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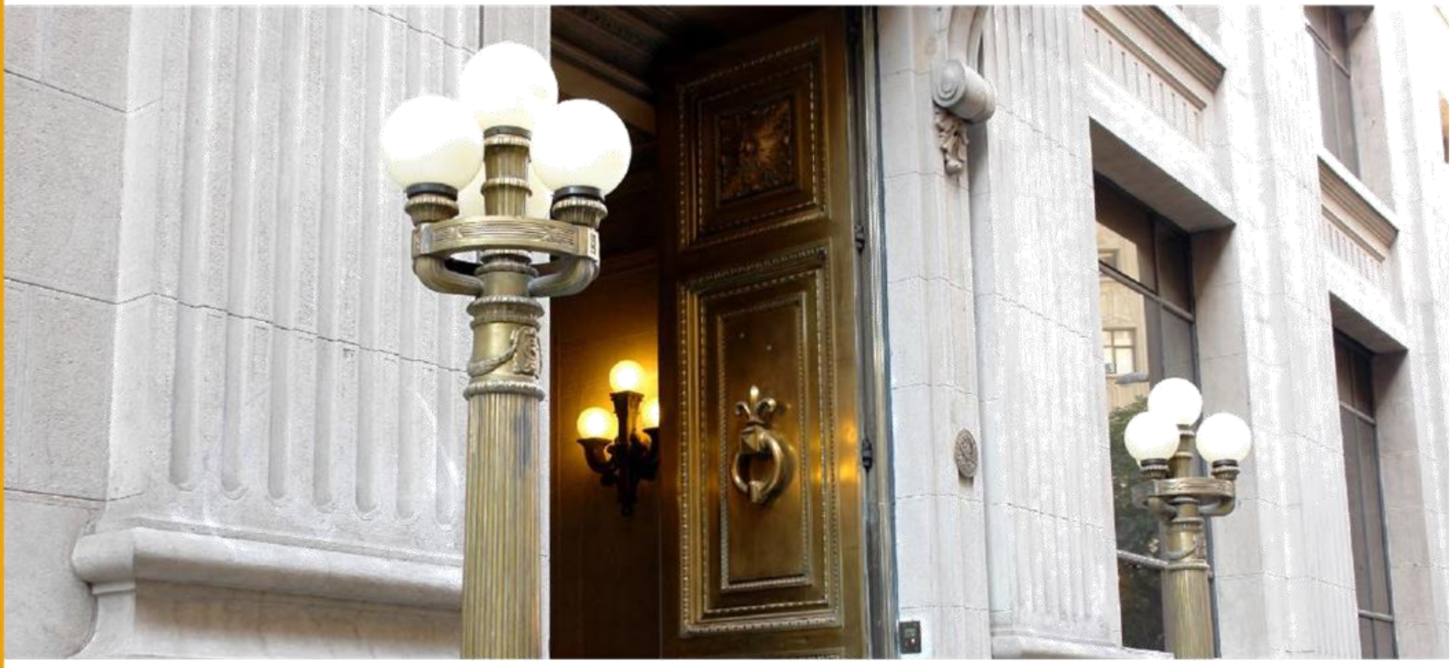

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Capital Ratios and the Weighted Average Cost of Capital: Evidence from Chilean Banks*

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Abstract

In this paper, we find that one additional percentage point of common equity Tier 1 to risk-weighted assets ratio is associated with an increase in the Weighted Average Cost of Capital (WACC) of Chilean banks by a maximum of only 11.7 basis points. This result is found by assessing the impact of capital ratios on the return of capital and the return of debt, following alternative empirical strategies, which consider both market data and banks' balance sheet information. We find that higher capital ratios decrease the return on banks' capital—partially because more capital makes banks less risky—in magnitudes similar to those found in the literature for other countries. Secondly, we study the role of capital on the return of banks' debt. We find a strong impact of capital ratios on the return of subordinated debt, and no effect on senior debt.

Resumen

En este documento, encontramos que un punto porcentual adicional de la razón de Capital Básico Tier 1 sobre los Activos Ponderados por Riesgo está asociado con un aumento en el Costo Promedio Ponderado del Capital (*Weighted Average Cost of Capital*, o WACC en su sigla en inglés) de los bancos en Chile, en un máximo de 11,7 puntos básicos. Este resultado se obtiene al evaluar el impacto de los ratios de capital sobre el rendimiento del capital, siguiendo estrategias empíricas alternativas, las que consideran tanto información de mercado, como información de balance. Encontramos que ratios de capital más altos disminuyen el rendimiento del capital, en parte, porque más capital hace que los bancos sean menos riesgosos. Además, las magnitudes encontradas para esta asociación entre ratios de capital y rendimiento del capital de los bancos en Chile son similares a las encontradas para otros países. En segundo lugar, estudiamos el rol de los ratios de capital sobre la rentabilidad de los bonos bancarios. Encontramos un fuerte impacto de los ratios de capital en el rendimiento de los bonos subordinados y ningún efecto sobre los bonos senior.

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1 Introduction

One of the key lessons learned from the Global Financial Crisis was the need to enhance the resilience of banking institutions through new regulations aiming to improve banks' solvency by requiring better and more capital. That is why Basel III introduced the concept of capital buffers (counter-cyclical, conservation, and systemic importance capital buffers) to reduce the undesired real and fiscal effects associated with tightened financial conditions and public support that typically characterize financial crises (BIS, 2017). In Chile, reforms to the General Banking Act in 2019 introduced these recommendations, which are gradually being implemented (Aguilera et al., 2020). Consequently, depending on the state of the financial cycle and on their systemic importance, banks in Chile are likely to require more capital to meet these new requirements. Motivated by this new regulatory environment, and following a set of complementary approaches, in this paper we estimate how costly it is to increase capital funding in Chile[1/].

This paper estimates empirically the marginal effect of funds on the average cost of funds across Chilean banks. For this purpose, we first estimate the impact that additional capital has on the market returns of bank's equity, showing that this effect is slightly negative and statistically different from zero. Alternatively, we test the effect of higher capital ratios on the return on equity (ROE). Our findings are consistent with the previous approach, but the magnitude of the impact found is somewhat larger. In a second step, we assess the marginal effect of banks' capital ratios on the return of their debt. In particular, we look at the correlation between the market's internal rate of return of debt securities issued by banks and the level of banks' capital ratios. We do so after controlling by a set of characteristics of both bonds (subordinated vs. senior, maturity, risk) and banks (size, liquidity, among others). Overall, we find a significant effect of capital ratios on the return of subordinated debt and no effect on senior debt [2/]. Considering all the effects found, we show that one additional percentage unit of the capital to risk-weighted assets ratio potentially increases banks' weighted average cost of capital (WACC) by a maximum of only 11.7 basis points, on average.

From a theoretical perspective, the classical result of Modigliani and Miller (1959) regarding the irrelevance of a firm's funding structure on its value, implies that the degree of capitalization of any firm should not affect its average cost of funds. When applied to banks, and in the stylized context in which Modigliani and Miller (MM) derive their result, the previous statement implies that increasing the degree of capitalization of banks should not have an impact on their overall cost of funds. This result follows from the core of MM's main theorem, i.e. that the value of a firm depends on the level and risk of the return of its assets and not on its funding structure. MM call this principle the "law of conservation of value". In addition, by a simple accounting identity, the average cost of a firm's funds is equal to the return of its assets. It follows that the average cost of funds is not related to the funding structure of a firm.

Therefore, we should discuss why we may have found that a higher share of capital in the funding of banks increases its funding cost. Certainly, MM's theorem does not imply that the cost of debt and equity, when taken separately, do not depend on the funding structure. On the contrary, they very much

[1/] It should be noticed that we assess how costly it is to increase capital ratios, independently if they are required or voluntary.

[2/] Notice that in applying all these alternative approaches, we do not claim to assess a causal relationship between capital and the cost of capital or debt. Instead, we make our best attempt to estimate the correlations among them, and then use these correlations to calibrate the weighted average cost of capital.

depend on such a structure. Nevertheless, the weighted average of the cost of debt and equity does not. If, for example, equity increases relative to debt, debtholders will be willing to accept a lower interest rate since a higher capital buffer provides them better insulation from risk. Shareholders also demand a lower return since a higher capital buffer will now absorb certain shocks, and therefore bankruptcy is less likely. However, even though both returns are reduced, their weighted average remains constant and equal to the return on assets. Finally, if equity falls relative to debt, both shareholders and debtholders will demand a higher return, but the average will remain constant since it is equal to the return of assets, according to MM's main theorem.

Therefore, changes in funding should not affect the average cost of funds. The previous analysis provides a solid argument against the idea that the average cost of funds will increase in that scenario since "equity is more expensive than debt"[3/]. However, the MM theorem is derived under extremely stylized assumptions, making its prediction an empirical matter. In practice, there are several deviations from the stylized case presented above:

1. The existence of taxes implies that a higher level of leverage increases the return on equity because interest expenses reduce the tax base, while the payment of dividends, in contrast, does not. This provides an incentive to increase leverage.

2. If debt is not sensitive to increases in risk because of implicit guarantees, shareholders, as residual claimants, will be left with a return higher than the minimum they would demand in the event of higher leverage (higher debt-to-capital ratio). Therefore, in the absence of debt sensitivity to leverage, shareholders will be incentivized to choose a funding ratio biased towards debt.

3. Higher leverage may not increase the cost of all existing debt but that of the marginal, newly issued debt only. This limited impact occurs because the terms of existing debt are fixed, and no clauses allow existing debtholders to receive compensation for the higher risk they face when leverage increases. If this is the case, an increase in leverage will positively impact the return on equity since they receive the additional return that is not paid to existing debtholders. Therefore, existing debtholders will be expropriated by shareholders. If such an increase in leverage is possible—either contractually or regulatory—there will be an incentive to do it (Admati et al., 2018). For this reason, contractual constraints in the degree of leverage and minimum capital requirements provide the right incentives for shareholders not to fall into these dynamics that increase leverage.

Therefore, deviations from the MM assumptions tend to generate too low capital ratios, as per compared with what a correct pricing of risk would imply. This justifies mandatory minimum capital requirements. Now, how much capital should the regulatory authority require banks to hold? Cochrane (2014) argues that capital requirements should increase until they eliminate the distortionary advantages resulting from the deposit insurance and the externalities associated with the existence of banks that are too big to fail. Miles et al. (2012), in turn, highlights the role of externalities arising from banks' position in a monetary economy. In particular, they show that when banks' bankruptcy social costs are higher than private losses, the "optimal bank capital ratio" should be around 20% of risk-weighted assets or more. Finally, Kashyap et

[3/] Supporters of this view would argue that higher banks' capital requirements will necessarily increase banks' lending rates (Elliott, 2013). However, this argument forgets that higher capital requirements reduce the return required in both debt and equity, as the risk is lower for shareholders and debtholders, as it has been explained here.

al. (2010) argues that banks tend to adopt funding structures that minimize their funding costs. Since the only comparative advantage that banks have is their cost of funds, they will aim to increase their leverage as much as possible in order to maximize their profits. Therefore, imposing higher capital requirements would move the entire financial system towards a more capitalized equilibrium and higher social welfare.

Nonetheless, the question of the appropriate level of minimum capital requirements is outside the scope of this paper, as it would require accounting for the impact of higher capital ratios on lending rates and the overall economic performance.

At a practical level, the implementation of higher capital requirements faces some challenges. One of them, as raised by Myers and Majluf (1984), is that the market could punish increases in banks' capitalization, as it could be interpreted as if current shareholders would like to dilute expected adverse results. Nonetheless, the fact that banks' regulation on capital requirements is exogenous to each institution weakens the power of this argument. Secondly, we must address two additional practical issues: (i) how gradual should the implementation of higher capital requirements be, and (ii) whether the additional capital required should be constituted only through the accumulation of profits or other methods should be considered. This last issue is important because banks might prefer to "adjust" to higher capital requirements through reducing assets instead of profit retention or issuing new equity. Therefore, it is usually desirable to introduce an ad-hoc regulation that limits assets reduction, ensuring that new capital requirements are not met through in that way.[4/].

The rest of this article is organized into five sections. Section 2 outlines the empirical strategies implemented to estimate the marginal effects of capital. Section 3 describes the data and sample of banks used in the empirical strategy. Section 4 presents the results of our estimations. Section 5 calibrates the overall impact of higher levels of capitals on banks' WACC. Finally, section 6 concludes with final remarks, a policy discussion, and directions for future research.

2 Empirical strategy

2.1 Weighted average cost of capital (WACC)

To estimate the potential long-term impact of a higher capital ratio on the funding cost of banks, we focus on measuring the weighted average cost of capital (WACC). In this definition, "capital" should be understood as "funds" in general, i.e., it could be either debt or equity. Then, the WACC is equivalent to a weighted average return of equity (r^e), and bonds' return (r^d), whith the weights being the participation of each one in the banks' funding structure, K/A and (1 - K/A), respectively:

$$WACC = r^e \left(\frac{K}{A}\right) + r^d \left(1 - \frac{K}{A}\right) \tag{1}$$

Following this definition, an increase in the capital ratio, K/A, affects WACC through its direct impact on the return on equity $\frac{\partial r^e}{\partial (K/A)}$, on the return of debt $\frac{\partial r^d}{\partial (K/A)}$, and the fact that changes in leverage change

[4/] The conservation capital buffer introduced in the Basel III framework addresses this issue by constraining banks' profit distribution depending on the level of common equity Tier 1 that is above and beyond the conservation range or the sum of all capital buffers that each institution must hold at each given time.

the weights, having an impact of the WACC whenever r^e is different from r^d. More specifically:

$$\frac{\partial WACC}{\partial (K/A)} = \frac{\partial r^e}{\partial (K/A)} \left(\frac{K}{A}\right) + \frac{\partial r^d}{\partial (K/A)} \left(1 - \frac{K}{A}\right) + (r^e - r^d) \tag{2}$$

In what follows, we provide alternative empirical strategies to estimate both derivatives in equation 2, i.e., the impact of a higher share of capital in the funding structure of banks on the return on equity and on the return on debt. Later, in section 5, we use these results to calibrate the impact of higher capital ratios on the WACC of Chilean banks.

2.2 Capital ratios and the return on equity

We use two approaches to assess the impact of the increase in the share of capital on the return on equity. First, we look at the sub-set of four banks in Chile that trade their shares publicly in the stock market. Following Kashyap et al. (2010) and Miles et al. (2012), we apply the capital asset pricing model (CAPM) to evaluate whether the sensitivity of banks' stocks returns to market fluctuations (βs) are affected by banks' capital ratios. Our second approach consists of studying the relationship between the return on equity (ROE)—obtained directly from banks' income statements—and the capital ratios. This last exercise is implemented over a broader set of eleven medium and large-sized banks, including those considered when applying the CAPM approach.

2.2.1 The CAPM approach

We implement the CAPM approach to estimate the relationship between the expected return of banks' equity (r^e), measured by the effective stocks' return of bank b, and the expected market return. In particular, we know that:

$$r^e_b = r^{rf} + \beta_b \cdot RiskPremium \tag{3}$$

where r^{rf} represents the return on a risk-free asset, and $RiskPremium$ is measured as the difference between the effective market return and r^{rf}. Therefore, it follows that an increase in capital in the funding structure (K/A, which in what follows we denote by k_b) affects the return on equity (r^e_b) through its impact on β_b, i.e.:

$$\frac{\partial r^e_b}{\partial k_b} = RiskPremium * \left(\frac{\partial \beta_b}{\partial k_b}\right) \tag{4}$$

To determine the impact of k_b on β_b, we first estimate equation 3 for each bank separately using daily returns within a moving-average window[5/]. Then, we compute monthly averages for each β_b estimated, and merge them with the banks' monthly characteristics. Finally, as section 4 explains, we construct a quarterly panel dataset and estimate the average relationship between β_b and k_b, from the following specification:

$$\beta_{bt} = \alpha + \gamma k_{bt-1} + \eta X_{bt-1} + \delta_b + \delta_t + \epsilon_{bt} \tag{5}$$

[5/] We used different sizes for this moving-average window, but our results did not change substantially. Therefore, following Kashyap et al. (2010), we decide to keep a 2-years window as our benchmark result.

Our benchmark measure of banks' capital ratios is *Common Equity Tier 1* as a percentage of total assets. In addition, we use alternative capital ratios, including the regulatory capital adequacy ratio, as defined by the ratio between regulatory capital and the risk-weighted assets, among several others. The set of bank's controls X_b includes banks' characteristics, such as size, a credit risk indicator, and a liquidity ratio[6/]. Finally, δ_b, δ_t, and ϵ_{bt} are bank and quarterly time fixed-effects, and the error term, respectively.

From equation 5 we obtain $\hat{\gamma}$, i.e. the average relationship between banks' capital ratios and their β, or $\frac{\partial \beta_b}{\partial k_b}$. Finally, the variable $RiskPremium$ in equation 3 represents the average stock market excess return observed during the sample period. Thus, from equation 4, we obtain the impact of banks' capital ratios on the return on equity, as follows:

$$\frac{\partial r^e}{\partial k_b} = RiskPremium * \hat{\gamma} \tag{6}$$

2.2.2 Capital ratios and the accounting return on equity (ROE)

As a second approach, we compute the relationship between the return on equity (ROE), obtained directly from banks' income statements, and alternative measures of the capital ratio. In particular, we construct a quarterly panel dataset for ROE, measuring the annualized cumulative after-tax profits as a percentage of total assets. Then, instead of following the two-step procedure described above, we estimate the following equation directly:

$$ROE_{bt} = \alpha + \gamma k_{bt-1} + \eta X_{bt-1} + \delta_b + \delta_t + \epsilon_{bt} \tag{7}$$

The banks' controls and fixed-effects are the same as in equation 5. However, in this case, the capital ratio impact on the return on equity is given directly by the parameter $\hat{\gamma}$.

2.3 Banks' capital ratio and the return on debt

To account for the relationship between banks' capital ratios and debt returns ($\frac{\partial r^d}{\partial (K/A)}$), we estimate a bilateral relationship at the bond-bank level. In particular, we relate the internal rate of return (IRR) of instrument i issued by bank b at time t (r^d_{ibt}) with a set of bonds characteristics (X_i), such as duration, the volume involved in the transaction, and whether the bond is senior or subordinated (Sub_i). Also, we control by the issuers' characteristics (X_{bt}), including different measures of the capital ratio (k_{bt}), and banks' characteristics, including size and liquidity.

This bilateral panel structure allows us to differentiate between subordinated and senior bonds to account for potential differences in the impact of capital ratios on their debt returns. This distinction is important because the sign and significance of this relationship and the size and significance of the impact of the control variables on bonds' yields could differ across these two types of instruments[7/]. Considering this, we estimate the following regression:

[6/] We also include a dummy variable to account for mergers and acquisitions that occurred during the sample period

[7/] Senior and subordinated bonds differ in terms of the risk taken by debtholder since, in the event of a liquidation, subordinated bondholders are only paid when there are sufficient resources available once senior bondholders have been paid. Moreover, bonds' characteristics also differ in duration and size, as subordinated debt securities tend to be longer in duration and involve higher transactions volumes.

Table 1: Summary statistics: Market return on equity data

	N	mean	p25	p50	p75	sd	min	max
β	8184	0.89	0.79	0.88	1.01	0.15	0.49	1.26
Stock return	8184	0.05	-0.65	0.00	0.74	1.42	-14.75	10.59
Risk premium	8184	0.04	-0.41	0.02	0.50	0.94	-6.48	5.67

Note: β refers to the estimated coefficient as in the equation 3. Stock returns refers to the daily market return on equity for four publicly listed banks in the Chilean stock market during the 2010-2017 period. Risk premium is measured as the average stock market excess return observed during the sample period.

Source: Authors' calculations from information obtained from Bloomberg.

$$\begin{aligned} r^d_{ibt} \quad = \quad & \alpha + \gamma k_{bt} + \theta Sub_i + \eta_1 X_i + \eta_2 X_{bt} + \mu_1 Sub_i k_{bt} + \\ & \mu_2 Sub_i X_{it} + \mu_3 Sub_i X_{bt} + \delta_b + \delta_t + \epsilon_{bt} \end{aligned} \tag{8}$$

Under this specification, γ measures the relationship between banks' capital ratios and the return on debt for senior bonds. At the same time, $\gamma + \mu_1$ captures the relationship between bank capital ratios and the return on subordinated bonds' debt. Section 4.2 reports these results, including the average marginal effect of capital ratios on the return on debt and its overall impact.

3 Data

The empirical strategies described above are implemented over a different set of banks. First, we run the CAPM approach to estimate the relationship between banks' capital ratios and the return on equity on the four publicly listed banks in the Chilean stock exchange market. This group of banks represents "Sample 1"[8/]. With this information and the market stock return proxied by the Index of Selective Share Prices (IPSA, in Spanish) from the Santiago Stock Exchange, we create a set of βs from the estimation of equation 3. Table 1 shows the detailed statistics of the information used the estimations. We collapse and merge these βs with banks' balance sheet information provided by Chilean Financial Markets Commission (CMF)[9/]. Table 2 presents the descriptive statistics of this combined dataset for this group of banks.

For our second approach that estimates the relationship between banks' capital ratios and the return on equity (equation 7), we used the same banks' balance-sheet information as above. However, this time we apply this strategy to 11 medium and large-size banks. In this case, the return on equity is proxied by the accounting measure of after-tax profits as a percentage of core capital. See the descriptive statistics of the variables included in this estimation under the heading "Sample 2" in Table 2. Finally, we consider only those banking institutions that issued bonds securities during the 2003-2009 period to estimate the debt returns. In particular, our dataset is based on daily debt securities transactions of 573 instruments traded 553.152 times.

[8/] Including Santander, BCI, Chile, and Scotiabank. We do not include Banco Security because its shares refer to a whole financial group and not only to the bank itself.

[9/] Since June 1st, 2019, the former Chilean bank supervisor *Superintendencia de Bancos e Instituciones Financieras* (SBIF) was integrated into the CMF, overseeing not only banks but other financial intermediaries as well.

Table 3 provides summary statistics on variables used to estimate equation 8.

This dataset contains the bonds' yield or internal rate of return (IRR) associated with these transactions.

All databases are unbalanced and include information for the 2010-2017 sample period. As some banks appear and disappear throughout the sample period, we include a dummy variable to account for the impact generated by mergers and acquisitions[10/]. If the bank that issued the bond security is absorbed, the remaining liabilities are reassigned to the institution that takes over. We add a series of dummies to indicate this switch in the property of bonds' liabilities. By the end of 2017, Sample 1 represents approximately 54% of total assets, while Sample 2 and 3 approximately 95%.

We conduct our estimations on observed changes in the capital share of banks' funding structure rather than changes in regulatory caps on capital requirements. While it would be desired to estimate the impact of this latest concept, there are no variations in the regulatory capital requirements to follow such an approach in Chile. We use common equity Tier 1 as a percentage of total assets as our benchmark capital ratio. Still, we also perform additional analysis using alternative capital measures, such as common shares, regulatory capital, retained earnings, Tier 2 capital, among others[11/].

As is presented in Tables 2 and 3 the different measures of capital ratios vary among the different samples. For instance, taking only the four banks listed on the stock market, the average common equity Tier 1 is 8,72% and has relatively low dispersion. This ratio declines to 7,67% for the set of large and medium-sized banks. Regarding regulatory capital over risk-weighted assets, the median is 13.4, 12.7, and 12.9%, respectively. Finally, Table 4 presents the main summary statistics of the bonds securities issued by banks, differentiating if the bond is subordinated or senior, including the internal rate of return, the transaction volume, and the average duration[12/].

4 Results

In this section, we discuss firstly the results of the econometric specifications of equation 5 using β_k and equation 7 with ROE as dependent variable. Secondly, we look at equation 8 that accounts for the relationship between the capital ratios and the return of debt. For the outcomes of the first two exercises, we compute $\frac{\partial r_k}{\partial(K/A)}$, while for the third, we compute $\frac{\partial r^d}{\partial(K/A)}$. After estimating all these derivatives, we replace them into equation 2.

4.1 Capital ratios and the return on equity

Table 5 shows general results of equation 5 with β_b as left-hand-side variable and common equity Tier 1 over total assets as the capital ratio control variable. Column (1) presents the simple relation of our dependent variable β_b and the capital ratio when controlling by time fixed-effect. As expected, the sign of the coefficient associated with the capital ratio is negative. After including bank fixed-effects, we lose the

[10/] During the past two decades, the number of banks in Chile has dropped due to mergers and acquisitions, while foreign banks increased their market share during the same period. Fortunately, the most significant mergers and acquisitions occurred during the 1990s and early 2000s, and therefore do not alter the results in this study.

[11/] We also construct the capital ratios using, as the denominator, total assets and the risk-weighted assets.

[12/] See appendix **??** for a more detailed description of the variables used in the regression analysis, as well as their definition and sources.

Table 2: Summary statistics of sample 1 and 2

	Sample 1								Sample 2							
	N	mean	p25	p50	p75	sd	min	max	N	mean	p25	p50	p75	sd	min	max
β	124	0.92	0.81	0.95	1.00	0.14	0.51	1.19								
ROE	124	17.76	13.96	18.72	21.79	6.01	0.06	30.33	334	13.97	10.14	13.63	18.08	5.84	-0.24	30.33
%Total Assets																
Common equity Tier 1	124	8.72	7.85	8.25	8.82	1.58	7.17	14.57	334	7.67	6.50	7.62	8.45	1.80	4.39	14.57
Common shares	124	5.73	3.92	6.43	7.14	1.99	2.31	9.75	334	4.38	2.45	4.39	6.33	2.26	0.47	9.75
Regulatory capital	124	11.04	10.39	10.95	11.36	1.25	8.72	14.89	334	10.40	9.37	10.37	11.09	1.73	7.00	18.14
Retained earnings	124	2.99	1.14	2.93	4.87	1.93	0.18	6.10	334	3.29	1.75	3.51	4.31	1.80	0.18	7.24
Tier 2 capital	124	2.32	1.60	2.48	3.21	1.06	0.26	4.21	334	2.74	2.30	2.96	3.26	0.92	0.26	5.39
% Risk Weighted Assets																
Core capital	124	10.47	9.78	10.36	10.79	1.25	8.26	16.13	334	9.38	8.18	9.16	10.35	1.64	6.38	16.13
Common shares	124	6.79	4.90	7.48	8.35	2.02	3.19	10.00	334	5.28	3.25	5.27	7.49	2.54	0.62	10.00
Regulatory capital	124	13.29	12.89	13.44	13.87	0.93	10.90	17.20	334	12.77	11.90	12.72	13.61	1.20	9.17	17.20
Retained earnings	124	3.68	1.38	3.67	5.91	2.42	0.20	7.79	334	4.10	2.08	4.45	5.60	2.25	0.20	9.13
Tier 2 capital	124	2.83	1.99	3.07	3.77	1.28	0.27	4.97	334	3.39	2.88	3.74	4.15	1.08	0.27	5.04
Assets to core capital ratio	124	11.74	11.34	12.11	12.74	1.56	6.86	13.95	334	13.72	11.83	13.13	15.38	3.07	6.86	22.79
Assets to regulatory capital ratio	124	9.17	8.80	9.13	9.62	0.96	6.71	11.47	334	9.85	9.01	9.65	10.67	1.48	5.51	14.29
Excess capital (%)	124	24.22	15.56	20.98	34.36	11.44	6.32	71.97	334	24.45	15.87	22.47	32.32	11.96	-8.25	71.97
Excess capital (level)	124	2.54	1.72	2.31	3.46	1.08	0.76	7.20	334	2.49	1.68	2.29	3.32	1.18	-0.83	7.20
log(TotalAssets)	124	23.66	23.51	23.87	24.06	0.63	21.90	24.38	334	22.98	22.38	23.12	23.85	0.99	20.42	24.38
Loan loss provisioning (% total Assets)	124	1.02	0.84	1.00	1.23	0.27	0.33	1.65	334	0.84	0.63	0.84	1.09	0.34	0.08	1.65
M&A's dummy	124	0.01	0.00	0.00	0.00	0.09	0.00	1.00	334	0.00	0.00	0.00	0.00	0.05	0.00	1.00

Note: Sample 1 refers to the subgroup of 4 banks that are publicly listed in the stock market. Sample 2 refers to the 11 medium and big size banks in Chile, defined according to Jara and Oda (2015).

Source: Authors' calculations from information obtained from CMF.

Table 3: Summary statistics of sample 3

	N	mean	p25	p50	p75	sd	min	max
Debt Return (r^d)	11064	2.71	2.01	2.68	3.48	0.84	0.89	4.37
Amount(Q)	11064	19.89	19.36	19.98	20.48	0.83	16.09	24.46
Duration	11064	4.55	2.34	3.50	5.84	3.07	0.32	19.30
Subordinated debt dummy (SB)	11064	0.09	0.00	0.00	0.00	0.28	0.00	1.00
% of total assets								
Common equity Tier 1	11064	7.85	6.89	7.74	8.55	1.81	4.58	20.32
Market capital	7705	19.13	12.70	20.04	25.72	8.41	2.77	54.35
Common shares	11064	4.47	2.67	4.34	6.42	2.14	0.51	18.13
Regulatory capital	11064	10.44	9.59	10.42	11.04	1.65	7.50	18.43
Retained earnings	11064	3.38	2.11	3.60	4.30	1.50	0.38	6.99
Tier 2 capital	11064	2.59	2.18	2.73	3.18	0.91	-1.89	5.30
% of risk weighted assets								
Core capital	11064	9.64	8.47	9.60	10.51	1.56	6.53	15.86
Common shares	11064	5.40	3.42	5.30	7.64	2.30	0.65	14.06
Regulatory capital	11064	12.86	11.99	12.97	13.52	1.01	10.10	15.78
Retained earnings	11064	4.24	2.58	4.62	5.59	1.89	0.48	9.00
Tier 2 capital	11064	3.22	2.79	3.50	3.92	1.05	-1.00	4.79
Assets to core capital ratio	11064	13.40	11.71	12.93	14.54	2.94	6.01	21.87
Assets to regulatory capital ratio	11064	9.81	9.06	9.60	10.44	1.37	5.57	13.34
Excess capital	11064	22.84	15.76	19.84	27.96	10.04	1.03	57.82
Excess capital (level)	11064	2.36	1.66	2.14	2.88	0.97	0.10	5.78
Market capital (in logs)	7705	11.57	10.21	11.88	12.52	1.11	8.88	12.86
Loan loss provisioning (% total Assets)	11064	0.90	0.67	0.94	1.04	0.27	0.23	1.34
Assets market share	11064	13.32	12.75	13.60	13.96	0.71	10.39	14.20
Liquid assets (% total assets)	11064	13.87	10.30	12.56	16.36	5.06	4.34	31.12
Subordinated debt share	11064	2.91	2.11	2.89	3.60	1.02	0.59	5.86
ROA	11064	1.16	0.74	1.14	1.61	0.53	0.01	2.43
M&A's dummy	11064	0.80	1.00	1.00	1.00	0.40	0.00	1.00

Note: Sample 3 refers to the 11 banks in Chile that issued senior and subordinated bonds during the 2010m1-2017m12 period, and that can be classified as big and medium size banks according to Jara and Oda (2015).

Source: Authors' calculations from information obtained from CMF and Santiago Exchange.

Table 4: Summary statistics: subordinated and senior bonds

	N	mean	p25	p50	p75	sd	min	max
$SB = 0$								
Debt Return (r^d)	10080	2.64	1.97	2.59	3.41	0.83	0.89	4.37
Amount (Q)	10080	19.89	19.36	19.95	20.46	0.80	16.09	24.46
Duration	10080	4.05	2.31	3.43	5.61	2.26	0.32	19.30
$SB = 1$								
Debt Return (r^d)	984	3.40	2.98	3.64	3.91	0.68	1.07	4.37
Amount (Q)	984	19.88	19.38	20.25	20.62	1.08	16.29	21.94
Duration	984	9.66	5.36	9.72	13.67	5.02	0.40	19.03

Note: Includes descriptive statistics of subordinated debt (SB=1) and senior bonds (SB=0) issued by 11 big and medium size banks during the 2010m1-2017m12 period.

Source: Authors' calculations from information obtained from Santiago Exchange.

significance of this coefficient, but it is then recovered in columns (3) and (4) after adding banks' controls. One interpretation of this result is that banks with higher capital ratios are less synchronized with the rest of the stock market because higher capitalized banks are more stable or less risky[13/].

Table 6 shows that our result matches similar estimations in the literature. In comparison, Kashyap et al. (2010) obtain a coefficient of -0.04 for US banks, just one basis point over our -0.05. As an alternative measure of the capital variable, Miles et al. (2012) used bank leverage for UK banks. By construction, the sign of the variable is expected to be positive. When using leverage instead of core capital, we obtain an estimate for the coefficient which is identical to that of Miles et al. (2012). Also, Baker and Wurgler (2015) estimated a similar model forcing the regression intercept to zero because of the assumption of riskless debt and reaching a coefficient of the equity beta on leverage of 0.074 for US banks.

Overall, our results support the idea that more capital makes banks less risky, independent of the measure of the capital ratio used, except for the Tier 2 definition of capital (See Table B.1). Nonetheless, before we move on to the next approach, and given the trajectory shown by the estimated β's in Figure A.1), we test for autocorrelation. The null hypothesis of the no-existence of autocorrelation is rejected at 1% after applying the Wooldridge (2002) test. Therefore, we re-estimate equation 5 using Driscoll and Kraay (1998) standard errors, which are computed using a non-parametric covariance matrix robust to different ways of cross-sectional or temporal dependence[14/]. The significance of most coefficients shown in Table B.1 are kept after correcting for serial autocorrelation problems[15/].

Then, to compute the impact of capital ratios on the return of capital we take the mean return in the domestic stock price index ($IPSA$) as the $RiskPremium$ and the estimated $\hat{\gamma} = -0.05$ to replace them in equation 6[16/]. Therefore, $\frac{\partial r_k}{\partial (K/A)} = -0.29$, meaning that, on average, one additional unit of common equity Tier 1 as a percentage of total assets reduces in 29 basis points the returns of capital.

We now turn to the direct impact of banks' capital ratios on the return on equity (ROE). Table 7 shows the results of the panel regression with 11 banks during the $2010q1 - 2017q4$ sample period. Our results are consistent with previous findings. In particular, we get a negative relationship after controlling by banks' fixed effects, which also turns to be statistically significant when the banks' size is included as an additional control variable. Notice that common equity Tier 11 over total assets keeps its negative relationship with ROE and statistical significance after adding more banks' controls. Thus, in column (5), we get a statistically significant coefficient at 1% equal to -0.57. Moreover, these results are again consistent with different definitions of the capital ratio, except when the Tier 2 definition of capital is used (See Table B.1).

Given the characteristics of this estimation, we can directly attribute this coefficient to the marginal effect of capital on the return on capital, i.e., $\frac{\partial r_k}{\partial K/A} = \hat{\gamma} = -0.57$. Thus, one additional unit of banks' common equity Tier 1 as a percentage of total assets, on average, and *ceteris paribus*, decreases banks' return on equity on 57 basis points.

[13/] These results complement the approach followed by Beas (2020) that finds that higher capital requirements improve the resilience of the Chilean banks, reducing the probability of a systemic crisis.

[14/] Similar to the Newey-West standard errors' correction, this approach guarantees the consistency of the covariance matrix, despite the low "N" and large "T."

[15/] These results are available upon request.

[16/] This mean return was equal to 5.8% during the 2010-2017 period.

Table 5: Capital ratio and β_b

	(1)	(2)	(3)	(4)
k_{t-1}	-0.02***	-0.01	-0.04***	-0.05***
log(TotalAssets)$_{t-1}$			0.24***	0.25***
M&A's dummy$_t$				0.17***
Observations	124	124	124	124
F test	7.52	0.87	6.90	5.54
R^2	0.13	0.69	0.75	0.76
R^2 adjusted	-0.16	0.56	0.66	0.66
R^2 within	0.05	0.01	0.23	0.25
Bank FE	NO	YES	YES	YES

Note: The dependent variable is the market β driven by equation 3. The capital ratio k refers to the common equity Tier 1 to assets ratio. Data are quarterly from 2010Q1 to 2017Q4 for a panel of all resident banks with presence in the domestic stock market. All specifications include time fixed effects. Standard errors are robust. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Source: Authors' calculations from information obtained from CMF.

Table 6: Capital ratio and banks' equity β: literature comparison

	Coef.	CI-	CI+	Kashyap et al. (2010)	Miles et al. (2012)
Core Capital	-0.05***	-0.07	-0.02	-0.04	
Assets to core capital ratio	0.03**	0.01	0.06		0.03
Observations	124			1226	156
Bank FE	YES			NO	YES
Time FE	YES			YES	YES
Bank controls	YES			YES	NO

Note: The coefficients here refer to the γ coefficient of equation 3 using common equity Tier 1 to assets ration and leverage as the k measure. In addition, we present the 5% confidence interval. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Source: Authors' calculations from information obtained from CMF, Kashyap et al. (2010) and Miles et al. (2012).

4.2 Capital ratios and the return on debt

We now discuss whether banks' capital has any significant effect on banks debt' returns. For this purpose, we take advantage of a large dataset of banks bonds securities transactions. Following the specification of equation 8, we estimate the differentiated impact that banks' capital ratios have on bonds' returns, distinguishing between subordinated and senior bonds. Table 8 shows the direct outcome of this estimation when considering common equity Tier 1 over total assets as the measure for the capital ratio. In particular, Column (1) shows the results of estimating equation 8 when bonds' characteristics and banks' fixed-effects are included in the regression. Column (2), on the other hand, considers the specific set of banks' controls and their interactions with the subordinated versus senior bonds dummy[17/]. Finally, Column (3) presents the complete set of bonds' and banks' characteristics (which vary over time), as well as

[17/] Notice that the individual bonds' characteristics are dropped since they tend to be constant over time, and we include the bonds' fixed effects as a control variable in this specification.

Table 7: Capital ratios and the return on equity (ROE)

	(1)	(2)	(3)	(4)	(5)
k_{t-1}	0.58	-0.75	-0.62***	-0.66***	-0.57***
log(TotalAssets)$_{t-1}$			-5.24***	-2.91*	-3.69***
M&A's dummy$_t$				-5.68***	-5.74***
Loan loss provisioning (% assets)$_{t-1}$					-3.88***
Observations	301	301	301	301	301
F test	0.52	3.03	23.21	37.29	34.41
R^2	0.14	0.83	0.85	0.85	0.86
R^2 adjusted	0.05	0.81	0.82	0.83	0.84
R^2 within	0.03	0.08	0.16	0.20	0.26
Bank FE	NO	YES	YES	YES	YES

Note: The dependent variable is the market *ROE*. Capitalisation variable k refers to the common equity Tier 1 to total assets ratio. Data are quarterly from 2010Q1 to 2017Q4 for a panel of 11 banks. All specifications include time fixed effects. Standard errors are robust. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Source: Authors' calculations from information obtained from CMF.

banks' fixed-effect, similar to the full specification described in equation 8. Then, Table 9 summarizes the aggregate impact of the control variables after accounting by the role of the interaction terms. We also show in this Table the average marginal effect for the whole sample. Also, Table B.2 highlights the main results of the previous two Tables (8 and 9), but this time considering alternative definitions for the capital ratio.

The main results from these estimations are the following[18/]:

1. Bonds' characteristics matter for the return on debt. In particular, the marginal effects in Table 9 show that there is a premium associated with subordinated debts, debt securities with longer duration, and those that require higher transaction volumes.

2. The characteristics of the issuers are also important determinants of debts' returns, but overall (i.e., when all types of debt securities are considered), capital ratios do not seem to affect the return on debt[19/]. These findings are true independently of the capital ratio considered.

3. However, higher capital ratios are an important determinants of the subordinated debt returns. In particular, higher capital ratios reduce the subordinated debt returns, except for the common equity Tier 1 ratios (see Table B.2).

Therefore, we find that, on average, there is no statistically significant relationship between banks' capital ratios and debts' returns. This result is explained mainly by the role played by senior debt securities. When looking at the differentiated effect of subordinated debt securities, we get that, in general, higher banks' capital ratios reduce the subordinated debts' returns, on average.

[18/] These conclusions are drawn from following rows show the individual coefficients associated with $\hat{\gamma}$ and the vectors $\hat{\eta}_1$ and $\hat{\eta}_2$ of equation 8. These coefficients capture the non-subordinated debt instruments' effects, i.e., when the subordinated bonds' dummy equals zero. Thus, the overall effect is equivalent to the sum of $\hat{\gamma}$ and the vectors $\hat{\eta}^i$ and $\hat{\eta}^b$ to $\hat{\mu}$, $\hat{\rho}^i$ and $\hat{\rho}^b$.

[19/] Notice that banks with higher credit risk have, in general, have higher debts' returns. Also, banks that rely more on subordinated debt face a higher yield.

Table 8: Capital ratio and the return on debt: full specification

	(1)	(2)	(3)
SB_t	0.73		0.08
k_{t-1}		-0.01	-0.01
Amount$_t$	0.03***		0.04***
$Duration_t$	0.09***		0.10***
Loan loss provisioning (% total Assets)$_{t-1}$		0.00	0.00**
Assets market share$_{t-1}$		0.01	0.03***
Liquid assets (% total assets)$_{t-1}$		0.01*	0.00
Subordinated debt share$_{t-1}$		0.08***	0.05***
ROA_{t-1}		-0.02	0.05
$SB_t * k_{t-1}$		0.11***	0.08***
SB_t*Amount$_t$	-0.02		0.02
$SB_t * Duration_t$	-0.04***		-0.06***
SB_t*Loan loss provisioning (% total Assets)$_{t-1}$		-0.00	-0.00*
SB_t*Assets market share$_{t-1}$		0.01	-0.00
SB_t*Liquid assets (% total assets)$_{t-1}$		-0.03**	0.00
SB_t*Subordinated debt share$_{t-1}$		-0.14**	-0.06
$SB_t * ROA_{t-1}$		0.18	-0.08
$M\&A's \quad Dummy_t$	0.02	-0.31***	-0.30***
Obs.	13810	11037	11064
F	126.31	5.66	65.91
R2	0.87	0.91	0.88
R2 adj	0.87	0.91	0.88
R2 w	0.47	0.04	0.47
FE	Bank	Bond	Bank

Note: The dependent variable is the market IRR. Capitalisation variable k refers to the common equity Tier 1 to assets ratio. SB refers to the subordinated debt dummy. Data are monthly from 2010m1 to 2017m12 for a panel of all resident banks. All specifications include time fixed effects. Standard errors are clustered by bonds. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Source: Authors' calculations from information obtained from CMF and Santiago Exchange.

5 Calibrating the impact on WACC and policy implication

We now compute the overall impact of our results on banks' weighted average cost of capital. In particular, we take the average differential $\frac{\partial WACC}{\partial(K/A)}$ of equation 2 from the average data of (K/A), r^e and r^d, and the estimated coefficients of our regression are used to compute $\frac{\partial r^e}{\partial(K/A)}$ and $\frac{\partial r^d}{\partial(K/A)}$. According to this, our WACC impact equation is as follow:

$$\frac{\partial WACC}{\partial(K/A)} = \frac{\partial r^e}{\partial(K/A)}\left(\frac{K}{A}\right) + (r^e - r^d) \tag{9}$$

Notice that we take the averages of K/A and r^e from Table 2, and r^d from Table 3. Finally, for $\frac{\partial r^e}{\partial(K/A)}$ we use two alternatives, both displayed in Table 10.

On the second and third rows of Table 10 we show the non-MM cases when keeping r^e and r^d un-

Table 9: Capital ratio and the return on debt: aggregate impact and marginal effects

	(1)	(2)	(3)
A.Aggregate Impact			
k_{t-1}		0.11***	0.07***
Amount_t	0.02		0.05
$Duration_t$	0.05***		0.04***
Loan loss provisioning (% total Assets)$_{t-1}$		-0.00	-0.00
Assets market share$_{t-1}$		0.02	0.03**
Liquid assets (% total assets)$_{t-1}$		-0.03*	0.01
Subordinated debt sharet-1		-0.06	-0.01
ROA_{t-1}		0.16	-0.02
B.Marginal Effects			
SB_t	0.21***	0.00	0.30***
k_{t-1}		0.00***	0.00
Amount_t	0.03***		0.04***
$Duration_t$	0.08***		0.10***
Loan loss provisioning (% total Assets)$_{t-1}$		0.19***	0.00*
Assets market share$_{t-1}$		0.01	0.03***
Liquid assets (% total assets)$_{t-1}$		0.00	0.00
Subordinated debt share$_{t-1}$		0.07***	0.04**
ROA_{t-1}		-0.00	0.05

Note: The dependent variable is the bond's market internal rate of return (IRR). The variable k refers to the common equity Tier 1 to assets ratio. SB is a dummy equal to one of the bond is a subordinated debt, and equal to zero if it is a senior bond. the estimation is done over the 2010m1 to 2017m12 sample period. All specifications include time fixed effects. Standard errors are clustered by bonds. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Source: Authors' calculations from information obtained from CMF and Santiago Exchange.

changed and just adding percentage point of common equity Tier 1 over total assets or risk-weighted assets, respectively. Thus, when the capitalization levels do not matter for the return on equity, increasing banks' capitalization by one percentage point will increase WACC by 15.0 or 11.3 basis points, depending on the estimations.

When introducing the MM effect, i.e., when $\frac{\partial r^e}{\partial (K/A)} = -0.05$ from the CAPM's analysis and $\frac{\partial r^e}{\partial (K/A)} = -0.57$ from the direct ROE's estimation, the overall impacts on WACC of a one percentage point of higher banks' capital ratios is now 12.5 and 6.9 basis points, i.e., 83% and 61% below the non-MM impact.

These results can now be used to compute a proxy of the effect of a rising capital ratios over banks' WACC. By taking the ratio $\frac{RWA}{A}$ from the division $\frac{(K/A)}{(K/RWA)}$, then transformation of the WACC partial is direct:

$$\frac{\partial WACC}{\partial K/RWA} = \frac{\partial WACC}{\partial K/A}\left(\frac{RWA}{A}\right) = \frac{\partial r^e}{\partial (K/A)}\left(\frac{K}{A}\right) * \left(\frac{RWA}{A}\right) + (r^e - r^d) * \left(\frac{RWA}{A}\right) \tag{10}$$

Thus, Table 10 shows that for one additional unit of the capital ratio, the average impact on WACC is 10.42 basis points, using the CAPM's exercise, i.e., 83% relative to the 12.53 of the highest non-MM result. Moreover, the impact effect is lower when using the direct ROE estimations and equivalent to 5.63 basis points, representing 61% of the non-MM result.

Finally, Table 11 shows the impact on WACC of four scenarios for increments in the common equity Tier 1 to risk-weighted asset ratio, which goes from 0.9% to a maximum of 2.7%[20/]. As expected from our previous analysis, the results show a limited impact on the weighted average cost of capital. An increase in a 0.9% of additional capital ratio can increase 11.27, 9.38, or 5.07 basis points in the $WACC$, depending on the model considered (No-MM, CAPM's approach, and ROE's estimation, respectively). While in the extreme case of a 2.7% rise, which takes a similar size to those additional capital charges included in Basel III, the weighted average cost of capital could increase by 28.13 or 15.21 basis points, depending on the model considered. In the appendices, tables B.3 and B.4 conduct the same exercises but calibrated for the end of the sample (2016-2017). In those results, the magnitudes of the impacts were even lower using both strategies, the CAPM and ROE .

Table 10: Impact on WACC

	CAPM			ROE		
WACC		4.03			3.57	
No-MM (bp)						
$\frac{\partial WACC}{\partial (K/A)}$		15.04			11.26	
$\frac{\partial WACC}{\partial (K/ARWA)}$		12.53			9.21	
	Est.	CI-	CI+	Est.	CI-	CI+
MM (bp)						
$\frac{\partial WACC}{\partial (K/A)}$	12.51	11.50	14.03	6.89	3.97	9.80
$\frac{\partial WACC}{\partial (K/RWA)}$	10.42	9.58	11.68	5.63	3.25	8.02
% max	83%	76%	93%	61%	35%	87%

Note: This table shows the estimated impacts on WACC of one additional point of capitalization measured as common equity Tier 1 over total or risk-weighted assets (RWA). The Non-Modigliani and Miller case (Non-MM) refers to only adjust the ratios K/A and $(1 - K/A)$, while the Modigliani and Miller case (MM) includes the empirically estimated impact of capital on equity rates.

Source: Authors' calculations from information obtained from CMF.

6 Concluding remarks

Increasing banks' capital has been at the core of the response of the international financial regulatory community after the Global Financial Crisis. In this paper, we analyze the impact of such an increase in Chile. We estimate the impact of increased capital ratios on both the return on capital and the return on debt. On the former, we find a negative impact similar in sign and magnitude to that found in the literature for other countries. This result means that equity holders demand less return when the share of capital in the funding structure is higher, as Modigliani and Miller's main theorem would predict. In the case of debt, while senior debt is not sensitive to the capital ratio, subordinated debt is. This latest result has not been previously reported in the literature. Overall, we find that higher capital ratios have a small

[20/] Notice that applying this methodology implies that the capital ratio impact on WACC is linear. Therefore, the analysis of higher levels of capital ratios, such as those that account for the full set of capital buffers included in Base III, is straightforward.

Table 11: Impact on WACC - RWA

FACTOR	No-MM (bp)	CAPM			ROE		
		Est. (bp)	CI- (bp)	CI+ (bp)	Est. (bp)	CI- (bp)	CI+ (bp)
0.90	11.27	9.38	8.62	10.52	5.07	2.92	7.21
1.00	12.53	10.42	9.58	11.68	5.63	3.25	8.02
1.80	22.55	18.76	17.24	21.03	10.14	5.85	14.43
2.70	33.82	28.13	25.86	31.55	15.21	8.77	21.64

Note: This table shows the estimated impact of rising the Chilean capital requirement (Common Equity Tier 1 as a percentage of the risk-weighted assets). Here we evaluate four potential tightening scenarios (first column).

Source: Authors' calculations from information obtained from CMF.

impact on the weighted average cost of capital. In particular, one additional percentage point of common equity Tier 1 as a percentage of risk-weighted assets has a maximum increase in WACC of only 11.7 basis points.

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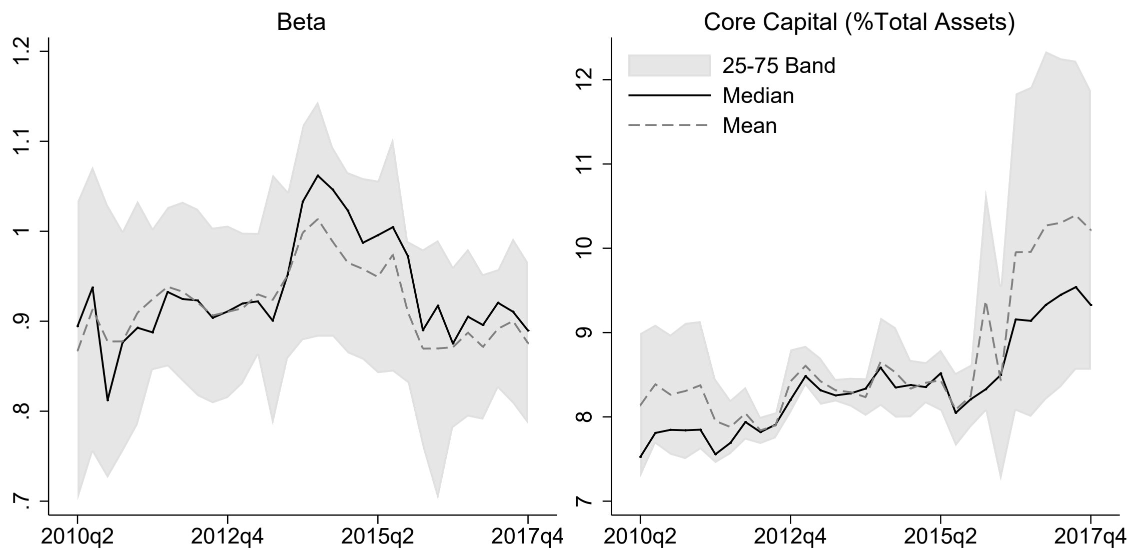
Appendices

A Additional figures

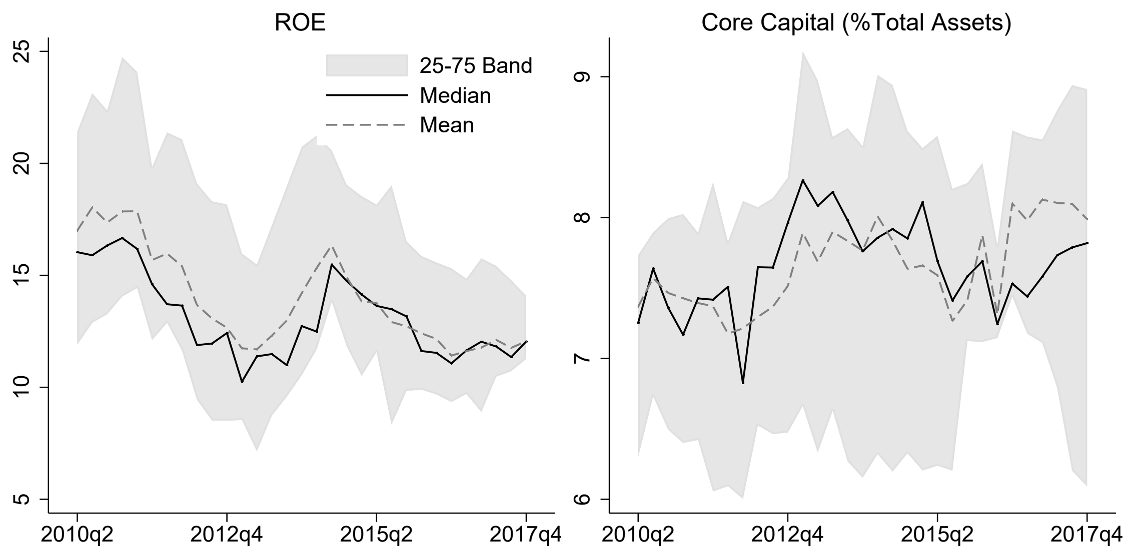
Figure A.1: Beta and Capital distributions



Note: Distribution of β calculated as shown in equation 3 and the series of core capital a percentage of total assets. Data are quarterly from 2010q1 to 2017q4 for a panel of all resident banks with presences in the domestic stock market.

Source: Authors' elaboration.

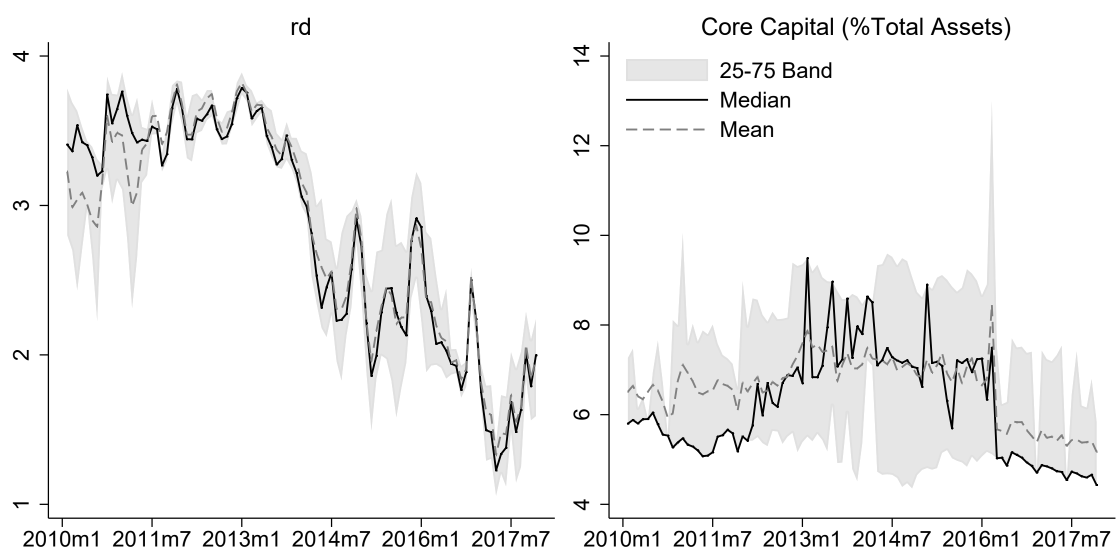
Figure A.2: ROE and Capital distributions



Note: Distribution of *ROE* and the series of core capital as a percentage of total assets. Data are quarterly from 2010q1 to 2017q4 for a panel of 11 banks.

Source: Authors' elaboration.

Figure A.3: r^d and Capital distributions



Note: Distribution of *rd* and the series of core capital as a percentage of total assets. Data are monthly from 2010m1 to 2017m12 for a bonds transaction panel of 11 banks.

Source: Authors' elaboration.

B Additional results

Table B.1: Capital ratios, market β and the return on equity (ROE): results for different measures of capital ratios

	β	ROE
% of total assets		
Common equity Tier 1	-0.05***	-0.57***
Common stocks	-0.03**	-0.77***
Regulatory sapital	-0.03**	-0.29*
Retained earnings	-0.02	-0.05
Tier 2 capital	0.09**	0.67**
% of Risk weighted assets		
Common equity Tier 1	-0.06***	-0.70***
Common stocks	-0.04***	-0.56***
Regulatory capital	-0.04**	-0.33
Retained earnings	0.00	0.07
Tier 2 capital	0.07**	0.90***
Assets to core capital ratio	0.03**	0.40***
Assets to regulatory capital ratio	0.03*	0.46**
Excess capital	-0.01***	-0.03
Excess capital (level)	-0.04**	-0.33
Observations	124	301

Note: Each column shows the estimators $\hat{\gamma}$ using as dependent variable the market β driven by equation 3 or ROE, and with the listed capital measures as the independent variable k_{t-1}. Data are quarterly from 2010Q1 to 2017Q4 for a panel of all resident banks. All specifications include bank and time fixed effects, as well as bank controls. Standard errors are robust. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' calculations from information obtained from CMF.

Table B.2: Capital ratios and the return on debt: results for different measures of capital ratios

	k_{t-1}	$SB_t * k_{t-1}$	$k_{t-1} + SB_t * k_{t-1}$	$EfMg(k_{t-1})$
%Total Assets				
Common equity Tier 1	-0.01	0.08***	0.07***	0.00
Market capital	0.00	-0.02***	-0.02***	0.00
Common stocks	0.01	-0.01	0.00	0.01
Regulatory capital	-0.01	0.10***	0.08***	-0.00
Retained earnings	-0.03	0.09***	0.06**	-0.02
Tier2 capital	-0.04	0.03	-0.01	-0.03
% RWA				
Common equity Tier 1	0.02	0.03	0.04*	0.02*
Common stocks	0.02**	-0.04**	-0.02	0.02*
Regulatory capital	0.01	-0.07**	-0.06**	0.01
Retained earnings	-0.02	0.05***	0.03	-0.02
Tier2 capital	-0.02	-0.16***	-0.18***	-0.04
Assets to core capital ratio	-0.00	-0.06***	-0.06***	-0.01
Assets to regulatory capital ratio	0.01	-0.11***	-0.11***	-0.00
Excess capital (%)	0.00	-0.01***	-0.01***	0.00
Excess capital (Level)	0.02	-0.09***	-0.08***	0.01
Market capital (in logs)	0.02	0.17	0.19	0.04

Note: The dependent variable is the market IRR. Data are monthly from 2010m1 to 2017m12 for a panel of all resident banks. All specifications include time fixed effects. Standard errors are clustered by bonds. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Source: Authors' calculations from information obtained from CMF and Santiago Exchange.

Table B.3: Impact on WACC 2016-2017

	CAPM			ROE		
WACC		3.15			2.77	
No-MM (bp)						
$\frac{\partial WACC}{\partial (K/A)}$		11.36			9.83	
$\frac{\partial WACC}{\partial (K/RWA)}$		10.02			8.09	
	Est.	CI-	CI+	Est.	CI-	CI+
MM (bp)						
$\frac{\partial WACC}{\partial (K/A)}$	5.52	3.19	9.03	5.25	2.20	8.30
$\frac{\partial WACC}{\partial (K/RWA)}$	4.9	2.80	8.00	4.30	1.80	6.80
% max	49%	28%	79%	53%	22%	84%

Note: Estimated impacts on WACC of one additional point of capitalization measured as common equity Tier 1 over total or risk-weighted assets (RWA), evaluating each derivative in the average values of 2016-2017. The Non-Modigliani and Miller case (Non-MM) refers to only adjust the ratios K/A and $(1 - K/A)$, while the Modigliani and Miller case (MM) includes the empirically estimated impact of capital on equity rates.

Source: Authors' calculations from information obtained from CMF.

Table B.4: Impact on WACC - APR 2016-2017

FACTOR	WACC No-MM	No-MM (bp)	CAPM			ROE		
			Est. (bp)	CI- (bp)	CI+ (bp)	Est. (bp)	CI- (bp)	CI+ (bp)
0.9	3.24	9.02	4.38	2.53	7.17	3.89	1.63	6.15
1	3.25	10.02	4.87	2.81	7.96	4.32	1.81	6.83
1.8	3.33	18.04	8.77	5.06	14.33	7.78	3.26	12.30
2.7	3.42	27.06	13.15	7.59	21.50	11.67	4.89	18.45

Note: Estimated impact of rising the Chilean capital requirement (core capital as a percentage of the risk-weighted assets), evaluating each derivative in the average values of 2016-2017. Here we evaluate four potential tightening scenarios that differentiate each other in their rising factor (first column).

Source: Authors' calculations from information obtained from CMF.

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