Banks' Equity Capital Frictions, Capital Ratios, and Interest Rates: Evidence from Spanish Banks*

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Banks' choices on their economic capital factor into the cost of funds and are key to the assessment of the social cost from higher equity capital ratios set by Basel III. We model the determinants of equity capital and the influence of its ratios on the interest rates of bank loans by using data from Spanish banks. The results show that a combination of value-maximization choices and inertial earnings retentions determine equity capital and that the inertia component is more important to savings banks than to commercial banks. We also find that loans' interest rates increase with equity capital and the increase is higher during the adjustment period than in the steady state.

JEL Codes: D24, G21.

1. Introduction

The financial crisis of 2008 uncovered weaknesses in the regulations on the capital requirements of banks and promoted changes aimed at increasing the minimum equity capital ratios. Common equity capital is the most effective loss-absorption financial instrument. Thus,

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the reinforcement of common equity capital within the total regulatory capital of banks should contribute to financial stability and, from that, to sustained economic growth. However, higher equity capital requirements can also have social costs if, for example, banks meet the new ratios by granting less credit and/or charging higher interest rates. Regulatory and policy-related institutions (Bank for International Settlements 2010; De Ramon et al. 2012; Oliveira-Santos and Elliott 2012), as well as the academic research (Admati et al. 2010; Hanson, Kashyap, and Stein 2011), have expressed concerns for the consequences of the reforms under way, while others have performed cost-benefit analyses of the main regulatory changes (Miles, Yang, and Marcheggiano 2011).

The aim of this paper is to advance the assessment of the potential costs from strengthened regulation on the requirements of equity capital for banks both in the period of transition from the current to the new standards (flow costs) and in the new steady state after the adaptation of the new regulatory capital (stock costs). The social costs of higher equity capital during transition come from the possibility that banks contract the volume of credit to reduce the absolute requirements of additional equity, instead of increasing the volume of equity (Holmstrom and Tirole 1997). The stock costs during the steady state, after which the banks have met the new standards of capital, could potentially affect their funding costs and, ultimately, their decision on interest rates (Admati et al. 2010).

First, we use an econometric model on the determinants of equity capital ratios to evaluate the flow costs of higher equity capital (Berger et al. 2008; Flannery and Rangan 2008; Gropp and Heider 2010). A key issue in this paper is the examination of whether banks adjust their equity capital ratio to selected targets or, alternatively, whether the inertia from earnings retentions under information constraints determines the observed equity capital (Myers 1984). On the one hand, if banks adjust their equity capital ratios towards a target, the regulatory action should take into account the speed of the adjustment towards this target. On the other, if equity capital only depends on earnings retentions, regulation can alleviate the flow costs by setting a transition period according to the banks' potential to generate yearly earnings.

Second, we evaluate the potential stock costs of increasing capital ratios with a model that determines the interest rates on loans as a function of the current and the target equity capital ratios. Under the Modigliani and Miller (1958) world of perfect capital markets, the economic value of banks should be independent of their financial structure so that higher equity capital ratios do not have an effect on the cost of capital to the banks and consequently to their interest rates. However, in a more realistic world with taxes, bankruptcy, and agency costs, the capital structure does affect the economic value of the banks and, consequently, their interest rates.

Several papers (Elliott 2009, 2010; Kashyap, Stein, and Hanson 2010; King 2010; Oliveira-Santos and Elliott 2012) provide tentative estimates of the increment in the cost of funds and in the interest rates on bank loans that result from higher equity capital ratios by using different pricing formulas. In this paper, we approach the relation between interest rates and equity capital ratios as an empirical matter. Particularly, we formulate and estimate two econometric models that provide estimates of the changes in the interest rates and the equity capital ratios—one in the situation of the steady state around the target ratio, and the other when banks are out of the target ratio and are adjusting their equity capital to close the target gap. Both models comprise bank-level data.

The data for the empirical analysis comes from Spanish banks during the period of 1992 to 2007, which includes a period of economic expansion and high credit growth (1997–2007). Banks in the database are heterogeneous in terms of their sizes and comprise both commercial and savings banks, each with similar market shares in 2007. Savings banks are not-for-profit organizations that do not have shareholders. Thus, they satisfy their equity capital requirements with retained earnings.[1] The models on equity capital targets and on the determinants of interest rates are estimated for the whole sample of banks and also separately for commercial and savings banks. The empirical results point to clear differences between both groups.

For commercial banks, the evidence supports the existence of a target capital ratio to which banks tend to adjust at a relatively

[1] Noteworthy is that, since 2007 (last year of our database), the Spanish banking sector has gone through a process of deep reforms. One of the consequences has been the practical extinction of savings banks, because they have been transformed into commercial banks, merged or absorbed by other banks, or obliged to limit their activities to their provinces of origin.

high speed: 48 percent of the gap is closed per year, or it takes a little more than two years to reach the target. Part of this speed of adjustment is the consequence of contributions to equity capital from earnings retentions. For interest rates, we find a positive and significant effect from the equity capital ratios of commercial banks on the interest rates of their loans. The effect is different in the steady state and in the process of transition to the steady state. In the steady state, we estimate that a percentage point of the target equity capital ratio contributes 6.8 basis points (bps) to the interest rate; but in the transition period (when actual and target equity capital can differ), the contribution to interest rates is 8.5 bps per percentage point of actual equity capital and 12 bps per percentage point in the difference between the target and actual capital ratios.

The results are quite different for savings banks. We find a much lower speed of adjustment towards their target equity capital than in commercial banks even though their contributions of earnings retentions to the equity capital ratio are almost three times higher than in commercial banks. These results suggest that inertia from earnings retentions is more important as a determinant of equity capital ratios for savings banks than for commercial banks. In addition, the estimated coefficients for the equity capital ratios in the models of the determinants for interest rates are not statistically significant for savings banks, which suggests they do not attribute any extra cost to equity capital.

These results highlight the relevance of taking into account the heterogeneity in the population of banks at the time of the assessment of the potential costs of the equity capital regulations. This paper also complements the literature that explains the relation between equity capital and credit growth by providing new evidence on the estimated effects of equity capital ratios on interest rates. Further, our results support the strong dependence of equity capital on profits and the moderate effect of equity capital on interest rates in the steady state. Thus, the results suggest that the concerns for the regulation of banks' equity capital ratios should be greater for flow costs than for stock costs.

The rest of the paper is organized as follows. In section 2, we review the literature on the determinants of equity capital and interest rates of banks and focus on the theoretical models subject to empirical estimation. Section 3 presents the database and the empirical models. In section 4, we present the results of the econometric estimations. The final section includes a summary of the main results of the paper.

2. Determinants of the Equity Capital Ratios and the Interest Rates on Bank Loans

Regulations set minimum capital requirements for banks. Regulatory capital includes equity (issued shares and reserves from retained earnings) and other liabilities, such as preferred stocks and subordinated debt. Out of them, equity capital is the component of regulatory capital that better protects from losses and that better contributes to financial stability. Basel III strengthens the regulatory capital of banks by increasing the minimum amount of equity capital in the total regulatory capital of banks and sets a time period, up to year 2019, for banks to comply with the new regulatory standards.[2]

The flow and stock costs arising from this regulatory change depend on whether the regulatory constraints are binding or not (Ayuso, Pérez, and Suarina 2004; Barth, Caprio, and Levine 2005). In terms of the social costs, what matters is whether banks adjust to the change by issuing new equity or by reducing credit. Also, knowing whether banks charge higher interest rates during the transition period is important. The announcement of additional regulatory capital requirements might imply, in the presence of dynamic frictions, an extra cost of being below the target capital ratio for the bank, which is then transmitted to the interest rates of the loans. In the long run, once the new target capital ratio is reached, the focus shifts to the stock costs. These costs take into account how the less-leveraged financial structure of the banks impacts their costs of funding and, ultimately, the amount of credit they grant and the interest rates they charge.

Consequently, the assessment of the flow and the stock costs resulting from higher equity capital requirements depends on how banks choose their equity capital ratios and on the relation between

[2]In Basel II, the minimum core equity capital (retained earnings and shares issued) is 2 percent of the risk-weighted assets of the bank. In Basel III, the minimum ratio is 7 percent, plus a buffer of 2.5 percent. See www.bis.org/press/p100912.pdf?noframes=1.

the capital structure of banks and their costs of funding. Some recent papers (Berger et al. 2008; Flannery and Rangan 2008; Gropp and Heider 2010) show the dispersion of regulatory capital ratios in large banks and examine the determinants of these differences. They confirm that banks manage their capital ratios. Thus, the assessment of flow and stock costs from the new regulations justifies a detailed exploration into the theories that explain banks' decisions on their levels of equity capital.

The theories on the firms' capital structure range from those that consider unconstrained firms (banks) choosing a debt-to-equity ratio that maximizes shareholders' wealth, to those that consider capital structure decisions are mainly determined by a set of constraints.[3] Merton (1977) considers that banks operate under the safety net of insured deposits and the too-big-to-fail privilege. As a consequence, shareholders' value-maximizing banks tend to take high economic and financial risks with capital ratios that adhere to the minimum regulatory standard. This conclusion changes when banks earn positive quasi-rents over time. In this case, the choice of capital ratios is the result of balancing the gains from risk by shifting the increased leverage from the expected loss with the higher likelihood of losing the quasi-rents in the case of bankruptcy or financial distress (Merton 1978; Marcus 1984; Keeley 1990; Elizalde and Repullo 2007; Repullo and Suárez 2012).

Banks then choose an optimal (target) equity capital ratio that balances the benefits and the costs of increasing their leverage ratios. Any change that affects the marginal costs and benefits of leverage leads to immediate decisions to adjust the capital ratios to meet the new target. The empirical evidence from large U.S. banks (Berger et al. 2008; Flannery and Rangan 2008) is consistent with the prediction that banks choose a target capital ratio, but the adjustment towards this target is not immediate but gradual, which suggests that they face non-trivial adjustment costs.

The constraints that affect the choice of the capital structure of firms (banks) are attributed to information asymmetries between insiders (managers) and outsiders (investors) of the firm that cause

[3]The contest between these two views was first stated by Myers (1984). For an exhaustive literature review on theory and empirical results on the capital structure of firms, see Frank and Goyal (2008).

adverse-selection problems (Myers and Majluf 1984). As a consequence, retained earnings arise as the cheapest source of financing, followed by debt and new equity, which is the most expensive. The pecking order of financing justifies that banks set equity capital ratios above the regulatory standard to prevent the high costs of issuing equity under unexpected circumstances. In light of this theory, the changes in regulatory equity capital standards affect banks in a different manner during periods of high profits, when retained earnings can be high, than in periods of low profits, when higher equity capital requirements can only be met by issuing new equity.

Other plausible explanations and theories exist for why equity capital ratios stand above the regulatory minimum. One is that there might be a planned buildup of equity capital if banks are anticipating new acquisitions. Another possibility is that high equity capital might be the consequence of high-profitability periods combined with dividend smoothing. In this framework, the path of equity capital ratios is not one of adjusting towards a target capital ratio, but one evolving in parallel to the history of earnings.

Thus, the empirical analysis on the determinants of equity capital ratios should consider two sets of variables—those capturing the benefits and costs of equity versus debt financing (target ratio), and those that capture the retentions of earnings over time. The basic model is as follows:

$$KE_{i,t+1} - KE_{i,t} = \lambda \left(KE^*_{i,t+1} - KE_{i,t} \right) + \psi P_{i,t} + \varepsilon_{i,t+1}, \qquad (1)$$

where KE_{it} and KE^*_{it} denote the observed and the desired (target) equity capital ratios of bank i in year t, respectively. P_{it} is a measure of the profits of the bank, and ε denotes the error term. The parameter λ measures the speed of adjustment, and ψ is the parameter that captures the inertia in equity capital from profit retentions. The target ratio KE^*_{it} is a function of some proxy variables for benefits and costs, X_{it}:

$$KE^*_{i,t+1} = \beta X_{i,t}. \qquad (2)$$

From the discussion above, the vector X_{it} should include variables such as quasi-rents, portfolio risk, size, taxes, bankruptcy costs, exogenous macroeconomic shocks, and possibly the idiosyncratic characteristics of banks, such as the risk preferences of owners and managers. Adding equation (2) into (1), we obtain the empirical formulation of the model on the determinants of the equity capital of banks:

$$KE_{i,t+1} = (-\lambda)KE_{i,t} + \gamma X_{i,t} + \psi P_{it} + \varepsilon_{i,t+1}, \tag{3}$$

where $\gamma = \beta\lambda$ because of the equations above. In equation (1), the profit variable P contributes to the equity capital ratio from the inertia created by earnings retentions when the capital structure responds to the pecking-order theory. However, accounting profits might be correlated with the quasi-rents from market power, and banks might decide on their target equity capital ratio by taking into consideration these quasi-rents. This means that profits P might also be among the variables of vector X in equation (2) and, thus, in the empirical analysis the possibility of isolating the pecking order from the target equity capital explanation becomes complicated.

One branch of the literature has examined the influence of banks' equity capital on credit growth by directly explaining the growth of bank loans as a function of the equity capital ratios of banks (Adrian and Shin 2010; Berrospide and Edge 2010; Gertler and Karadi 2011; Aiyar, Calomiris, and Wieladek 2012; Hernando and Villanueva 2012; Jiménez-Zambrano et al. 2012). In this paper, we follow a different approach and model the relation between equity capital and the cost of financing for banks that affects interest rates, the demand for credit, and the investment in capital by borrowers.

The most extended view is that, in reality, equity capital is more expensive than debt so that higher equity capital requirements increase the cost of funds for banks, increase the costs of credit to firms and households, and reduce investment and the growth rates of output. Kashyap, Stein, and Hanson (2010) anticipate three sources of increments in the costs of funds for banks that result from higher equity capital. The most important one is the loss of the benefits from the tax deductibility of the interest on debt: If one unit of long-term debt is substituted by one unit of equity, then they estimate that the weighted cost of debt and equity increases in the amount of the interest rate of debt (r) times the corporate tax rate (u). Other possible incremental costs are those attributed to a liquidity premium if long-term debt is substituted instead of short-term debt and a premium attributed to undefined frictions in the markets, which cause the departure from the ideal environment of the Modigliani and Miller (1958) theorem.[4] Kashyap, Stein, and Hanson (2010) estimate that one additional percentage point of equity capital in substitution of long-term debt implies, in the steady state, an increase in the cost of funds of banks in a range between 2.5 bps and 4.5 bps (interest rate of 7 percent and tax rate of 35 percent). However, using aggregated (time-series) data on the banks' equity capital and the interest rates of loans in the United States, they do not find statistically significant effects from equity capital ratios on interest rates.

Other papers (Elliott 2009; King 2010; Oliveira-Santos and Elliott 2012) use a pricing formula of the price equal to the marginal cost to evaluate the sensitivity of the interest on loans to the equity capital of banks:[5]

$$r_L(1-u) = e \cdot r_E + (1-e)r_f + h(1-u), \tag{4}$$

where r_L is the interest rate, u is the tax rate, e is the amount of equity consumed in the financing of the loan (so $(1 - e)$ is the proportion of risk-free debt), r_E is the cost of equity (shareholders' expected return after taxes), r_f is the interest rate of the risk-free debt, and h is the non-financial cost of the loan (comprises net operating costs and the credit-risk premium). Interest rates on debt are tax deductible, but the cost of equity is not.

From equation (4), the changes in the equity capital ratio imply that the changes in the interest rate are as follows:

$$\frac{\partial r_L}{\partial e} = \frac{1}{1-u}(r_E - r_f(1-u)) + \frac{e}{1-u}\frac{\partial r_E}{\partial e}. \tag{5}$$

[4]Kashyap, Stein, and Hanson (2010) and Miles, Yang, and Marcheggiano (2011) explicitly test for the hypothesis of risk conservation, which is the basis of the Modigliani and Miller theorem, with data from U.S. and UK banks. The test consists of a regression on the "beta" of the stock-market returns of banks' shares against their respective leverage ratios. The data confirm 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 is also reduced to half.

[5]See also Repullo and Suárez (2004) and Ruthenberg and Landskroner (2008) for models of the loan-pricing implications of Basel II.

A cost of equity higher than the risk-free interest rate implies that the first term in the right-hand side of equation (5) is positive, but the second term is negative because higher equity capital reduces the financial risk and the shareholders' expected return. The sign of equation (5) should depend on how banks actually recalculate the weighted cost of capital under the new values of the equity capital ratio.[6] If banks have market power in the loan market, then the actual interest of the loans is the product of the marginal cost times a markup that also multiplies the terms in the right-hand side of equation (5).

In the empirical approach we formulate and estimate two econometric models that are approximations to the pricing formula (4). The first model establishes the relation between the interest rate and the target capital ratio in the long run; that is, when the equity capital reaches the steady-state level, then we represent it with the estimated target equity capital ratio from equations (2) and (3):

$$r_{L,i,t} = \alpha KE^*_{it} + \varphi Z_{i,t} + v_{it}, \tag{6}$$

where r_{Lit} is the loan interest rate of bank i in year t; KE^*_{it} is the target equity capital ratio; Z_{it} is a vector of variables that control for the economic risk of the bank that affects r, the composition of the loan portfolio that in turn affects the spread due to the credit risk, operating costs, and other factors potentially affecting the interest rate; and ν_{it} is the stochastic error term. The estimated coefficient α gives an empirical estimate of the change in the interest rate associated with the variations in the target equity capital ratio.

The second formulation applies to transition periods during which banks are out of the steady-state level of equity capital. In this case, we assume that banks set the interest rate by taking into

[6]There are several approximations to the formula of the weighted cost of debt and equity that provide a value estimate of the derivative in equation (5). Modigliani and Miller (1963) propose the following equation for the weighted cost of debt and equity with corporate taxes: $r = r(1 - u(1 - e))$, in which r is the opportunity cost of capital for an unleveraged firm and r^* is the adjusted cost of capital with taxes and leverage. Substituting this expression in the pricing formula (4) as an approximation to the weighted cost of equity and debt, then the change in the interest of loans to changes in the equity capital ratio in (5) will be $ru/(1 - u)$. For $r = 10\%$ and $u = 0.33$, then the change in the interest of loans will be 5 bps.

account the cost of the current equity capital consumed with the loan and, additionally, the extra cost attributable to the dynamic frictions from not being in the target equity capital ratio:

$$r_{L,i,t} = \alpha_1 KE_{it} + \alpha_2(KE^*_{it} - KE_{it-1}) + \partial Z_{i,t} + v_{it}. \tag{7}$$

Coefficient α_2 should be positive. This positive coefficient means that banks charge a higher interest rate on loans the higher the target capital ratio is in relation to the observed capital ratio.

3. Database, Variables, and Regression Models

The database comes from the information contained in the balance sheets and income statements, as well as complimentary files, that individual banks (non-consolidated) report to the Banco de España. The sample period spans from 1992 to 2007. In 1993, Spanish banks were regulated under the requirements of Basel I (CBE 5/93) for the first time. Basel I regulation remains unchanged for the sample period because Basel II was first introduced in 2008. The sample period also ends in 2007, before the beginning of the recent financial crisis.

3.1 Database

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 in assets is smaller than 0.1 percent. The total number of banks available with usable information starts at 143 in 1992 and decreases to 90 in 2007. When two banks merge, we consider the merger as a newly created bank. The banks considered in this paper cover around 90 percent 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.

The sample data splits almost evenly in observations between commercial and savings banks. Savings banks do not have shareholders and their ownership and governance involve representatives of different interest groups. At least 50 percent of their profits must be retained and the rest can be either retained or distributed to support social activities. The amount dedicated to this purpose is tax deductible. Therefore, if corporate taxes are important in determining the cost of capital as a function of the leverage ratio, the effect of changes in the equity capital ratio on interest rates should be lower among savings banks than among commercial banks. Although Spanish savings banks can issue non-voting shares (the so-called *cuotas participativas*), very few issued these in the past. Thus, earnings retentions is their main source of equity capital during the sample period.

Given the unique characteristics of savings banks and their relative importance to the Spanish banking system, we present separate analyses of the determinants of equity capital and interest rates for commercial and savings banks.

3.2 Equity Capital Model

The dependent variable in equation (3) is the equity capital ratio (KE_{it}) that is defined as the ratio between both the tangible equity and the total assets of the bank at the end of year t. The tangible equity comprises startup equity capital, equity from issuing new shares, and retained earnings (reserves). The reasons to focus on the tangible equity are as follows: (i) it is the more conservative measure of the capital in banks, (ii) it is the first to absorb losses, (iii) it is the one that receives more attention at the start of a financial crisis, and, more importantly, (iv) it is the component of the regulatory capital that Basel III sets at a higher/lower bound compared with the bound under Basel II.

The papers on the determinants of the capital ratios of banks differ in their measures for capital. For example, some papers use the stock-market values of equity and others use tier 1 or tier 2 capital. In this paper, we restrict equity capital to tangible equity because tier 1 capital includes hybrid securities (such as preferred stocks) that, in normal times, work more like debt than like equity because they are issued at a fixed interest rate, and the interest expenses are tax deductible. Both the numerator and the denominator of the equity capital ratio are expressed in book values. The market value could be a reasonable alternative to book value because it is forward looking while book value reflects past decisions. However, the market value of equity is not available for most of the banks in the sample because they are not listed in the stock market.[7]

The vector X_{it} in equation (3) includes those explanatory variables that are likely to affect the marginal benefits and costs in the decisions for the capital structure under the trade-off theory and the value-maximization approach. With the available data, the empirical version of equation (3) is formulated as follows:

$$\begin{aligned} KE_{i,t} = \gamma_0 &+ (1-\lambda)KE_{i,t-1} + \gamma_1 DEPOSITS_{it-1} \\ &+ \gamma_2 PRODUCTIVITY_{it-1} + \gamma_3 LOANRESTATE_{it-1} \\ &+ \gamma_4 LOANOTHERBUSINESS_{it-1} \\ &+ \gamma_5 LOANCONSUMPTION_{it-1} \\ &+ \gamma_6 LOWREGCAPITAL_{it-1} \\ &+ \gamma_7 NPL_{it-1} + \gamma_8 SDROA_{it-1} + \gamma_9 \ln ASSETS_{it-1} \\ &+ \psi ROA_{it-1} + TIME_t + BANK_i + \varepsilon_{i,t}. \end{aligned} \tag{8}$$

DEPOSITS is the ratio of deposits over total assets. Because the franchise value of banks should be larger in banks with more deposits, the trade-off theory predicts higher equity capital in banks with higher weights of deposits with respect to assets. *PRODUCTIVITY* is a measure of the total factor productivity from Martin-Oliver, Ruano, and Salas-Fumás (2012). Higher productivity implies higher quasi-rents. Thus, we expect a positive effect from this variable on the tangible equity capital ratio.[8] *LOANRESTATE* is the ratio of loans to construction and real-estate firms with respect to the

[7]Papers that use the market value of equity instead of the book value in the calculation of the capital assume that the market value of debt is equal to its book value. That is, they assume that share value-maximizing decisions on the capital structure of the banks do not affect the risk of banks' debt. This is a strong assumption, so the market-value-based capital ratios should use both equity and debt at their market values.

[8]Berger et al. (2008) identify three possible sources of quasi-rents for banking firms: market power (Keeley 1990), relational banking (Petersen and Rajan 1995), and production efficiency, especially in competitive markets (Stiroh 2000). The most common proxy of the quasi-rents from market power used in the literature is the market-to-book value of equity, but this variable is not available for all banks.

total loan portfolio of the bank. As these loans are viewed as highly collateralized, the effect of this variable on equity capital could be negative. On the other hand, construction and real-estate activities fluctuate more in crisis periods, and banks could hold higher capital ratios in anticipation of higher risk. *LOANOTHERBUSINESS* is the ratio of loans to the rest of the non-financial firms (excluding the construction and real-estate industries) over the total loans of the bank. The coefficient of this variable should be positive because business borrowers put pressure on banks to increase equity capital in order to preserve the long-term borrower-lender relation (Berger et al. 2008). This variable approximates the quasi-rents from relationship banking. *LOANCONSUMPTION* is the ratio of consumer loans with respect to the total loan portfolio of the bank. Because consumer loans are generally less collateralized than other types of loans, we expect a positive effect from this variable on equity capital. *LOWREGCAPITAL* is a dummy variable that equals one if the Basel I regulatory capital ratio of the bank, $(\frac{Tier1+Tier2}{RWA})$, is higher than 9.5 percent and zero otherwise. We conjecture that banks with lower buffers in their regulatory capital will support regulatory pressure to increase the buffer with higher tangible equity. The definition of the threshold is equal to 1.5 bps over the regulatory minimum, in line with the definition used in Flannery and Rangan (2008). *NPL* is the proportion of non-performing loans in the total assets of the bank. As a measure of the credit risk of the bank, *NPL* should have a positive effect on the equity capital ratio. *ASSETS* is a measure of the size of the bank and its total assets at book value. Because larger banks should be less risky because they are more diversified, we can expect a negative effect from this variable on the banks' capital ratio. However, the pecking-order approach predicts a positive sign for the coefficient of this variable because large banks are better known by investors and face lower asymmetric information costs, which favors equity over debt. The net sign of both effects remains an empirical question. *SDROA* measures the ex ante risk of the bank that is defined as the standard deviation of the return on assets, *ROA*. The standard deviation is calculated for a five-year period that starts in 1987. The benefits of holding more equity should increase with risk. Thus, the trade-off theory predicts a positive effect on capital. *ROA* is the profitability of the bank measured by the return on assets. This is the variable used to represent profits

(P in equation (3)). *ROA* is calculated as the net profits divided by the total assets of the bank. The effect of this variable on equity capital is ambiguous. On the one hand, the pecking order predicts a positive effect from profits on banks' tangible equity because the capital ratio varies with the retained profits under a stable dividends policy. Also, a higher *ROA* could positively impact capital ratios if it is an indicator of quasi-rents from market power, and the banks are willing to increase the capital ratios to avoid bankruptcy and preserve these rents. On the other hand, a bank with more profits has more taxable income and a lower likelihood of financial distress that, according to the trade-off theory, could favor an increase in debt with respect to capital so as to rebalance the costs and benefits of taxes and bankruptcy. *BANK* and *TIME* stand for individual and time effects. *BANK* captures the idiosyncratic, time-invariant characteristics of banks because the research finds a large contribution from bank-specific effects in explaining observed differences in banks' capital ratios. *TIME* is a vector containing time dummy variables that controls for external macroeconomic effects common to all banks. In some estimations, they are replaced by a list of variables indicative of the business cycle and monetary conditions, including GDP growth (*GDPG*), the interbank interest rate (*INTERBANK*), consumer price inflation (*INFLATION*), and volatility (*SDIBEX*) measured by the annualized standard deviation of the daily stock-market returns. The model uses the two-step, first-differenced GMM estimator to control for unobserved heterogeneity that could bias the coefficient for the lagged capital ratio. We treat the lagged dependent variable and the ratio of deposits to assets as predetermined and include the $t-2$ and $t-3$ lags of the capital ratio, the risk-weighted assets, and the number of workers per branch (assuming that a larger network of smaller branches increases the capacity to collect deposits) in the matrix of instruments. The standard errors are computed using the final-sample correction posited in Windmeijer (2005) to correct the bias in the second-step estimation.

3.3 Interest Rates on Loans

The econometric model for the determinants of interest rates in the steady state from equation (7) is formulated as follows:

$$
\begin{aligned}
r_{Li,t} = \beta_0 &+ \alpha KTARGET_{i,t} + \varphi_1 PRODUCTIVITY_{i,t-1} \\
&+ \varphi_2 WAGE_{it-1} + \varphi_3 IDSECURITIZ_i \\
&+ \varphi_4 WEIGHTSECURITIZ_{it-1} + \varphi_5 NPL_{it-1} \\
&+ \varphi_6 \frac{RWA_{it-1}}{ASSETS_{it-1}} + \varphi_7 \ln ASSETS_{it-1} \\
&+ BANK_i + TIME_{ti} + \nu_{i,t}. \qquad (9)
\end{aligned}
$$

For the transition period, the econometric model of equation (9) is modified by replacing the term $\alpha KTARGET_{i,t}$ with the sum of $\alpha_1 CAPITALRATIO_{it} + \alpha_2(KTARGET_{it} - CAPITALRATIO_{i,t-1})$, where $CAPITALRATIO$ is the current equity capital ratio of the bank. The resulting empirical equation for the transition period is

$$
\begin{aligned}
r_{Li,t} = \delta_0 &+ \alpha_1 CAPITALRATIO_{i,t} + \alpha_2 TARGETGAP_{i,t} \\
&+ \delta_3 PRODUCTIVITY_{i,t-1} + \delta_4 WAGE_{it-1} \\
&+ \delta_5 IDSECURITIZ_i + \delta_6 WEIGHTSECURITIZ_{it-1} \\
&+ \delta_7 NPL_{it-1} + \delta_8 \frac{RWA_{it-1}}{ASSETS_{it-1}} \\
&+ \delta_9 \ln ASSETS_{it-1} + BANK_i + TIME_{ti} + e_{i,t}, \qquad (10)
\end{aligned}
$$

where $TARGETGAP_{it} = KTARGET_{it-}\ CAPITALRATIO_{it-1}$.

The dependent variable in both equations (r_{Lit}) is the average interest rate quoted by bank i in year t. The rate is calculated as the ratio between the interest income in year t and the average of the stocks of loans at the end of year t and $t-1$. The explanatory variables account for the sources of the costs that enter into the calculation of the interest rate as described earlier. The variables related to the capital ratios capture the impact of the financial structure of the bank on the interest rate: $KTARGET$ for the steady state in equation (9) and $CAPITALRATIO$ and $TARGETGAP$ for the disequilibrium in equation (10). The rest of the variables are common to both equations. The interest rates should be negatively correlated with $PRODUCTIVITY$ because a higher productivity implies lower operating costs. The average labor costs per employee, $WAGE$, have a positive effect on the interest rates if the salaries are independent of the quality of the labor services, and they might have no effect on interest rates if the higher wages are indicative of the higher qualifications of the employees.

The interest rates also depend on the marginal cost of obtaining external funds. Some banks in the sample, especially after year 2000, financed their credit growth by issuing mortgage-backed securities (MBS). This type of securitization became an alternative source of funds to deposits and presented a different cost structure. We control for the potential effects of securitization on the price of bank loans with the variable *IDSECURITIZ,* which takes the value of one when the bank is active in the securitization market and zero otherwise. We also add the variable *WEIGHTSECURITIZ,* which is defined as the proportion of securitized loans over the total assets of the bank, to account for the size effect of securitization. We expect a negative effect from these variables on the price of loans; the securities are backed by mortgages, and banks issue the securities directly to the market, for instance, as compared with deposits.

The cost attributed to risk is measured with the variables *RWA/ASSETS* and *NPL.* The former stands for the ratio of the risk-weighted assets to the book value of the assets of the bank. The *NPL* is the ratio between the non-performing loans and the total assets of the bank. The size of the bank, ln*ASSETS,* can also affect the cost of loans because larger banks are more diversified than small banks. Therefore, size is inversely related to risk.

The *BANK* variable captures the idiosyncratic, time-invariant effects of banks, and the *TIME* variable is a vector of the dummy variables for time added for similar purposes to the case of equity capital. In robustness checks, we replace the *TIME* dummy variables with macroeconomic variables, such as *GDPGROWTH*, *INTERBANK*, *INFLATION*, and *SDIBEX*.

The estimation of the model uses panel data techniques, that is, fixed- or random-specific effects of the banks.

4. Empirical Results

Figures 1 and 2 present the time evolution of the distribution of the equity capital ratio and the regulatory capital ratio, respectively, for the banks in the sample.

Figure 1. Descriptive Statistics of the Variable Equity Capital Ratio

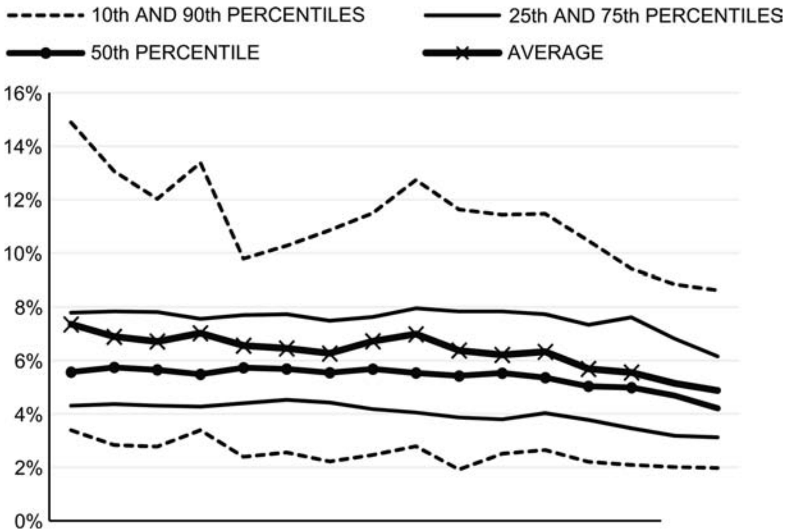
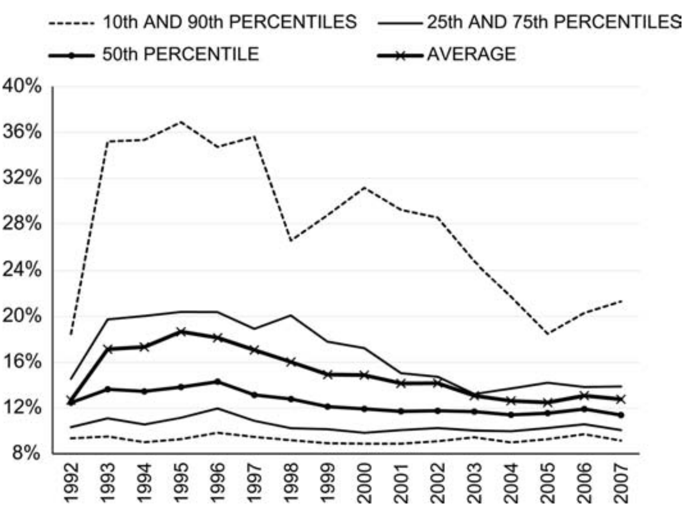


Figure 2. Descriptive Statistics of the Variable Regulatory Capital Ratio



4.1 Descriptive Information on the Variables

Figure 1 shows that the average equity capital ratio stayed around 6.8 percent until 2000. After 2000, the ratio started to decrease until it fell to 4.88 percent in 2007. The average value for the whole sample is 6.3 percent (table 1). The mean of the distribution is above the median, which indicates the distribution is skewed somewhat towards the larger values of the ratio. The distribution of the regulatory capital ratios in figure 2, ($\frac{Tier\,1+Tier\,2}{RWA}$), shows that the mean and the median ratios fall over time, although the drop of the former is more pronounced than the drop of the latter. The mean and median values of the regulatory capital ratios are more than twice the mean and median values of the equity capital ratios when the equity and total assets are at their book values.

The differences between the equity capital and regulatory capital results are in part due to the differences in the denominator (book values of assets in the equity capital ratio and RWA in the regulatory capital ratio). The yearly average of RWA over the assets at book value (not reported) increases over time from 0.497 in 1993 to 0.781 in 2007. Hence, the ratio of the tangible equity over RWA shows a more pronounced decline over time than that observed in figure 1. This decline necessarily implies that the decline in the regulatory capital ratio in figure 2 occurs at the same time that the hybrid securities replace the tangible equity in the total regulatory capital of banks.

As for the interest rates, figure 3 shows that the average rate decreases sharply until year 2000, when Spain became a founding member of the EMU; since then it remains stable in nominal terms (although it decreases in real terms) until 2006. The reason for this evolution is that Spanish banks became part of the interbank euro zone and benefited from the low interest rates set by the European Central Bank. During the first part of the period, the mean and the median of the distribution of the interest rates are very similar, but after the euro, the mean is above the median, which discloses that the distribution is slightly skewed towards higher interest rates.

4.2 Descriptive Statistics of Explanatory Variables

Table 1 presents the descriptive statistics for each explanatory variable. The list of variables includes the target equity capital ratio,

Table 1. Descriptive Statistics of the Explanatory Variables

This table provides the average, standard deviation, and some representative percentiles of the distribution of the explanatory variables that enter in the models of equations (7), (9), and (10). *CAPITALRATIO* is the current equity capital ratio of the bank; *DEPOSITS* is the ratio of deposits over total assets. *PRODUCTIVITY* is the productivity of banks; *LOANREALESTATE* is the ratio of loans to construction and real-estate firms with respect to the total loan portfolio of the bank; and *LOANOTHERBUSINESS* is the ratio of loans to the rest of non-financial firms over the total loans of the bank. *LOANCONSUMPTION* is the ratio of consumer loans with respect to the total loan portfolio of the bank; *LOWREGCAPITAL* is a dummy variable that equals one if the regulatory capital ratio of the bank is higher than 9.5 percent and zero otherwise; *NPL* is the proportion of non-performing loans in the total assets of the bank; *ROA* is the profitability of the bank measured by the return on assets; *SDROA* stands for the standard deviation of the return on assets; *ASSETS* stands for the volume of assets of the bank; *RWA/ASSETS* is the ratio of risk-weighted assets to book value of the assets of the bank; *KTARGET* is the target equity capital ratio, which is estimated from the econometric model of equation (8); *TARGETGAP* is the difference between *KTARGET* and *CAPITALRATIO*; *WAGE* stands for the labor costs per employee; *IDSECURITIZ* is a dummy variable that equals one when the bank is active in the securitization market and zero otherwise; and *WEIGHTSECURITIZ* stands for the proportion of securitized loans over total assets of the bank. Some estimations include macro variables, which are GDP growth (*GDPG*), interbank interest rate (*INTERBANK*), consumer price inflation (*INFLATION*), and volatility (*SDIBEX*) measured by the annualized standard deviation of the daily stock-market returns.

	Average	**Sd. Dev.**	**10^{th} Perc.**	**25^{th} Perc.**	**50^{th} Perc.**	**75^{th} Perc.**	**90^{th} Perc.**
CAPITALRATIO	0.064	0.040	0.026	0.040	0.538	0.077	0.114
DEPOSITS	0.599	0.247	0.144	0.489	0.679	0.785	0.839
PRODUCTIVITY	7.486	0.489	6.883	7.155	7.469	7.828	8.137
LOANREALESTATE	0.152	0.122	0.022	0.082	0.136	0.204	0.289
LOANOTHERBUSINESS	0.365	0.305	0.133	0.202	0.322	0.483	0.631
LOANCONSUMPTION	0.060	0.122	0.000	0.012	0.034	0.061	0.095
LOWREGCAPITAL	0.122	0.328	0.000	0.000	0.000	0.000	1.000
NPL	0.031	0.062	0.002	0.005	0.012	0.034	0.074

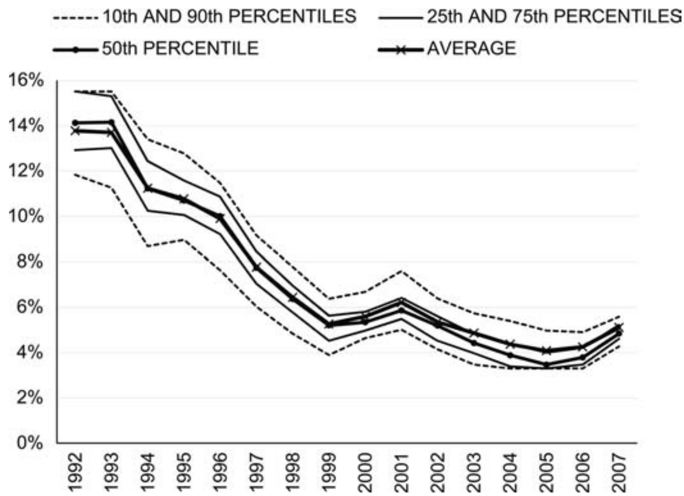
(continued)

Table 1. (Continued)

	Average	**Sd. Dev.**	**10^{th} Perc.**	**25^{th} Perc.**	**50^{th} Perc.**	**75^{th} Perc.**	**90^{th} Perc.**
ROA	0.009	0.029	−0.002	0.005	0.011	0.016	0.024
SDROA	0.005	0.007	0.001	0.001	0.002	0.005	0.012
ASSETS (m€)	4,295	6,490	304.6	736.1	2,064	5,489	10,108
RWA/ASSETS	0.571	0.229	0.232	0.436	0.586	0.751	0.844
KTARGET	0.061	0.034	0.028	0.042	0.055	0.074	0.101
TARGETGAP	−0.001	0.017	−0.019	−0.009	−0.001	0.007	0.017
WAGE (th€)	35.087	8.926	28.200	29.983	32.797	37.733	43.244
IDSECURITIZ	0.297	0.457	0.000	0.000	0.000	1.000	1.000
WEIGHTSECURITIZ	0.034	0.070	0.000	0.000	0.000	0.023	0.143
WEIGHTMORTG	0.418	0.221	0.047	0.249	0.462	0.594	0.681
GDPGROWTH	3.174	1.461	2.400	2.700	3.600	3.900	4.700
INTERBANK	0.054	0.028	0.023	0.034	0.044	0.074	0.100
INFLATION	0.033	0.009	0.020	0.028	0.034	0.036	0.047
SDIBEX	0.194	0.064	0.130	0.138	0.188	0.247	0.308

Note: All of the variables are expressed in unit terms, except *ASSETS* and *WAGE*, which are expressed in thousands of euros and at end-of-year values.

Figure 3. Descriptive Statistics of the Variable Loan Interest Rates



*KE**, from the estimated econometric model of equation (7). The mean of the *KTARGET* is 6 percent (the range goes from 2.8 percent in the lowest decile to 10 percent in the highest decile). The yearly average and median of the target equity capital ratio (not reported) are very similar to those of the observed equity capital ratios (the partial correlation between the target and the observed capital ratios over the whole sample period is 0.82 with $p < 0.01$). The descriptive statistics in table 1 support the high heterogeneity among the banks in the sample, which present substantial differences in all the variables, especially in size.

4.3 Regression Results for Equity Capital in the Total Sample of Banks

The first column of table 2 shows the results of the estimation of a restricted formulation of equation (7), with all the coefficients for the explanatory variables set equal to zero except the lagged equity capital ratio and the lagged *ROA*. If only the inertial of earnings retentions determine the equity capital ratio, then the coefficient for the lagged equity capital should be close to one, and the coefficient

Table 2. Results from Estimating the Model on the Determinants of the Equity Capital Ratio

This table shows results from the estimation of the model of equation (8). The dependent variable is *CAPITALRATIO*, the ratio of equity capital to total assets. *PRODUCTIVITY* is the productivity of banks; *DEPOSITS* is the ratio of deposits over total assets. ln*ASSETS* captures the log of the assets of the bank; *ROA* is the profitability of the bank measured by the return on assets; *SDROA* stands for the standard deviation of the return on assets; *NPL* is the proportion of non-performing loans in the total assets of the bank; *LOWREGCAPITAL* is a dummy variable that equals one if the regulatory capital ratio of the bank is higher than 9.5 percent and zero otherwise; *LOANREALESTATE* is the ratio of loans to construction and real-estate firms with respect to the total loan portfolio of the bank; and *LOANOTHERBUSINESS* is the ratio of loans to the rest of non-financial firms over the total loans of the bank. *LOANCONSUMPTION* is the ratio of consumer loans with respect to the total loan portfolio of the bank. All estimations include either time dummy variables or macro variables, which are GDP growth (*GDPG*), interbank interest rate (*INTERBANK*), consumer price inflation (*INFLATION*), and volatility (*SDIBEX*) measured by the annualized standard deviation of the daily stock-market returns. The model is estimated using the two-step, first-differenced GMM estimator. We treat the lagged dependent variable and the ratio of deposits to assets as predetermined and add the $t-2$ and $t-3$ lags of the capital ratio, the risk-weighted assets, and the number of workers per branch to the matrix of instruments. The standard errors are computed using the final sample correction posited in Windmeijer (2005) to correct the bias in the second-step estimation.

	Specification I	**Specification II**	**Specification III**
$CAPITALRATIO_{t-1}$	0.886***	0.513***	0.485***
	(0.027)	(0.088)	(0.085)
$DEPOSITS_{t-1}$		0.000	0.040**
		(0.018)	(0.016)
$PRODUCTIVITY_{t-1}$		0.006	−0.007
		(0.006)	(0.006)
$LOANREALESTATE_{t-1}$		0.042***	0.028***
		(0.007)	(0.010)
$LOANOTHER\ BUSINESS_{t-1}$		0.013**	0.015***
		(0.006)	(0.006)
$LOANCONSUMPTION_{t-1}$		0.010	0.004
		(0.018)	(0.014)

(continued)

Table 2. (Continued)

	Specification I	**Specification II**	**Specification III**
$LOWREGCAPITAL_{t-1}$		0.000	0.001
		(0.001)	(0.002)
NPL_{t-1}		−0.040	−0.036
		(0.046)	(0.042)
ROA_{t-1}	0.150***	0.185***	0.179***
	(0.020)	(0.040)	(0.034)
$SDROA_{t-1}$		0.162	0.165
		(0.187)	(0.201)
$\ln ASSETS_{t-1}$		0.004	0.007
		(0.007)	(0.006)
$GDPGROWTH_t$			0.000
			(0.000)
$INTERBANK_t$			−0.011
			(0.036)
$INFLATION_t$			0.018
			(0.081)
$SDIBEX_t$			0.006
	Instrumental		(0.007)
P-value 2nd Autocorrelation	Variables, No	0.482	0.498
P-value Overidentif. Restrict.	Fixed Effects	0.203	0.053
Time Dummies	Yes	Yes	No
No. Observations	1615	1429	1429

Notes: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Standard errors are in parentheses.

for the *ROA* should be positive. Indeed, we find that the estimated coefficient for the lagged equity ratio is 0.886 (the standard error is 0.027) and the estimated coefficient for the *ROA* is 0.150 (the standard error is 0.020).

These results suggest that, on average, the equity capital ratios of banks are greatly determined by time-persistence factors, contrary to the hypothesis of selected target ratios and the high speed of adjustment. However, not controlling for unobserved heterogeneity in the dynamic panel data results in biased estimates of the coefficient for the lagged dependent variable (Arellano and Bond 1991; Blundell and Bond 1998). Therefore, we estimate the full model for equation (7) by using the two-step, first-differenced GMM estimator that computes the standard errors by using a final-sample correction, as posited in Windmeijer (2005).

The p-values of the tests at the bottom of table 2 support the validity of the estimations, because the null hypotheses of both the absence of the second-order autocorrelation and the validity of the matrix of instruments cannot be rejected. We observe that the coefficient for the lagged capital ratio has been reduced to 0.513 (s.e. 0.088), which implies that banks are indeed adjusting their capital ratios towards a target capital: the distance to the target is reduced by 48.7 percent each year for around two years to close the gap. The lower estimate of the coefficient for the lagged dependent variable that controls for the unobserved heterogeneity, compared with the coefficient in column 1, is recurrent in the estimation of the dynamic econometric models on equity capital and leverage (Flannery and Rangan 2006 and Lemmon, Roberts, and Zender 2008 for non-financial firms and Berger et al. 2008 and Gropp and Heider 2010 for banks). Furthermore, our estimate of the speed of adjustment is also in line with these papers. The estimates from column 2 are more consistent with the hypothesis that banks manage their equity capital ratio and that each bank makes decisions to correct the deviations from the chosen target, although the adjustment is not instantaneous because of the adjustment costs.

The variables for relative weight of loans to firms in real estate and in other industries (*LOANREALESTATE* and *LOANOTHERBUSINESS*) are the only variables with statistically significant estimated coefficients out of the list of all explanatory variables that represent the benefits and costs of equity financing. In both cases, the estimated coefficients are positive, a result consistent with the hypothesis that higher equity capital protects the quasi-rents generated under relationship lending. The high time persistence of the variables at the bank level can explain why their coefficients are not statistically significant after controlling for the lagged dependent variable and the unobserved heterogeneity. These idiosyncratic, time-invariant fixed effects are strong determinants of the equity capital target of each bank, consistent with other papers (Flannery and Rangan 2006; Lemmon, Roberts, and Zender 2008).

The coefficient for *ROA* in column 2 is positive, 0.185, and statistically significant at the 1 percent level. The earnings retentions also contribute to the time trend in the equity capital ratios, as the inertial explanations of the leverage ratios predict (the pecking order). However, the estimated positive and significant coefficient for the *ROA* variable should also be consistent with the hypothesis that accounting profits are correlated with the quasi-rents from market power and that the banks protect these rents with higher equity capital ratios. At this point, the only thing that can be said is that the equity capital ratios of banks vary positively with the level of accounting profits.

The last column of table 2 substitutes the time dummy variables with four variables that capture the time variation in the macroeconomic conditions (GDP growth, interbank interest rate, inflation, and risk) common to all banks. The sign and significance of all of the rest of the coefficients remain almost unaltered, and the macroeconomic variables do not statistically affect the capital ratios. This result is consistent with those of column 2 where none of the coefficients for the time dummy variables are statistically significant. This result implies that, once we control for the rest of the explanatory variables, there are no time trends in the equity capital ratios of the Spanish banking industry for the period of 1993 to 2007.

4.3.1 Savings Banks versus Commercial Banks

Table 3 reports the estimations for the models analogous to those reported in table 2, distinguishing between commercial and savings banks. The validity of the specification conditions (autocorrelation of residuals and validity of instruments) is satisfied in all the estimations. The results of the estimation for the subsample of commercial

Table 3. Results from Estimating the Model on the Determinants of the Equity Capital Ratio: Commercial Banks and Savings Banks

This table shows separate estimations of equation (8) for commercial and savings banks. The definition of the variables is the same as in table 2.

	Commercial Banks			Savings Banks		
$CAPITALRATIO_{t-1}$	0.881***	0.521***	0.525***	0.922***	0.801***	0.860***
	(0.024)	(0.093)	(0.115)	(0.029)	(0.205)	(0.058)
$DEPOSITS_{t-1}$		−0.003	0.008		−0.005	0.016**
		(0.017)	(0.021)		(0.022)	(0.008)
$PRODUCTIVITY_{t-1}$		0.006	0.000		0.006	−0.001
		(0.006)	(0.007)		(0.004)	(0.002)
$LOANREALESTATE_{t-1}$		0.043***	0.038***		0.008	0.003
		(0.008)	(0.011)		(0.014)	(0.008)
$LOANOTHERBUSINESS_{t-1}$		0.012**	0.015**		−0.018**	−0.002
		(0.005)	(0.006)		(0.008)	(0.003)
$LOANCONSUMPTION_{t-1}$		0.012	0.013		−0.033	0.003
		(0.018)	(0.017)		(0.059)	(0.008)
$LOWREGCAPITAL_{t-1}$		−0.001	0.001		0.001	0.000
		(0.002)	(0.002)		(0.001)	(0.001)
NPL_{t-1}		−0.038	−0.043		−0.064	−0.008
		(0.046)	(0.043)		(0.071)	(0.032)
ROA_{t-1}	0.051	0.187***	0.206***	0.383***	0.425**	0.564***
	(0.070)	(0.040)	(0.053)	(0.063)	(0.208)	(0.153)
$SDROA_{t-1}$		0.244	0.141		−0.123	−0.006
		(0.189)	(0.188)		(0.689)	(0.261)

(continued)

Table 3. (Continued)

	Commercial Banks			**Savings Banks**		
$\ln ASSETS_{t-1}$		0.002	0.004		0.021*	0.000
		(0.007)	(0.007)		(0.011)	(0.001)
$GDPGROWTH_t$			0.000			−0.001***
			(0.001)			(0.000)
$INTERBANK_t$			−0.030			0.023
			(0.067)			(0.035)
$INFLATION_t$			0.087			−0.101**
			(0.150)			(0.047)
$SDIBEX_t$			0.007			−0.007**
			(0.013)			(0.003)
P-value 2nd Autocorrelation	Instrumental Variables, No Fixed Effects	0.509	0.530	Instrumental Variables, No Fixed Effects	0.259	0.028
P-value Overidentif. Restrict.		0.939	0.234		0.956	0.999
Time Dummies	Yes	Yes	No	Yes	Yes	No
No. Observations	881	795	795	699	634	634

Notes: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Standard errors are in parentheses.

banks are very similar to those from the whole sample (table 2). However, in the subsample for savings banks, the results are quite different.

For the savings banks, the estimated coefficient for the lagged dependent variable decreases from 0.922 (s.e. 0.029) to 0.801 (s.e. 0.205) when controlling for the unobserved bank-specific heterogeneity (the null hypothesis that the coefficient equals one is not rejected). In fact, if we estimate the model with the moment conditions (Blundell and Bond 1998) for the cases of large persistence of the dependent variable, the point estimate rises to 0.906. From these point estimates of the coefficient for the lagged equity capital ratio, it takes between five and ten years to close the gap between the actual (current) equity capital ratio and the capital target. Thus, even if savings banks set target equity capital ratios, the fact that they take so long to reach lowers their economic relevance in comparison with commercial banks. Additionally, the estimated coefficient of the *ROA* variable for savings banks, around 0.40, is more than twice the coefficient estimated for the commercial banks. This difference means that the evolution of equity capital ratios among savings banks is more dependent on the level of profits (earnings retentions) than commercial banks are.

4.3.2 Loan Interest Rates

We are now going to show the results from estimating the model of equation (7) on the determinants of the interest rates in bank loans. As indicated in section 2, the main purpose of this analysis is to obtain estimates of the sensitivity of interest rates to changes in the equity capital ratios of the commercial and savings banks. We estimate two versions of equation (7): one when the banks are in a steady-state situation and the relevant equity capital ratio is the target equity capital (equation (9)), and the other when equity capital ratios are out of the target and the banks are adjusting to close the gap (equation (10)). We present the estimates of the random-effect estimator with the standard errors clustered at the bank level because this estimator is more efficient than the fixed-effect estimator, and the Hausman test cannot reject the consistency of the random- versus the fixed-effect estimator.

4.3.3 Equation of Interest Rates in the Steady State

Table 4 shows the results from estimating the model of equation (9) for the whole sample. The first specification is a benchmark estimation that explains the interest rates as a function of the target equity capital ratio and the time dummy variables. The estimated coefficient for the target equity capital ratio without other controls provides a rough estimation of the magnitude of the overall correlation between the interest rates and the target equity capital variables. The estimated coefficient is 0.09 for the target equity capital variable that implies an increment of 1 percentage point in the target equity capital raises the interest rate by 9.0 bps. When the other control variables are added to the regression (second column of table 4), the estimated coefficient for the target equity capital variable is 0.057. The estimated 5.7 bps increase in the interest rate per unit of equity capital is above the range of 2.5 bps to 4.5 bps postulated in Kashyap, Stein, and Hanson (2010) and in line with the value of 5 bps estimated in section 2; but it is lower than the 15 bps marginal increment in the interest rate simulated by the Bank for International Settlements (BIS) and International Monetary Fund (King 2010; Gambacorta 2011; Oliveira-Santos and Elliott 2012).

As for the rest of explanatory variables, the coefficients for the time dummies (not shown) confirm the decrease in the interest rates observed in the descriptive statistics and explained by Spain joining the euro zone. The empirical results show that banks that issue securities ($IDSECURITIZ_{t-1} = 1$) charge interest rates on their loans of 4 bps lower, on average, than banks that do not issue them. Each percentage point of the volume of issued securities relative to the total assets of the bank ($WEIGHTSECURITIZ_{t-1}$) lowers the interest rate by 1.8 bps. The riskier banks charge higher interest rates, as expected: one additional percentage point of *NPL* in the balance sheet increases the interest rate by 4.8 bps; higher risk-weighted assets relative to the book value of the assets implies a higher interest rate, but the effect is economically non-significant. Further, the results show that the interest rates are lower among the large banks than the small banks.

Columns 2 and 3 of table 4 show the results of the estimation of the model on the determinants of the interest rates separately for commercial and savings banks. The estimated coefficients of the

Table 4. Results from Estimating the Model on the Determinants of the Interest Rates of Loans: Total Banks, Commercial Banks, and Savings Banks

This table shows results from the estimation of equation (9). The dependent variable is the average loan interest rate, r_{Lit}, quoted by bank i in year t that is calculated as the ratio between the interest income in year t and the average of the stocks of loans at the end of year t and $t-1$. *KTARGET* is the target equity capital ratio (KE^*_{it-1}) estimated from the econometric model of equation (8). *PRODUCTIVITY* is the productivity of the bank; *WAGE* stands for the labor costs per employee; *RWA/ASSETS* is the ratio of risk-weighted assets to the book value of the assets of the bank; *NPL* is the ratio between non-performing loans and total assets of the bank; ln*ASSETS* stands for the log of the asset value of banks; *IDSECURITIZ* is a dummy variable that takes the value of one when the bank is active in the securitization market and zero otherwise; and *WEIGHTSECURITIZ* stands for the proportion of securitized loans over total assets of the bank. All estimations include time dummy variables. The model has been estimated with the random-effect estimator by clustering the standard errors at the bank level.

	Total Banks		Commercial Banks	Savings Banks
$KTARGET_t$	0.090***	0.057*	0.068*	0.016
	(0.021)	(0.030)	(0.034)	(0.016)
$PRODUCTIVITY_{t-1}$		−0.002	−0.001	−0.006**
		(0.004)	(0.005)	(0.002)
$WAGE_{t-1}$		0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)

(continued)

Table 4. (Continued)

	Total Banks		Commercial Banks	Savings Banks
$IDSECURITIZ_{t-1}$		-0.004^{**}	-0.003	0.001^{*}
		(0.002)	(0.003)	(0.001)
$WEIGHTSECURITIZ_{t-1}$		-0.018^{*}	-0.019	-0.004
		(0.011)	(0.014)	(0.005)
NPL_{t-1}		0.048^{***}	0.043^{***}	0.098^{***}
		(0.017)	(0.016)	(0.024)
$RWA/ASSETS_{t-1}$		0.007^{*}	0.010^{**}	0.001
		(0.004)	(0.005)	(0.004)
$\ln ASSETS_{t-1}$		-0.002^{**}	-0.002^{*}	-0.001
		(0.001)	(0.001)	(0.001)
Random Effects	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
No. Observations	1428	1428	794	634

Notes: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Standard errors are in parentheses.

explanatory variables differ between the two subsamples. Our main focus is on the effects of the interest rates on the equity capital variable. Among commercial banks, a marginal increase (1 percentage point) in the target equity capital ratio implies a 6.8 bps increase in the interest rate. Among savings banks, the estimated coefficient for the target equity capital ratio is not statistically significant. This result confirms that the target equity capital ratio has a low importance for savings banks when setting the interest rates on their loans, which reinforces the previous evidence that savings banks do not "manage" their equity capital ratios.

4.3.4 Equation of Interest Rates for the Adjustment Process

Following the exposition in the theory section, the model of equation (9) is modified so that the target equity ratio is replaced in the list of explanatory variables by two new variables: the observed equity capital ratio and the difference between the equity capital ratio and the lagged observed equity capital ratio. In the steady state, the three variables converge to the equity capital target. Table 5 shows the results of the estimation of equation (10) for the whole sample and separately for commercial and savings banks in columns 2 and 3.

The estimated coefficients of the two new variables are positive and statistically significant for the whole sample and for the subsample of commercial banks, but are not significant for the subsample of savings banks. Therefore, this result confirms that for savings banks, interest rates are independent of the equity capital ratios. For commercial banks, the estimate of the coefficient for the current equity capital target ratio is 0.085, which is higher than the estimate of 0.068 in table 4, although the null hypothesis of equal coefficients is not rejected.

The estimated coefficient for the gap variable, *TARGETGAP*, is 0.12 and is statistically significant. Therefore, the banks add 12 bps to the interest rate per each percentage point of positive difference between the target and the current equity capital ratio. This result means that the flow costs from the additional regulatory equity capital requirements are higher than the estimated costs for the steady-state situation. If we take as a point of comparison the estimate of 0.068 from table 4, then the costs from the higher equity capital requirements in the adjustment period are approximately 75 percent

Table 5. Determinants of the Interest Rates of Loans when Banks Are Adjusting Their Current Equity Capital Ratio to the Target: Total Banks, Commercial Banks, and Savings Banks

The table shows results from the estimation of equation (10). The variables are the same as in table 4, but *TARGET* has been replaced by the banks' capital ratio, *CAPITALRATIO*, that includes *TARGETGAP*, which is the difference between *KTARGET* and *CAPITALRATIO*.

	Total Banks	Commercial Banks	Savings Banks
$CAPITALRATIO_t$	0.070***	0.085***	−0.007
	(0.025)	(0.030)	(0.027)
$TARGETGAP_t$	0.108***	0.120***	0.023
	(0.035)	(0.046)	(0.017)
$PRODUCTIVITY_{t-1}$	−0.003	−0.003	−0.006**
	(0.004)	(0.005)	(0.002)
$WAGE_{t-1}$	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
$IDSECURITIZ_{t-1}$	−0.003*	−0.003	0.001*
	(0.002)	(0.002)	(0.001)
$WEIGHTSECURITIZ_{t-1}$	−0.019*	−0.022	−0.006
	(0.011)	(0.014)	(0.005)
NPL_{t-1}	0.050***	0.043***	0.100***
	(0.015)	(0.014)	(0.023)
$RWA/ASSETS_{t-1}$	0.006	0.008*	0.002
	(0.004)	(0.008)	(0.004)
$\ln ASSETS_{t-1}$	−0.002	−0.002	−0.001
	(0.001)	(0.001)	(0.001)
Random Effects	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes
No. Observations	1428	794	634

Notes: ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Standard errors are in parentheses.

(that is, (0.12–0.068)/0.068) higher than the costs in the steady state.

4.3.5 Robustness Tests

We also estimate the empirical model of the determinants of the equity capital ratios (equation (8)) with an OLS that comprises the bank dummy variables (i.e., allowing a different intercept for each bank, equivalent to the fixed-effect estimator) and with the standard errors clustered around the banks. The overall results do not change with respect to those shown in the paper and obtained through the GMM estimation, although the coefficient of the lagged dependent variable is slightly smaller, which is to be expected because of the different properties of the two estimation methods (Arellano 2003).

The interest rate from equation (9) is also estimated by replacing the time dummy variables with the same macroeconomic variables that were introduced in the estimation of equation (8) for the capital ratio. The estimation confirms the influence of the EMU monetary policy in the time trend of the interest rates, although with differences between commercial and savings banks: the estimated coefficient of the interbank interest rate (monetary policy transmission coefficient) in equation (9) is 0.837 (s.e. of 0.078) for the commercial banks and 0.693 (s.e. of 0.022) for the savings banks. Another result of the estimation is that the interest rates are negatively and significantly correlated with the GDP growth (point estimate of –0.005) and the inflation rate (point estimate of 0.25) in both commercial and savings banks. Therefore, the interest rates are countercyclical and respond partially to inflationary conditions (the real interbank interest rate).

The interest rate equation in the adjustment period equation (10) is estimated by splitting the difference between the target and the current equity capital ratios into two variables, one with positive values and the other with negative values. We do not find evidence of asymmetric effects for the equity gap in the interest rate whether the gap is positive or negative. We have also estimated a dynamic version of the loan interest rate equation (9) that includes the lagged interest rate as the explanatory variable in the model. The estimated coefficient for the lagged dependent variable is not statistically significant, so we keep the long-run model presented in the text. Although loans with different maturities in the credit portfolios of banks might induce some time persistence in the interest rates (dependent variable), most of the bank loans offered by Spanish banks are at floating interest rates, that is, indexed at the Euribor-interbank rate. We also find that the estimation of the coefficient for the target equity capital ratio is robust to changing the *RWA* with variables of the composition of the loan portfolio (consumer and commercial loans, mortgages, etc.).

Finally, we substitute the target equity capital ratio in the estimation of the interest rates for savings banks with the observed capital ratio. Because the results of table 3 suggest that savings banks might not set any target, we test whether the inclusion of the observed capital ratio instead of the target ratio could make a difference. Nonetheless, the coefficient remains non-significant, even though when we estimate the model without any measure of the capital ratio, the rest of the coefficients remain unchanged. This robustness check supports the evidence that savings banks behave as if they perceive no differences in the cost for their equity capital compared with other sources of funds.

5. Conclusion

Bankers argue that asking banks to hold more equity capital increases the cost of funds, causing credit to become more expensive and the investment rate to fall, all combined having a highly negative impact on economic growth (Institute of International Finance 2011). If this argument is true and equity does increase the cost of funds, then the differences in costs caused by the differences in equity should be difficult to sustain in a competitive industry, unless banks differentiate their products and customers.

The casual observation of banks' capital ratios shows that banks keep positive buffers of regulatory capital and that equity capital ratios differ substantially among banks. This observation suggests that different levels of equity capital among banks do not have significant effects on the volume and price of bank loans, because otherwise competition should penalize those banks that deviate from the efficient target for the ratio. Research papers on how equity capital ratios affect banks' lending decisions focus on the relation between capital ratios and credit growth, but also on samples with only large and/or listed banks. Systematic research on the relation between equity capital ratios and interest rates are non-existent, especially with data from banks of all sizes and different ownership forms. More recently, published estimates exist of the effect of Basel III on interest rates that rely on simulated results that use theoretical pricing formulas, but no evidence exists from actual bank-level data.

This paper contributes to the assessment of the potential costs of higher equity capital requirements, providing empirical evidence with data from Spanish banks. More concretely, we provide evidence on how banks choose their equity capital and on how interest rates are affected by the levels of equity capital. Spanish banks are heterogeneous in their sizes and differ in their ownership form. For this reason, our results provide evidence for banks of different sizes and legal natures not explored so far.

The results of this study indicate that the consequences of the reform on regulatory capital might differ among banks with different ownership forms. In Spanish savings banks, the equity capital ratios are mainly determined by an inertial process of contributions from retained earnings. Moreover, the savings banks do not seem to assign to equity an opportunity cost different from that assigned to other sources of funds. These results might be explained by the fact that savings banks are not owned and controlled by shareholders but by multiple interest groups, each with different effective decision-making powers. The managers and employees of savings banks, the insiders, are likely to have the power to impose their own goals that are more oriented to growth than to profitability. But the high dependence between equity capital and earnings retentions in savings banks might also be the consequence of earnings retentions being the only source of equity capital for savings banks. Furthermore, the earnings distributed as social dividends by savings banks are tax deductible. Therefore, if corporate taxes are the main source of the differences between the cost of debt and the cost of equity, these differences are much less important for savings banks. This lack of importance could explain why interest rates are independent of the equity capital ratios in the sample of savings banks.

In Spanish commercial banks, the results are different: they set equity capital targets in a manner consistent with value-maximization objectives. In addition, although current profits explain part of the variations observed in the equity capital ratios among commercial banks, the impact is lower than among savings banks, as might be expected, if commercial banks can also issue new equity to meet equity capital targets. Commercial banks assign a positive differential cost to equity capital, compared with debt, when pricing bank loans. For commercial banks, dividends to shareholders are not tax deductible, so the equity capital is more expensive than debt financing. Commercial banks charge a premium on the interest rates proportional to the level of equity capital chosen as a target ratio to compensate for the difference in cost. The current reform under way in the Spanish banking industry, with the *cajas* transferring their banking activity and assets to corporations with similar ownership forms to commercial banks, will homogenize the behavior among the surviving banks.

The consequences for economic growth of a permanent increase in the average interest rate from higher equity capital depend on (i) the price elasticity of the demand for credit, (ii) the relative importance of bank credit in financing investment, and (iii) the elasticity of the output to capital services. In order to quantify this effect, we use three inputs. The first is the estimation by Martín-Oliver (2010) of the price elasticity of bank loans equal to –1.18. This estimate takes into account that there are alternative sources of financing different from bank credit—for example, equity. Second, data from the financial accounts of the Spanish economy show that bank credit represents around 33 percent of the total funds available to finance investment. Third, we take 0.30 as a reasonable estimate of the elasticity of output to the capital services input.

If 1 percentage point of additional regulatory capital increases the target of equity capital in the same amount, it creates a 1-percentage-point gap with the current equity capital ratio. The estimation in table 5 shows that 1 percentage point in the gap between the target and the current equity capital ratio increases the interest rates on loans by 12 bps. This increase represents 1.62 percent of the average interest rate in the sample period (7.42 percent). This increase in the cost of credit reduces the output (GDP) by 0.19 percent $(1.62 \cdot (-1.18) \cdot 0.33 \cdot 0.3)$ per year until the gap is closed.

Once in the steady state, our estimate of the increase in the interest rate per percentage point of equity capital target is between 6.8 bps and 8.5 bps (table 4). That is between 56 percent and 70 percent of the increase in the transition period. Therefore, from the third year on, the estimated loss in GDP per percentage point of increase in the equity capital ratio is between 0.11 percent and 0.14 percent of GDP. These numbers are in the range of cost estimates published by international organizations (see table 1 in Oliveira-Santos and Elliott 2012).

The assessment of these cost estimates has to take into consideration the potential benefits of higher financial stability resulting from more equity capital. Another consideration is the general economic and financial conditions under which the higher requirements have to be met. The adjustment period from 2013 to 2019 set by the BIS for compliance with the regulatory capital possibly takes into account the current situation of low profits and high cost of capital due to the financial crisis. The market perception about the country risk can also affect the country strategy of bank recapitalization and restructuring. All this means that while the estimated costs in the steady state are relatively robust to market conditions, the adjustment costs in the transition period might be dependent on the current economic and financial conditions of each country.

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