The full econometric formulation of the model to be estimated, including the control variables, is the following,

$$r_{i,t} = \beta_0 + \beta_1 KE_{i,t-1} + \beta_2 \ln Productivity_{i,t-1} + \beta_3 Salaries_{i,t} + \beta_4 Securitization / Assets_{i,t} + \beta_5 LLP / Assets_{i,t} + \beta_6 Solvency\ coef_{i,t} + \beta_7 RWA / Assets_{i,t} + \beta_8 \ln Assets_{i,t} + \eta_i + \varepsilon_{i,t} \quad (7)$$

We include time dummy variables (β_0) and, to control for unobservable heterogeneity, banks' fixed effects (η). We use the same instruments for *Productivity* and (equity) *Capital ratio* as in the equity capital equation. Additionally, productivity is instrumented with the expenditures in office supplies by each bank (Levinsohn and Petrin, 2003). The model has been estimated using the two-step instrumental variables. Table 3 reports the results of the estimation.

The estimation reported in column I, includes the equity capital ratio as the only explanatory variable, in addition to time and banks' fixed effects. The estimated coefficient of the capital ratio variable is 0.047 significant at the 1% level. This value implies that an increase of one percentage point in the banks' equity capital ratio is translated into an increment of 4.7 basis points in the interest rate to bank loans. This estimate is in line with the calibration of the marginal effect of equity capital on the interest rate of loans obtained by Kashyap et al (2010), in the context of USA's financial markets and tax institutions (2.5 to 4.5 basis points).

The estimation presented in column II coincides with the empirical model in equation (7). The estimated coefficient of the equity capital ratio continues positive and significant although the estimated value is now 0.037. Two control variables, *LLP/Assets* and *Securitization/Assets* have statistically significant coefficients (with positive and negative signs, respectively). Thus, banks with higher loan loss provisions (i.e. banks with riskier loans) charge higher interest rates and securitization appears to reduce the interest rate of bank loans. Since securitization involves mortgage loans which are less risky than non-mortgage ones, it is unclear whether the negative coefficient of the *Securitization/Assets* variable responds to the securitization process itself or it just reflects the expected lower interest in more secure loans.

To clarify this issue and for robustness purposes we report estimations in column III that replaces the variable *Securitization/Assets* by the variable *Mortgage/Assets*. The estimation results are practically the same than those discussed in column II although, *RWA/Assets* has a positive and significant coefficient. In IV, the *Mortgage/Assets* variable has, as in col III, a negative and significant coefficient but the coefficient of *Securities/Assets* is not statistically significant. Finally, we can conclude that interest rates are lower for safer mortgage loans, but securitization does not have *per se* any effect on the interest rates. Banks price risk in the interest of loans: safer (mortgage) loans are charged with a lower interest rate, while riskier one (higher loan loss provisions ratio and higher risk-weighted ratio) are charged with higher interest rate.

Finally, the specification reported in column V replaces bank dummy variables by banks' characteristics. We find that foreign branches charge, on average, lower interest rates on loans than national banks and that small banks charge higher interest rates than larger

banks. On the other hand, national banks charge higher interests on loans, on average, than regional and local banks.

In all the estimations, the coefficients of the time dummy variables (not reported) show the decreasing time trend anticipated by the descriptive information from Figure 3A. In years 2004 and 2005 the coefficients of the time dummies reach the highest absolute value, being the interest rates on average 7.7 percentage points lower than in 1993, controlling for the rest of explanatory variables.

The econometric analysis just presented provides empirical evidence that the level of profits of banks conditions the path towards the long run equilibrium equity capital ratio (pecking order theory). It also supports the view that higher equity capital has a marginal effect in the cost of credit in the line predicted by the corporate tax gap between equity and debt (Modigliani and Miller theorem with taxes). Now we turn to study the effect of a change of the capital ratio on the demand of loans.

4.2 The capital ratio and the demand of loans and interest rate: A simulation exercise.

This section examines the effect of equity capital regulation on the aggregate bank credit, taking into account competition among individual banks and the competition between bank credit and other sources of finance (i.e., bonds or retained earnings). The analysis is based in a simulation exercise that relies on the parameterized model of the Spanish banking industry proposed and estimated by Martín-Oliver (2010). The estimated parameters include the elasticity of the demand of bank loans to the interest rate for the representative bank, which is equal to -4.134; and the elasticity of the aggregate demand of bank loans to a general change in the interest rates set by all the banks, which is smaller and equal to -1.176. This implies that the price-elasticity is higher at the bank level than at the aggregate level. The reason can be explained as follows: when one bank increases the interest rate of loans, potential borrowers can go to the other banks since the competing banks offer imperfect substitute loans. When all banks raise the interest rate simultaneously due to, for example, an external shock common to all of them, the substitution is between bank loans and the alternative sources of finance. Then, the substitutability among loans from different banks will be higher than the substitutability among bank loans and other sources of finance.

The simulation exercise with the complete parameterized model proceeds as follows. We fix the values of the exogenous variables of the model at their average values for the Spanish economy during the period 1997-2003, according to Martín-Oliver (2010)¹⁹. Also, and consistently with the findings in Driscoll (2004) and Berrospide et al. (2011), we assume that the total assets and liabilities of the economy (which include bank loans and deposits) grow at the same rate as the GDP. Then, we simulate the effect of a tougher regulation of capital requirements. To do so, we consider that demanding a higher equity capital ratio to banks increases the weighted average cost of funds in a range between 0bp and 25bp. This range is the same that results from an increment in the equity capital ratio between 0 and 5 to 8 percentage points in the table of values elaborated by Kashyap et al (2010). Using the equilibrium conditions of the model, we are able to solve for the endogenous variables and obtain their optimal values for an individual bank.

¹⁹. Interbank interest rate (r^b): 4.5%; GDP growth ($GDPG$):3%; Cost of Equity ($r^E=12\%$); Physical Capital per Branch (k_b): 358; Salary per worker (w): 16; risk premium (r_p): 1.2%.

The evolution of the simulated equilibrium interest rates resulting from the marginal increments in the cost of funds are shown in Figure 3.1. A summary of the changes in some selected variables resulting from an increment of the cost of funds of 25 basis points is presented in Table 4. The equilibrium interest rate of loans increases from 7.53% to 7.87%, that is, a raise of 34 basis points (4.38 %). If we had predicted the change in the interest rates of loans using the mark-up resulting from the estimated price elasticity of -4.134, then the increment of 25 basic points in the cost of funds would imply a 33 basis points increase in the interest rate of loans (from equation (5): $4.134 / (4.134 - 1) \times 25 = 33$), very close to the 34 basis points obtained with the simulation.

The simulated increment of 34 basis points in the interest rate of loans that results from the increment in 25 basis points in the weighted cost of funds for banks is also consistent with the increment predicted from the econometric results of Table 3, which give the marginal effect of a higher equity capital ratio on the interest rate. The way to reconcile the results is by keeping in mind that the increment in the cost of funds comes from a higher equity capital ratio. Going back to the calibration results of Kashyap et al (2010), an increment in the cost of funds of 25 basis points could be the consequence of an increment in the equity ratio of 5 to 8 percentage points. Taking into account the estimated coefficient of the equity capital ratio of 0.042 in Table 2, a 5 to 8 percentage points of increase in the equity ratio implies an increment in the interest rate of loans between 21 (5x4.2) and 33.6 (8x4.2) basis points.

The summary of simulated equilibrium values in Table 4 includes other competitive decision variables of banks Branches and Advertising capital, as well as the Total Bank Loans also in the old and new equilibrium (see also Figure 3). In equilibrium, an increment in the cost of funds of 25 basis points implies that the number of branches increases in 0.29% and the advertising capital increases in 1.34%, relative to the base scenario. The aggregate demand of bank loans in the new equilibrium solution (cost of funds 25 basis points higher) decreases in 4.17% (from 81.9% to 78.8%) of the total financial resources of the economy. This means that the increase in the interest rate of loans in the new equilibrium induces bank borrowers to substitute bank loans for other sources of funds to finance their investments. As the higher requirements of equity capital apply to all banks, all of them experience the increment in the cost of funds resulting from the new regulatory requirements. For this reason, a generalized higher cost of funds does not change the market share of individual banks but it changes the aggregate market share of loans in the total funds available to finance investment.

It is of interest to compare the simulated change in the aggregate demand of bank loans with the predicted value, taking into account the change in interest rate and the estimated elasticity of the aggregate demand of bank equal to -1.176. The 25 basis points increment in the cost of funds implies an increment in interest rate of loans of 4.38%, according to the simulation results reported in Table 4. Then, the predicted decrease in the aggregate demand of loans from the estimated price elasticity would be equal to -5.15% ($4.38 \times (-1.176)$). This value is higher, in absolute terms, than the absolute value of 4.38% obtained in the simulation exercise. The difference between the two estimates can be explained by the increment in advertising capital and branches that occurs at the same time that the increment in the interest in deposits, since higher advertising capital and more branches have a positive effect in the demand of loans that compensates, in part, the negative effect of the higher interest rate.

5 Conclusions

This paper aims to evaluate the potential costs of demanding more equity in the regulatory capital of banks, providing empirical evidence from Spanish banks on how they adjust their equity capital ratios and on the long-run relationship between equity capital and the cost of and demand for bank credit. The analysis presented in the paper supports the relevance of the methodological distinction between the flow and the stock costs of equity capital regulation made by Kashyap et al. (2010). Each cost corresponds to a different market disturbance: information asymmetries, in the case of the flow cost, and different taxation of the cost of debt and equity, in the case of the stock cost. Therefore, the minimising of these costs will require different policy responses.

The evidence on potential flow costs provided by the paper is that Spanish banks gradually adjust their equity capital ratio and that the magnitude of the changes to adapt the capital ratios to the desired levels is positively associated with the profitability of banks. This suggests that retained earnings are preferred to new share issues as a source of equity. The transition period for fully complying with the new equity requirements set by regulations (as in Basel III) may have the purpose of reducing such costs by making it easier for banks to raise additional capital by gradual retaining of earnings instead of by issuing new shares.

The second piece of empirical evidence in the paper is that banks translate the higher cost of equity capital to lending rates and that the magnitude of this pass-through is compatible with what may be expected under the Modigliani and Miller theorem in the presence of taxes. In particular, Spanish banks raise their lending rates by 4.2 basis points for each percentage point by which the equity capital ratio is raised (the prediction from a pure tax effect would be 3.5 basis points in the period of study since the corporate tax rate during this period was 35%). Use of the Modigliani-Miller theorem with taxes in the evaluation of the long-term effects of higher equity capital reduces the uncertainty about the magnitude of the costs and sets an upper bound to this magnitude.

The upper bound to the expected increase in the cost of bank loans resulting from higher equity capital regulation is confirmed by the results of a simulation exercise based on a calibrated model of the Spanish banking industry that provides the equilibrium solutions for prices, quantities and management variables (such as advertising expenditure and branches), in response to a change in the cost of funds for banks. The bound, however, may be lower than that found in the econometric estimates because the simulation results suggest that, in addition to their lending rates, banks adjust other competitive variables (advertising expenditure, number of branches, etc.). The simulation exercise also reveals the contraction in the demand for bank credit that would result from the higher lending rates. We estimate that a regulatory increase of five percentage points in the equity capital ratio of banks would result in a contraction of credit for the whole economy of around 4%, i.e. the contraction in the stock of bank credit per percentage point of increase in the equity capital ratio would be equal to around 0.8 percentage points. This figure cannot be interpreted as the magnitude of the contraction in the total amount of funds available for financing investment and, therefore, as a contraction in investment itself, since bank credit may be substituted by other sources of finance.

The empirical analysis of the determinants of the equity capital ratio and Spanish bank lending rates provides additional results of interest. We find that the equity capital ratio of Spanish banks has been lower on average since the adoption of the euro. Our interpretation is that Spanish banks have valued the euro's contribution to financial stability positively (lower expected costs of financial distress) and, for this reason, have modified their target equity capital ratio to a lower value than in the pre-euro period. We also find that small banks maintain permanently higher equity capital ratios and charge higher lending rates than large banks (although the economic relevance of the difference is small). Therefore, during the period of study there is no evidence of full convergence of equity capital ratios and interest rates among banks in Spain. Small banks manage to be competitive and survive in a context of lower net interest margins, resulting from the easier financial conditions, by charging higher interest rates for their credit to compensate for the fact that their cost of funds is higher than that of large banks²⁰.

The social costs of the new regulatory regime are not the only relevant aspect of the capital regulation of banks. Another important consideration is the cost for bank shareholders of higher equity capital standards and, therefore, of lower leverage of banks' equity capital relative to the regime before Basel III. Suppose that the shareholders of banks collect all or a substantial part of the corporate tax benefits of debt versus equity finance. *Ceteris paribus*, the permanent substitution of one euro of equity for one euro of debt in the total regulatory capital of a bank involves an increase in the value of the bank equal, in present value terms, to the tax rate u . If all the gain goes to the shareholders, the return per unit of equity as a function of the debt to equity ratio L is, in present value terms, equal to Lu . This means that a debt to equity ratio of 4 in the current Basel II regulation of capital (2 percentage points of equity in the total regulatory capital ratio of 8%) implies a tax return for the shareholders of banks, in present value terms, of 120% if the tax rate is 30%. If Basel III regulation lowers the leverage ratio within the regulatory capital to 1/3, the tax-return goes down to only 10%.

Even if shareholders of banks obtain only a fraction of these tax gains from leverage, because competition forces them to share the gains with the banks' customers, the numbers are high enough to explain the concerns of banks in relation to a capital regulation that limits the leverage ratio within the regulatory capital ratio for banks much more than before. In any case, exploration of the potential private costs of the new bank capital regulation is an issue for future research.

20. Kashyap et al. (2010) justify their evidence of higher equity capital and higher lending rates for small banks in the United States by saying that small banks probably are more active in relational banking than large ones and, for this reason, they grant loans in a market environment that allows for more personification and differentiation of the activity. We find no evidence of differences in the equity capital ratio and the average interest rate of loans between commercial and saving banks.

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Table 1. Descriptive statistics of the main variables used in empirical models.

	Mean	Weighted Avg.	Std.Dev.	10th Perc.	25th Perc.	50th Perc.	75th Perc.	90th Perc.
<i>Capital Ratio (%)</i>	9.07	5.05	6.46	3.41	5.21	7.44	10.54	16.16
<i>Loan Interest Rate (%)</i>	7.39	5.52	3.46	3.70	4.65	6.08	10.07	12.77
<i>Productivity</i>	2,137	3,143	1,150	974	1,313	1,840	2,711	3,678
<i>ROA</i>	0.67	0.87	3.16	0.03	0.45	0.89	1.30	1.91
<i>LLP/Assets (%)</i>	0.36	0.30	0.37	0.01	0.13	0.29	0.49	0.75
<i>Salaries (the 1992)</i>	35.24	36.80	9.01	28.23	30.00	32.95	37.92	43.58
<i>Securitization/Assets (%)</i>	3.57	8.59	6.95	0.00	0.00	0.00	3.80	14.16
<i>Mortgages / Assets (%)</i>	41.17	48.27	22.44	3.47	24.11	45.59	59.08	67.67
<i>Solvency Coeff (%)</i>	14.63	11.70	8.27	8.93	10.17	12.19	16.61	24.74
<i>RWA/Assets (%)</i>	57.17	69.99	23.69	22.49	43.10	58.44	75.75	87.24
<i>Assets (m€ 1992)</i>	7,142	60,100	18,830	270	725	2,046	5,421	13,480

Table 2. Determinants of the equity capital ratios of banks

The estimates of this table correspond to the estimation of Equation (6) controlling for time effects and clustering standard errors at the bank level. The sample period is 1992-2007. Specifications (I), (II) and (III) include bank fixed effects whereas Specification (IV) includes dummy variables that identify savings bank, foreign branches, small/medium-size banks (default: big banks) and regional and local banks (default: banks operating nationwide). Columns below (I) present the Coefficient and Standard Errors (S.E.) for the basic specification, (II) instruments the capital ratio with the Solvency coefficient and the ratio of Risk Weighted Assets with respect to Assets (RWA/Assets); (III) substitutes the first lag of the variables Solvency and RWA/Assets by the second lag of these variables and (IV) substitutes bank fix-effects by dummies identifying bank characteristics. Asterisks refer to significance levels: (***) significant at 1%; (**) significant at 5%; (*) significant at 1%.

	I		II		III		IV	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
<i>Capital ratio</i> $t-1$	0.596 ***	0.066	0.568 **	0.223	0.535 ***	0.068	0.883 ***	0.031
<i>ln Productivity</i> $t-1$	0.007	0.005	0.004	0.034	0.011 **	0.005	0.006 **	0.003
<i>ROA</i> $t-1$	0.153 **	0.069	0.144 *	0.074	-0.018	0.105	0.100	0.063
<i>LLP/Assets</i> $t-1$	0.309	0.424	-0.167	0.478	0.575	0.369	0.385	0.520
<i>Solvency Coeff</i> $t-1$	-0.008	0.025			0.022	0.023	-0.022	0.019
<i>RWA/Assets</i> $t-1$	-0.017 *	0.009			-0.019 *	0.010	-0.008 *	0.005
<i>ln Assets</i> $t-1$	-0.005	0.006	-0.008	0.008	-0.005	0.006		
<i>Savings bank</i>							-0.001	0.002
<i>Foreign Branch</i>							-0.014 ***	0.005
<i>Small Size</i>							0.012 ***	0.003
<i>Medium Size</i>							0.003 **	0.001
<i>Regional Bank</i>							0.000	0.004
<i>Local Bank</i>							-0.002	0.003
<i>Fixed Effects</i>	YES		YES		YES		NO	
<i>Time Effects</i>	YES		YES		YES		YES	
<i>R² (%)</i>	85.09		84.74		86.20		80.09	
<i>N Observations</i>	1643		1643		1506		1643	

Table 3. Determinants of the interest rate of bank loans.

The estimates of this table correspond to the estimation of Equation (7) controlling for time effects; the capital ratio and productivity of each bank are instrumented with its expenditures of office stationary and with the average of these variables for the rest of competing banks. We cluster standard errors at the bank level. The sample period is 1992-2007. Specifications (I), (II), (III) and (IV) include bank fixed effects whereas Specification (V) includes dummy variables that identify savings bank, foreign branches, small/medium-size banks (default: big banks) and regional and local banks (default: banks operating nationwide). Specification (III) substitutes the ratio Securitization/Assets by the ratio Mortgages/Assets and specification (IV) includes both of them at the same time For each specification, we show the Coefficient and Standard Errors (S.E.). Asterisks refer to significance levels: (***) significant at 1%; (**) significant at 5%; (*) significant at 1%.

	I		II		III		IV		V	
	Coefficient	S.E.								
<i>Capital Ratio</i>	0.047 ***	0.155								
<i>In Productivity</i> $t-1$			0.037 **	0.018	0.042 **	0.017	0.042 **	0.017	0.022 *	0.013
<i>Salaries</i> (the 1992)			0.000	0.003	0.003	0.002	0.003	0.003	-0.001	0.002
<i>Securitization/Assets</i>			-0.031 ***	0.007			-0.005	0.006	-0.034 ***	0.007
<i>Mortgages / Assets</i>					-0.069 ***	0.008	-0.069 ***	0.008		
<i>LLP/Assets</i>			0.523 ***	0.162	0.508 ***	0.152	0.502 ***	0.153	1.201 ***	0.153
<i>Solvency Coeff</i>			-0.005	0.012	0.000	0.011	0.001	0.011	-0.002	0.010
<i>RWA/Assets</i>			0.000	0.004	0.010 **	0.004	0.010 **	0.004	0.000	0.002
<i>In Assets</i> (the 1992)			-0.002	0.002	-0.002	0.002	-0.002	0.002		
<i>Savings bank</i>									0.000	0.001
<i>Foreign Branch</i>									-0.013 ***	0.004
<i>Small Size</i>									0.009 ***	0.001
<i>Medium Size</i>									0.003 ***	0.001
<i>Regional Bank</i>									-0.007 ***	0.002
<i>Local Bank</i>									-0.006 ***	0.002
<i>Fixed Effects</i>	yes		yes		yes		yes		no	
<i>Time Effects</i>	yes									
<i>R² (%)</i>	89.97		90.33		91.50		91.49		80.75	
<i>N. Observations</i>	1643		1643		1643		1643		1643	

Table 4. Simulated equilibrium values for selected variables in a base scenario of the Spanish banking industry and in a new scenario with 25 basis points higher weighted cost of capital for banks.

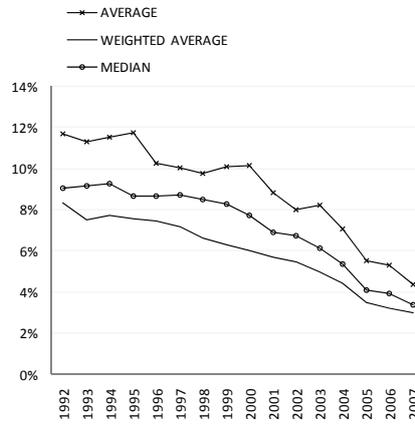
This table shows the results from the simulation of a 25 bp increase in the weighted cost of capital of banks using the partial equilibrium model of banking competition presented in Section 5. The first column refers to the level of the weighted cost of capital simulated in the exercise and the last row shows the growth rate of each variable due to the increment in the weighted cost of capital. From the 2nd to the 4th column, we present the values of the loan interest rate, branches and advertising of a bank that maintains the market share of 1% of the financing sources of the economy. Finally, the last column shows the volume of total loans granted by banks before and after the change in the cost of capital.

Weighted Cost of Capital (%)	SIMULATION FOR A BANK HOLDING 1% OF MARKET SHARE			TOTAL BANK LOANS
	Loan interest rate (%)	N.Branches	Advertising	
4.50	7.53	1,532	82,735	236,171,520
4.75	7.87	1,536	83,846	226,328,376
Growth Rate (%)				
5.56	4.38	0.29	1.34	-4.17

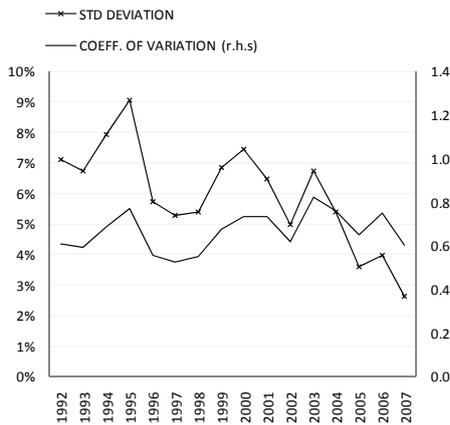
All the variables are expressed either in percentage points (when specified) or in thousands of constant euros of 1992.

Figure 1.A. Descriptive statistics of capital ratios of Spanish banks: Equity capital

A. Average, Weighted Average and Median



B. Standard Deviation and Coefficient of Variation



C. Percentiles

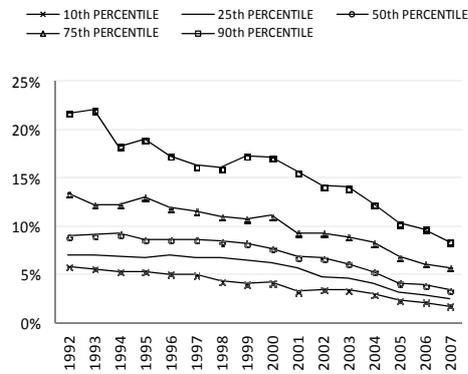
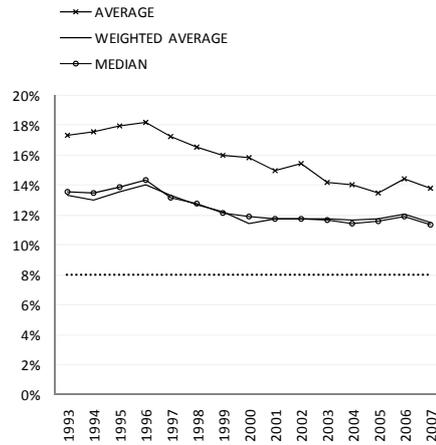
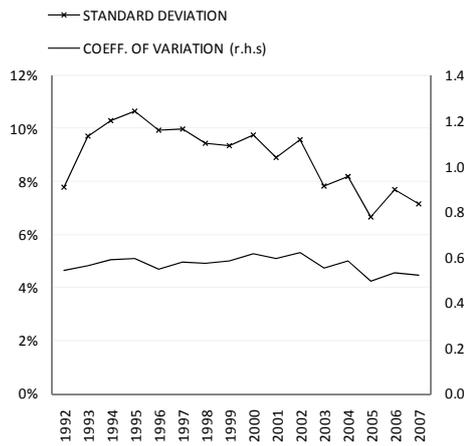


Figure 1. B Descriptive statistics of capital ratios of Spanish banks: Solvency ratio

A. Average, Weighted Average and Median



B. Standard Deviation and Coefficient of Variation



C. Percentiles

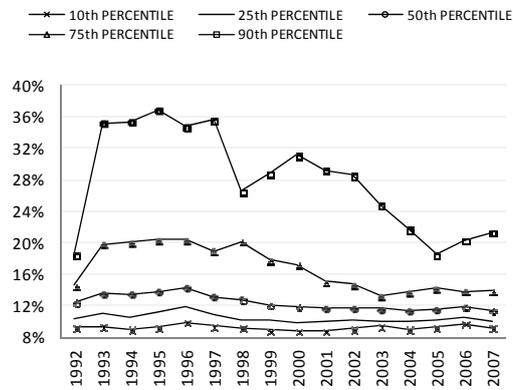
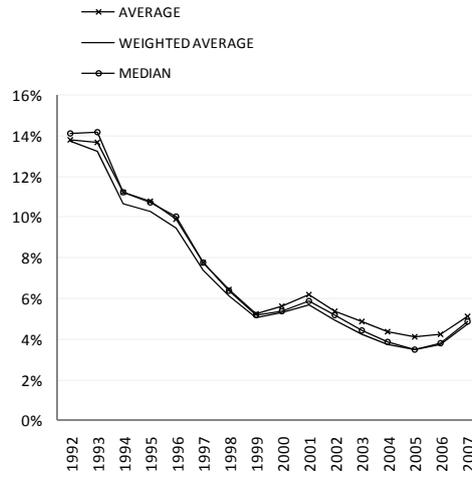
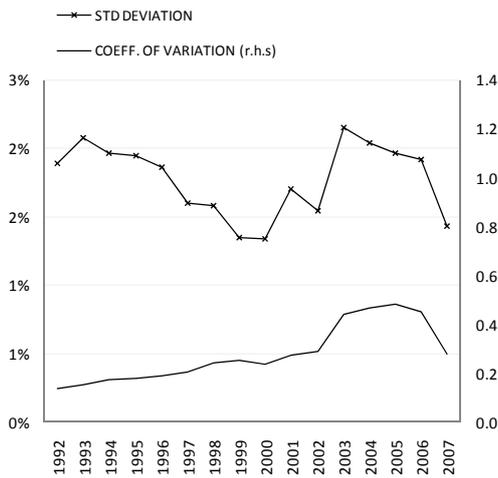


Figure 2. Descriptive statistics of interest rate of loans of Spanish banks

A. Linear Average, Weighted Average and Median



B. Standard Deviation and Coefficient of Variation



C. Percentiles

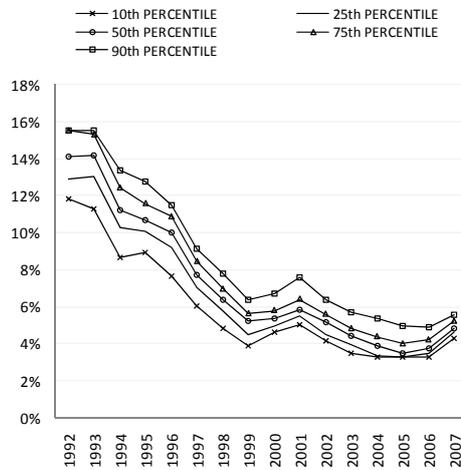
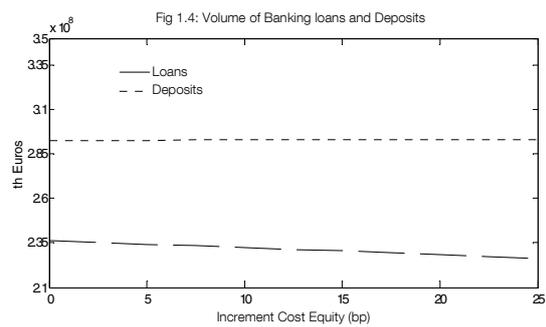
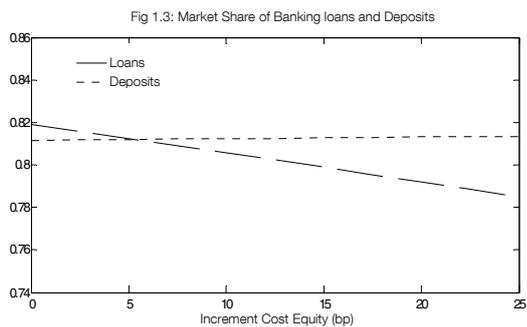
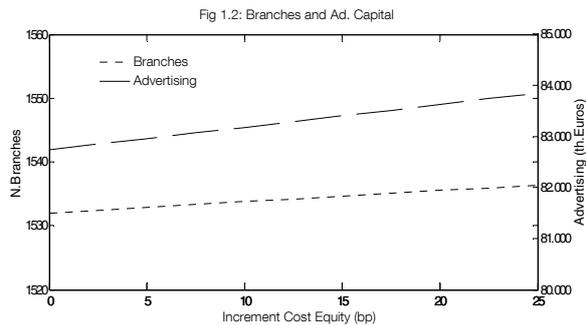
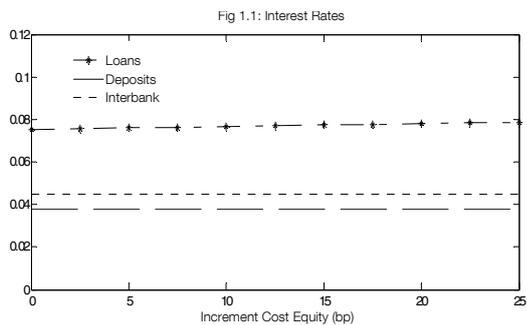


Figure 3. Results from the simulation: Increase of 25 basic points in the weighted average cost of capital



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