DISCUSSION NOTES

MONETARY POLICY DIVISION

N°8

Effects of bank capital regulation on bank credit supply

Miguel Acosta - Gent Bajraj - Maximiliano San Millán

banco central Chile

PREFACE

The Discussion Notes (DN) seek to examine issues that are relevant for monetary and financial policy in Chile and the world. Their goal is to discuss the current status of the literature, highlighting the most important implications for the design of monetary and financial policies. For that purpose, the Notes describe the different approaches set forth by frontier research, with emphasis on the consensus as well as debates that are still open. The DNs are prepared by economists from the Monetary Policy Division and the Financial Policy Division and do not necessarily reflect the official position of the Board of the Central Bank of Chile.

This eighth issue of the DNs examines the impact of changes in the banking system's capital regulation on the supply of credit. This topic is crucial in the design of these financial policy instruments, as it involves balancing the benefits associated with greater resilience of the financial system against the potential costs derived from a shrinking supply of credit to the real economy. In particular, this note reviews the evidence taken from empirical and structural analysis, on the effects of both increases and reductions in capital requirements, providing a comprehensive view of their impact on credit supply and especially stressing their relevance as a macroprudential tool. In addition, the note emphasizes the importance of further developing a research agenda that explores the interactions and synergies between monetary policy, macroprudential policies and other support measures in situations of macro-financial stress.

This discussion note was prepared by Miguel Acosta-Henao, Gent Bajraj, and Maximiliano San Millán. The authors are especially thankful for their contributions, comments, and suggestions to Elías Albagli, Sofia Bauducco, Mauricio Calani, Guillermo Carlomagno, Rosario Celedón, Miguel Fuentes, Mariana García, Enrique Orellana, and Juan Marcos Wlasiuk, and for the translation and edition work to Maria Consuelo Edwards. The comments of the Board and the staff of the Monetary Policy Division and the Financial Policy Division of the Central Bank of Chile during internal presentations are also gratefully acknowledged.

CONTENTS

1. INTRODUCCIÓN

This study examines the effects of the banks' capital requirements on their credit supply. It begins by explaining what motivates the implementation of capital requirements from a micro-prudential and macro-prudential point of view, and describes their history and usage in the light of the Basel Accords. The main empirical and structural estimates offered in the literature on the effects of different types of capital requirements --static and dynamic-- on the supply of credit are then studied. This analysis is complemented by two self-contained boxes describing, one, the effects of banks' voluntary decision to hold more capital than required, and the other, the interaction between capital requirements and monetary policy. It ends with a discussion of policy implications arising from the diagnosis of the found effects of these policies.

Five main conclusions are derived from the analysis:

i) **Increasing capital requirements may have a transitory negative effect on banks' credit supply**. But this effect is heterogeneous, as it depends on the banks' idiosyncratic conditions and aggregate conditions.

ii) **Although micro-prudential capital requirements help to preserve the strength and solvency of individual institutions, they can also accentuate the procyclicality of credit**, amplifying the effects of shocks and indirectly impacting the banks' balance sheets.

iii) **To moderate the effect of adverse economic and financial shocks on credit supply, the empirical evidence suggests that it may be useful to include macro-prudential tools such as the Countercyclical Capital Buffer (CCyB) and dynamic provisions**.

iv) **Evidence suggests that the CCyB has asymmetric effects in its activation v. release phase**: during activation, the effect on the supply of credit is smaller than during release. This note offers considerations in the interpretation of these results.

v) **In the face of frictions that warrant the use of both monetary and financial policy, implementing the two policy instruments is better than having a single policy instrument to address the objectives of controlling inflation and preserving financial stability simultaneously**. Nonetheless, the coordination of monetary policy, capital requirements, and other non-conventional tools that emerge in the face of other types of frictions is a core research topic on the research agenda of the Central Bank of Chile.[1]

[1] The Economic and Financial Series of 2021 examines the interaction of monetary policy with financial policy in both normal and critical times.

2. MOTIVATION AND HISTORY OF CAPITAL REQUIREMENTS

This section discusses the motivation behind prudential regulation. It then documents the evolution of bank capital requirements, highlighting the main milestones of the Basel Accords and their implementation. It also explores the different types of capital requirements, by classifying them into static and dynamic. Finally, it describes the adoption of these standards in Chile, detailing its convergence to a capital adequacy system aligned with Basel III.

2.1 Motivation: What motivates capital requirements?

The regulation of the financial system in force before the Global Financial Crisis (GFC) had a mainly micro-prudential focus.[2] This framework emphasizes the solvency of individual financial institutions, with the goal of guaranteeing their financial stability and soundness. Its rationale is as follows:

Banks are financed by government-insured deposits. Although deposit insurance has the desired effect of preventing bank runs (Diamond and Dybvig, 1983), it also creates incentives for banks to take excessive risks by shifting part of the costs of their losses to taxpayers. To mitigate these risks, regulation mandates that banks fund a certain portion of their assets with equity capital (Kareken and Wallace, 1978).

Sometimes, however, this regulation can result in unintended damage to the economy. A bank that suffers significant losses could be in breach of the regulation. To avoid this, the bank has two options: to issue new capital or to adjust its assets. If a single bank chooses to reduce its assets, they can be acquired by other institutions. But if a significant part of the financial system attempts to dispose of its assets at the same time in response to a common shock, this could lead to a reduction in credit or in asset depreciation.

After the GFC, the need for a regulatory approach with a macro-prudential perspective became evident. This new approach seeks to mitigate risks in individual institutions and, at the same time, protect the financial system as a whole, taking into account the (partial and general) equilibrium effects of excessive deleveraging of banks. Its main objective is to limit the social costs arising from the simultaneous contraction of the balance sheets of multiple financial institutions when hit by a common shock.

Within this framework, dynamic capital requirements emerge. These allow adjusting the amount of capital that banks must hold, depending on the economic and financial cycle. These requirements are proposed as an optimal solution in a model with a social planner that balances two objectives: one, to maintain the solvency of financial institutions; and two, to preserve credit creation during recessions, avoiding a credit crunch that aggravates the economic conditions (Kashyap and Stein, 2004). In response to these lessons, post-GFC reforms not only strengthened micro-prudential regulation, but also added a macro-prudential dimension. Thus, countercyclical capital buffers were included, with the objective of strengthening the financial system to enable it to provide financing to the real sector in adverse times.

[2] This section is based primarily on Hanson et al. (2011).

2.2. History: Recente implementation in light of te Basel Accords

The history of capital requirements for banks, from conception to implementation, varies across countries. The homogenization of these requirements, in terms of definition and implementation, began with the first Basel Accord in 1988. In this section we briefly document the recent history of capital requirements for banks as the Basel accords have developed and been implemented.

2.2.1 Recente history: Basel I, II y III

A first attempt at convergence in defining and implementing capital additions to banks in different countries in a homogeneous manner was born out of continuous discussions among financial regulators, including central banks, in the 1970s and 1980s. These discussions were motivated by severe disruptions in the banking and currency markets (notably, the bankruptcy of the Herstatt bank in West Germany). In addition, the concern for greater international regulation was also driven by the debt crises in Latin America in the early 1980s. In this context, the first cross-country agreement on minimum capital requirements was reached. This was published by the Basel Committee on Banking Supervision in 1988, known as Basel I. It should be mentioned that this Committee on Banking Regulation and Supervisory Practices was established in 1975, made up of the governors of the central banks of ten countries (G10). Currently, the Basel Committee has 45 member institutions, and the adoption of the Basel Accords has been extended to more than 100 countries, Chile is one.

Basel I focused on credit risk and asset weighting. With respect to capital requirements, the agreement was to implement a minimum requirement of the ratio of capital to credit-risk-weighted assets of 8% for banks with an international presence.[3] Initially, this accord comprised the G10 countries, which implemented it around 1992. This accord evolved over the years. For example, between 1991 and 1996 it underwent transformations and extensions related to the incorporation of banks' exposure to market risks (forex and equity, among others).

In 1999, the Committee proposed a new framework to address the capital adequacy ratio to supersede Basel I. This new framework, known as Basel II, was introduced in 2004. It consisted of three pillars: 1) Pillar I: Minimum capital requirements, building on what was developed in Basel I, based on standardized rules and the incorporation of internal models defined by each bank for weighting assets by their level of risk;[4] 2) Pillar II: Supervisory review of capital adequacy and internal assessment process; 3) Pillar III: Effective use of disclosure to strengthen market discipline and promote sound banking practices.

Various countries, both members and non-members of the Committee, agreed to adopt this new accord, but not with the same deadlines. Faced with a non-homogeneous implementation among countries, and given the high leverage of different global banks that had been observed until 2007, the GFC emphasized the imminent need to strengthen Basel II. Thus, different reforms to Basel II were proposed over the years, leading to the publication of a new accord in 2017, namely Basel III.

Basel III strengthened Basel II thus: 1) It increased high quality capital requirements and implemented charges for systemically important institutions; 2) It implemented the capital conservation buffer and the systemic risk buffer,[5] among others; 3) It introduced the Countercyclical Capital Buffer (CCyB); 4) It

[3] This capital includes both Common Equity Tier 1 capital (the main component of Tier 1 capital), which is explained below, and other instruments (e.g. subordinated bonds, known as Tier 2 capital). Common Equity Tier 1 capital is the highest quality component, as it allows for absorbing losses while the bank is in operation immediately when they occur. Tier 2 capital is designed primarily for loss absorption when the bank goes into liquidation.

[4] In Chile, the possibility of implementing internal capital models was incorporated in 2019 with the approval of the supervisor.

[5] Chile has a mandatory capital charge for banks rated as systemically important, but it is a permanent charge that does not operate as a buffer.

introduced requirements for liquidity and stable funding, and others. As with Basel II, several countries agreed to adopt Basel III, although with heterogeneity in its implementation. In Chile, Basel III standards were incorporated into the legal framework through the 2019 reform to the General Banking Law, following an implementation schedule that began in 2020 and will be completed by the end of 2025. Table 1 summarizes, in detail, the Basel III pillars, including risk management, market discipline and liquidity requirements, in addition to capital requirements.

2.3 Types of capital requirements

Although capital requirements have a clear objective, they differ in their characteristics. These instruments are grouped into two types, static or structural capital requirements and dynamic capital requirements, a distinction that allows for a better description of their intrinsic nature.

2.3.1 Static or structural capital requirements

Static, or structural, capital requirements are those that have a fixed value over time.[6] The value is subject to change given the revisions of different guiding policies, such as the Basel Accords. However, their value tends to be stable over time and seeks to be homogeneous across institutions and countries.

Minimum core capital requirement. This is a minimum requirement to the ratio of core capital to risk-weighted assets (RWA) (also known as the Common Equity Tier 1 ratio, CET1). Core capital consists primarily of the bank's common stock and reserves or withheld earnings. Risk-weighted assets are an average of the bank's assets, which are primarily loans, weighted by the risk of each loan (the riskier the assets, the higher the weighting factor). These risk weights can be determined by standard models defined by the financial regulator or by banks' own internal models.

Minimum ratio of capital to risk weighted assets. This requirement is defined on a broader notion of capital that includes CET1, hybrid instruments —such as preferred stock and perpetual bonds, known as Additional Tier 1 capital (AT1)— and subordinated bonds and voluntary provisions —Tier 2 capital, T2 —. As mentioned, this instrument has been globally implemented since Basel I and continues to be a pillar of financial regulation.[7]

Leverage ratio. This instrument is similar to the previous one, except that the assets (the denominator) are not risk weighted. Thus, it simply consists of the ratio of CET1 capital to total assets.

There are also other static capital requirements, such as the capital conservation buffer and the additional charges required for institutions that represent systemic risk, to name a few.[8] Non-compliance with the requirements does not imply implementing an early regularization process by banking supervisors, but it does often lead to the imposition of restrictions on banks' dividend payouts.[9]

[6] Although the amount of capital actually required from banks may vary due to fluctuations in the variables used to calculate risk weights, the capital required as a fraction of risk-weighted assets is static.

[7] In Chile, this instrument is implemented through a minimum requirement over the Capital Adequacy Ratio (CAR) (see Central Bank of Chile, 2024c).

[8] For example, Pillar II (Basel III) charges that may be implemented discretionally by the financial regulator in order to cover risks that, in their opinion, are not covered by the other capital buffers.

[9] In Chile, the charge for systemically important institutions is mandatory for banks included in this category.

TABLE 1 BASEL COMMITTEE ON BANKING SUPERVISION REFORMS- BASEL III
(Strengthens microprudential regulation and supervision, and adds a macroprudential overlay that includes capital buffers)

	Capital					Liquidity
	Pillar 1			Pillar 2	Pillar 3	
	Capital	Risk coverage	Containing leverage	Risk management and supervision	Market discipline	Global liquidity standards and supervisory monitoring
All Banks	**Quality and level of capital** • **Raising minimum common equity** to 4.5% of riskweighted assets, after deductions. • **A capital conservation buffer** comprising common equity of 2.5% of risk-weighted assets brings the total common equity standard to 7%. Constraints on a bank's discretionary distributions will be imposed when it falls into the buffer range. • **A countercyclical buffer** within a range of 0–2.5% comprising common equity will apply when credit growth is judged to result in an unacceptable build-up of systematic risk. **Capital loss absorption at the point of non-viability** Allowing capital instruments to be written off or converted to common shares if the bank is judged to be non-viable. This will reduce moral hazard by increasing the private sector's contribution to resolving future banking crises.	**Revisions to the standardised approaches** for calculating • **credit risk;** • **market risk;** • **credit valuation adjustment risk**; and • **operational risk** mean greater risk-sensitivity and comparability. **Constraints on using internal models** aim to reduce unwarranted variability in banks' calculations of risk-weighted assets. **Counterparty credit risk** More stringent requirements for measuring exposure; capital incentives to use central counterparties for derivatives; a new standardised approach; and higher capital for inter-financial sector exposures. **Securitisations** Reducing reliance on external ratings, simplifying and limiting the number of approaches for calculating capital charges and increasing requirements for riskier exposures. **Capital requirements for exposures to central counterparties (CCPs) and equity investments in funds** to ensure adequate capitalisation and support a resilient financial system. **A revised output floor**, based on Basel III standardised approaches, limits the regulatory capital benefits that a bank using internal models can derive relative to the standardised approaches.	A non-riskbased **leverage ratio** including off-balance sheet exposures is meant to serve as a backstop to the risk-based capital requirement. It also helps contain systemwide build-up of leverage.	**Supplemental Pillar 2 requirements** address firm-wide governance and risk management, including the risk of off-balance sheet exposures and securitisation activities, sound compensation practices, valuation practices, stress testing, corporate governance and supervisory colleges. **Interest rate risk in the banking book (IRRBB)** Extensive guidance on expectations for a bank's IRRBB management process: enhanced disclosure requirements; stricter threshold for identifying outlier banks; updated standardised approach.	**Revised Pillar 3 disclosu-rerequire-ments** Consolidated and enhanced framework,-covering all the reforms to the Basel framework. Introduces a dashboard of banks' key prudential metrics..	The **Liquidity Coverage Ratio** (LCR) requires banks to have sufficient high-quality liquid assets to withstand a 30-day stressed funding scenario that is specified by supervisors. The longer-term, structural **Net Stable Funding Ratio** (NSFR) is designed to address liquidity mismatches. It covers the entire balance sheet and provides incentives for banks to use stable sources of funding. The Committee's 2008 guidance **Principles for Sound Liquidity Risk Management and Supervision** takes account of lessons learned during the crisis. It is based on a fundamental review of sound practices for managing liquidity risk in banking organisations. **Supervisory monitoring** The liquidity framework includes a common set of intraday and longerterm monitoring metrics to assist supervisors in identifying and analysing liquidity risk trends at both the bank and system-wide level.
SIBs	The Committee identifies global systemically important banks (G-SIBs) using a methodology that includes both quantitative indicators and qualitative elements. In addition to meeting the Basel III risk-based capital and leverage ratio requirements, G-SIBs must have higher loss absorbency capacity to reflect the greater risks that they pose to the financial system. The Committee also developed principles on the assessment methodology and the higher loss absorbency requirement for domestic systemically important banks (D-SIBs).					Large exposures Large exposures regime established to mitigate systemic risks arising from interlinkages across financial institutions and concentrated exposures.

Source: BIS.

2.3.2 Dynamic capital requirements

Dynamic capital requirements are those that are state-dependent by nature. Depending on the state of the economy and financial conditions, they may change in value. However, this does not imply that these types of instruments are highly variable, nor that they do not have structural or static components. Although these capital requirements may change more frequently than the static requirements, they also have periods (often prolonged) in which they take on a constant value.

Countercyclical capital buffer. This is a macroprudential instrument introduced by Basel III. Its objective is to strengthen the resilience of the banking system, improving its capacity to absorb shocks, without requiring an abrupt deleveraging and a contraction in credit supply that would amplify the initial financial stress and its transmission to the rest of the economy.[10]

Dynamic provisions. Used in some jurisdictions, dynamic provisions are bookkeeping provisions for credit risk that are accumulated during the growth of a variable that indicates an increase in banks' income, such as credit or earnings (as defined by the financial regulator), in order for them to be used in times of economic stress. As a result of this objective, this instrument is countercyclical and macro-prudential in nature.

2.4 Use of capital requirements in Chile

In Chile, the New General Banking Act (Law No. 21130 of 2019) defines the general guidelines for establishing a capital adequacy system in line with Basel III standards. Thus, the regulatory framework for its implementation is determined by the Financial Market Commission (FMC|) and in some areas by the Central Bank of Chile (CBCh) or in coordination with it. In particular, the Law confers on the CBCh the responsibility to determine the activation or deactivation of the CCyB. This must be done, among other factors, in consideration of the phase of the cycle, in a range between 0 and 2.5% of RWAs, upon the prior report of the FMC for determining the level and term of implementation. In this way, both institutions act as financial regulators, and interact in the implementation of the CCyB, as with other instruments (e.g., liquidity standards).

The standards required by Basel III have been implemented gradually and progressively under the regulatory framework of the New General Banking Act. The country is in the process of convergence to higher capital requirements that will be completed by the end of 2025 (Table 2).

Within this progressive implementation, the gradual increase of minimum CET1 capital is of utmost importance, given that multiple capital requirements, including CCyB, must be met with this high quality capital component and are implemented based on this ratio. Based on the implementation decisions taken by the authorities to date, the CET1 capital requirement for the aggregate of Chilean banks is projected to increase from 8.2% at the end of 2023 to just under 10% of RWAs by the end of 2025 (Figure 1).

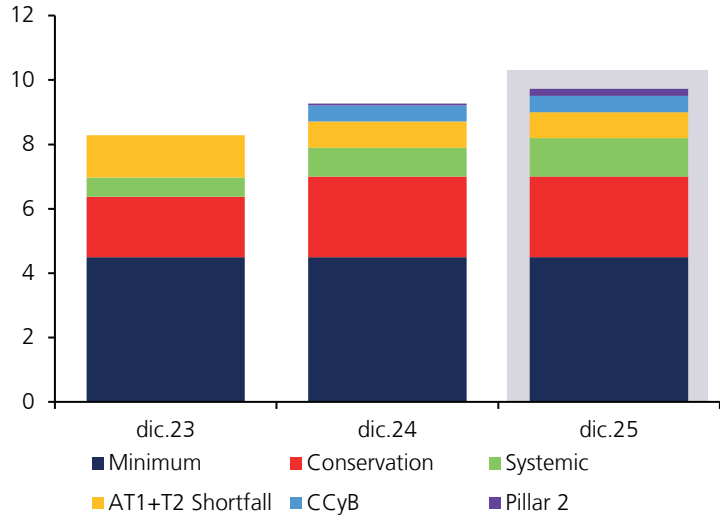
[10] The Basel Committee's initial proposal was very ambitious in terms of the objectives of this tool, since it was thought that it could help contain episodes of exuberant credit growth, reduce the likelihood of financial crises and promote greater stability in the supply of credit in the event of an adverse shock. However, the vision of this tool has evolved. Currently, the greater effectiveness of countercyclical buffers as policy instruments that contribute to counteract the procyclicality of the financial system and generate greater resilience in the financial system in the face of adverse shocks is emphasized.

TABLE 2 TRANSITION TO BASEL III IN CHILE

Period	2020	2021	2022	2023	2024	2025
Risk-Weighted Assets, RWA	RWA Basel I	RWA Full Basel III	RWA Full Basel III	RWA Full Basel III	RWA Full Basel III	RWA Full Basel III
Additional charge to systemically important banks	N/A	0%	25% of the charge	50% of the charge	75% of the charge	100% of the charge
Capital Conservation Buffer	0%	0.625%	1.25%	1.88%	2.50%	2.50%
Factor related to discounts on regulatory capital	0%	0%	15%	30%	65%	100%
Substitution factor of AT1 instruments for T2	1.50%	1.00%	0.50%	0%	0%	0%
Pillar III				First report		
Pillar II	The norm is implemented from September 2020	First Effective Capital Evaluation Report				

Source: Financial Marjet Commission (CMF).

FIGURE 1 CONVERGENCE OF MINIMUM CET 1 CAPITAL IN CHILE



Source: Central Bank of Chile, based on CMF data.

3. DIRECT EFFECTS OF CHANGES IN CAPITAL REQUIREMENTS OVER CREDIT SUPPLY

In this section we present results from the mainly empirical literature on the effects of changes in capital requirements on banks' credit supply. To simplify the discussion, we divide the analysis into four parts. First, we present results related to the effects of changes in static or structural capital requirements on the supply of credit.[11] Second, we discuss the effects on credit supply of changes in dynamic capital requirements, i.e., those explicitly designed to be contingently adjustable to the state of the economy or the evolution of banking sector conditions. Specifically, we devote this subsection to analyzing episodes of activation and release of countercyclical buffers, such as CCyB, and the use of dynamic provisions. We then analyze the potential procyclical effects of micro-prudential regulation, and end with a discussion of the potential limitations in the interpretation of the empirical evidence and complement it by presenting some results drawn from general equilibrium models.

3.1 Effects of changes on static or structural capital requirements

A broad review of the literature suggests that increases in static capital requirements tend to be associated with lower growth in the supply of credit.[12] This result is summarized, for example, in the literature review published by Malovaná et al. (2024). The authors find that a one percentage point (pp) increase in capital requirements is associated with slower bank credit growth of about 0.3pp per quarter.[13] However, there is ample evidence that the effects on bank credit supply are heterogeneous. They depend both on idiosyncratic conditions of each bank, as well as on the aggregate state of the economy at the time a regulatory change is introduced.

The literature highlights that the greatest effects are concentrated on those banks that, at the time the regulatory changes were implemented, have lower capital buffers than required by the authorities. For example, Gropp et al. (2019) find that the slowdown in the credit supply of banks with lower buffers was up to ten times greater than in banks with higher capital ratios. Their paper documents the effects of the 2011 European Banking Authority (EBA) capital exercise on the credit supply of banks under its jurisdiction. During this episode, the regulator suddenly raised the minimum CET1 capital requirements for a subset of banks. The increase was from 5 to 9 percent of risk-weighted assets, with an eight-month adequacy period. Despite the fact that many banks maintained significant buffers, the total capital shortfall for European banks following the EBA's measures was around €115 billion.

Similarly, Fang et al. (2022) find that, for each percentage point increase in capital requirements, Peruvian banks with lower capital buffers exhibit growth in their credit supply that, per quarter, is about 2pp lower than that of banks with higher levels of capitalization.[14]

[11] We also include in this group the effects of changes in capital buffers that some jurisdictions applied discretionally to specific financial institutions, as well as the effects of capital charges made by some countries based on stress tests, such as those performed by the Federal Reserve in its Comprehensive Capital Analysis and Review (CCAR) tests. We reserve subsection 3.2 for the analysis of the effects of changes in explicitly releasable requirements, such as CCyB.

[12] See, for example, Peek and Rosengren (1995), Aiyar et al. (2016), Fraisse et al. (2017), Gropp et al. (2019), Juelsrud and Wold (2020), De Jonghe et al. (2020), Fang et al. (2022), Malovaná et al. (2024), Cappelleti et al. (2024).

[13] The paper compiles nearly 1600 estimates from the empirical literature. The aggregation of these results is not trivial, given that different episodes of regulatory changes are collected and different methodologies are used. Still, the result can give a general idea of the sign of the relationship between capital buffers and credit supply growth.

[14] Differential effects for banks with lower capital headroom are also documented in other papers, e.g., Bridges et al. (2014) and Juelsrud and Wold (2020).

Some empirical studies highlight other bank characteristics as important determinants of the reaction of their credit supply to changes in regulation. Banks with higher profitability and liquidity exhibit a lower adjustment in their credit supply (Fang et al., 2022). Likewise, banks with a higher proportion of high-quality capital (CET1) exhibit more moderate effects on their credit supply. Gropp et al. (2019) find that banks with a higher proportion of subordinated debt in their liabilities exhibit a greater slowdown in their credit supply following the EBA capital exercise. Intuitively, increasing CET1 capital levels is more costly if potential new investors find that future fund flows will benefit subordinated debt holders. This problem, noted by Hanson et al. (2011) is essentially the same as that of debt overhang in Myers (1977), i.e., the fact that potential new investors may be reluctant to provide capital when the return on new projects goes to existing debt holders.

On the other hand, the effects of greater capital requirements may be influenced by aggregate conditions that affect the banks' ability to accumulate capital organically through withheld earnings.[15] Bridges et al. (2014) document that British banks' credit supply elasticity to increased capital requirements is higher during periods of poor economic growth.

3.1.1 Discussion about the magnitude, duration and composition of the effects on credit supply

The reviewed literature shows great variability in the magnitude of the effects on credit supply in response to changes in static capital requirements. Thus, for each percentage point increase in capital requirements, an impact on credit supply growth is found to range from zero to -7pp in one quarter.[16] Malovaná et al. (2023)'s review of estimates confirms that the range of effects is wide and that the estimates obtained vary depending on the sample and methodology used.

The studies reviewed also show high variability in the duration of the effects on credit supply, with values ranging from two to twelve quarters (Fang et al., 2022; Gropp et al., 2019). This may be partly due to differences in the implementation processes of higher capital requirements. For example, some studies, such as Fang et al. (2022) analyze the implementation of higher requirements on a gradual timeline, and find short-lived effects (two quarters) of both the announcements and the entry into force of the regulation. In contrast, other announcements such as the European Banking Authority's capital exercise, which required a subset of European banks to build higher capital levels in a very tight time frame and in a period of low bank profitability, appear to exhibit more persistent effects. (Mésonnier and Monks, 2015; Gropp et al., 2019).

On the other hand, the effects on the supply of credit can be decomposed into different dimensions. For example, a subset of studies uses information from credit registries that allows them to observe effects on both the extensive --new credit-- and the intensive --existing credit-- margin of credit supply. De Jonghe et al. (2020) find, for the case of increases in Pillar 2 charges to Belgian banks,[17] that the effect on credit supply is explained by both margins. This, in a context where banks become more reluctant to initiate and renew credit relationships after the regulatory change. In another study, Fraisse et al. (2020), using the French credit registry, show that the extensive margin is more important in explaining the slowdown in the credit supply of the banks most affected by regulatory changes.

[15] We elaborate on this discussion in subsection 3.2, where we discuss the effects of dynamic/releasable capital buffers.

[16] See, for example, Malovaná et al. (2023); Aiyar et al. (2016).

[17] Pillar 2 charges refer to additional capital charges imposed by the regulator as a result of the supervisory process related to risk and governance that it deems insufficiently covered by Pillar 1 charges (see Table 1).

An additional dimension that has been studied in the literature is the effect on the composition of the credit supply. The regulatory capital ratio of banks depends on three components, namely: their level of capital, their assets, and the risk weights applicable to those assets. Consequently, a re-composition of the banks' portfolios towards loans with lower risk weights can help them meet higher capital requirements on risk-weighted assets. The literature finds evidence that this adjustment channel is actively used by banks[18].

3.1.2 Bank-level and firm-level effects

There are (at least) two analytical levels to describe the potential effects of changes in the banks' capital regulation on the supply of credit to the real sector.

A first level focuses on the differential effects of credit growth according to each bank's exposure to regulatory change. We interpret this type of estimates as "bank-level effects," that is, as informative results on the effect of regulation on a bank compared to other institutions. The estimates reported in subsection 3.1.1 belong to this group.

A second level focuses on the effects on firms' total access to credit through their exposure to regulatory change due to their relationships with financial institutions. This type of analysis is possible thanks to the availability of credit registry data, which makes it possible to observe the relationship of each company with each financial institution and thus calculate its degree of exposure to changes in the capital regulation of the banks that finance it.

The results of this kind of analysis, usually referred to in the literature as "firm-level effects," indicate that some firms may partially replace credit from banks more exposed to regulatory changes. Thus, firm-level effects tend to be more limited than those at the bank level. This type of result is found, for example, in Berrospide and Edge (2024), who analyze the effects of additional charges by the Federal Reserve based on stress tests.

The authors find that, on average, a loan granted by a bank subject to an additional percentage point requirement grows by about 1 pp less (per quarter), compared to financing from other banks that grant credit to the same firm and are not subject to the higher requirement. However, when examining firm-level effects, the authors find a non-significant effect on credit following increases in capital requirements. This is consistent with the substitution mechanism between more and less affected credit providers by the change in regulation.[19] Other studies find that firm-level substitutability is only partial (Gropp et al., 2019; Juelsrud and Wold, 2020), although it typically occurs during episodes of big changes in requirements and a relatively short adequacy period.

3.2 Effects of changes in dynamic-type capital requirements

This section analyzes the effects of activating and releasing dynamic requirements, such as the countercyclical capital buffer. It is important to note that the literature devoted to the effects of CCyB on credit supply is scarce, considering this tool's relatively recent implementation. We complement these studies with the analysis of the dynamic provisions implemented in Spain between 2000 and 2012, a tool similar in spirit to the CCyB, for which empirical results of high scientific quality are available.

[18] See, for example, Juelsrud and Wold (2020) for the case of Norwegian banks. Their study finds that, during the transition to higher capital charges, there is a portfolio re-composition of banks with lower capital buffers towards the real estate sector (whose risk weights are lower).

[19] As discussed in subsection 3.2, this substitution capacity may be reduced during a crisis.

3.2.1 Effects of activating dynamic requirements

The effects of activating the CCyB seem to resemble the results obtained for episodes of implementation of other types of requirements, such as those described in subsection 3.1. An increase in dynamic capital requirements tends to be associated with a slowdown in the supply of credit by the institutions most affected by the measure, but the aggregate effects seem to be limited.

For Chile, we have recent evidence on the effects of activating the countercyclical buffer announced in May 2023, which had a period of one year for its implementation.[20] A study by the Central Bank of Chile (2024b) finds that the decision to raise the countercyclical buffer, and to implement other policy measures, would not have had a significant negative effect on the supply of bank commercial credit at the aggregate level. Although credit granted by banks with lower capital buffers exhibited lower growth (about 3pp for each pp of buffers, between November 2022 and December 2023), when weighting the regressions by credit size, the effect becomes non-significant, indicating a more limited effect at the aggregate level. As for firm-level effects, the paper finds heterogeneous effects for different groups of borrowers. Firms with access to multiple banking relationships were able to substitute between banks more and less affected by the change in regulation, while those with a single banking relationship experienced greater sensitivity to the exposure of their credit providers to the increase in regulation.

In the case of dynamic provisioning, introduced in Spain in 2000, Jiménez et al. (2017) document lower growth in credit supply for those banks that had to provision more funds. The paper, which uses Spain's credit registry for the period 2000-2013, finds that an additional standard deviation in the funds that banks had to provision was associated with growth of the order of one pp lower in their supply of credit to firms. The authors find that this effect takes about ten quarters to become non-significant. However, the firm-level analysis reveals that in this case firms were able to make a nearly complete substitution between more and less affected banks. Thus, the authors find no significant effects on firm-level credit during the activation episode.

More recently, in the case of European banks, Bedayo and Galán (2024) find that the activation of the CCyB is associated with lower credit supply growth, although only for those banks with lower capital buffers (below the median of the sample). The authors find, for these banks, a negative effect on credit supply growth in the order of 0.25pp per quarter, which becomes statistically non-significant after two quarters.

In a separate recent study, exploiting data from a European credit registry, Behn et al. (2024) show that the effects of triggering the post-pandemic countercyclical requirement have been limited. The authors find no significant effects for the average bank, although they do find significant effects for banks with smaller capital buffers. For banks with buffers in the lowest third of the sample (i.e., a voluntary buffer of 4.7% of risk-weighted assets over CET1 requirements), lending exhibits a slowdown in the order of 1.5pp per quarter for each additional pp increase in capital requirements. The study finds heterogeneous effects at the firm level, with the largest effects concentrated in small firms and those with only one banking relationship.

[20] See Central Bank of Chile (2024b). The measure to activate the countercyclical requirement was taken concomitantly with other policy changes. In particular, the measure was close to the phase-in of the capital conservation buffer and the standardization process of eligible collateral for the Conditional Finance for Increased Lending program (*Financiamiento Condicional al Incremento en las Colocaciones*) (FCIC).

3.2.2 Effects of releasing dynamic requirements

The effects of the release of dynamic requirements have received more attention after the pandemic episode provided a shock that led to the lowering of the requirement in jurisdictions that had previously activated and accumulated it. During the GFC, the case of dynamic provisioning in Spain provides another episode to study the effects of releasing capital measures during a crisis.

The literature reviewed indicates that releasing the capital requirements during an episode of tension has positive effects on the banks' credit supply, especially for those that have less capital slack at the moment of the release.

The case of the adjustment of dynamic provisions in Spain, analyzed by Jiménez et al. (2017), shows robust evidence of the positive effects of regulatory adjustment on credit supply during the GFC. First, the study shows that those banks that came to the crisis having built up greater levels of dynamic provisions exhibited higher growth (or a smaller decline, in this case) in their supply of credit.[21] Second, the paper shows that the regulator's decision to lower the minimum provisioning floor led to a smaller drop in the supply of credit for those banks that would have been in noncompliance had the requirement not been adjusted. Third, the effects at the firm level are significant and persistent over time: compared to the level of credit between 2008 and 2010, the fall in credit to firms was 9pp lower for each additional percentage point of provisioning by banks prior to the onset of the GFC.

More recently, a number of studies have analyzed the effects of CCyB release during the pandemic. For European banks with lower capital buffers, the literature finds positive effects on credit growth of between 0.5 and 2.7pp per quarter.[22] For mortgage lending to households, Mathur et al. (2023) show that the release of the countercyclical buffer in the UK contributed to sustaining the credit supply of banks with lower capital headroom, documenting a positive effect in the order of 2.3pp per quarter.

3.2.3 Asymmetric effects between the activation and release of dynamic requirements

A central point in the analysis of the costs and benefits of adopting countercyclical measures is the discussion about the potentially asymmetric effects on credit supply during episodes of activation and release. The available evidence suggests that, when comparing the absolute value of their effects on credit supply, they are larger in the release than in the activation. However, this evidence should be evaluated and interpreted carefully.

In the case of the dynamic provisions analyzed by Jiménez et al. (2017), although at the bank level the activation episode and the release episode have a similar effect, the result at the firm level is remarkably asymmetric. The latter was not affected by the introduction of dynamic provisions in 2000. However, during the crisis, firms that took credit from banks with higher levels of dynamic provisions had better access to financing, an effect that is statistically and economically significant. In the same vein, Bedayo and Galán (2024) find that the effects of activation are about half the effects of the release of the buffer for banks with low capital headroom, analyzing a sample of European banks before and during the Covid-19 pandemic.

[21] This result may depend on two factors: i) the fact that banks arrived at the crisis better capitalized and therefore with a better loss absorption capacity; and ii) the fact that, by lowering the level of provisions required, the banks did not have to adjust their assets so strongly in order to comply with the regulation.

[22] See Basel Committee on Banking Supervision (2021), Couaillier et al. (2022), Dursun de Neef et al. (2023), Avezum et al. (2024), Bedayo y Galán (2024).

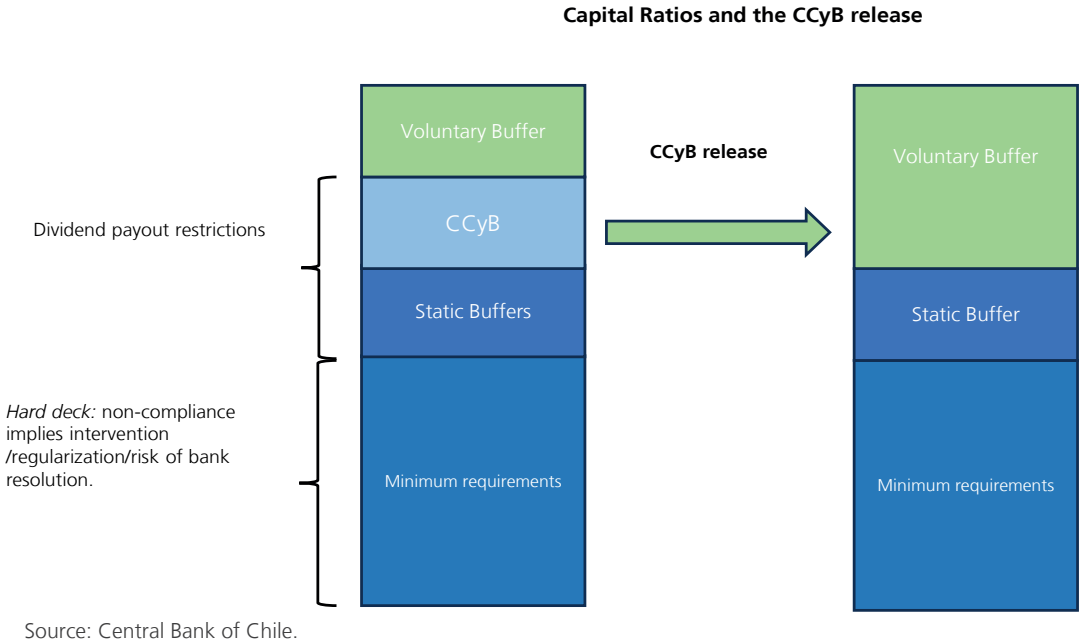
It is important to contextualize this evidence and note that a pattern of asymmetry could be explained by several factors. For one, countercyclical requirements are activated gradually and spaced out over time, while their release is effective immediately for the entire banking system upon the authority's decision. Consequently, the requirement's change per unit of time is not the same.

On the other hand, the accumulation of the buffer typically occurs in an economic environment in which banks are earning positive returns, so that capital can be built up using withheld earnings, without necessarily having to resort to capital issuance (which can be more costly for banks). In other words, the timing of activation of the requirement is not random. Instead,macro-prudential authorities typically evaluate the circumstances that allow them to minimize the cost of activating it in terms of lower credit supply. In contrast, the release of the CCyB occurs after shocks that may negatively affect banks' balance sheets, at times when banks value more maintaining positive regulatory headroom. For example, there is evidence that European banks were reluctant to use structural capital buffers (such as the Capital Conservation Buffer) during the Covid-19 crisis.[23] This evidence is consistent with the notion that the banks adjust their capital ratios to avoid the stigma of crossing into the dividend payout restriction zone, implied in using regulatory buffers.

Figure 2 illustrates how the release of the CCyB de facto generates greater capital headroom for banks. As will be discussed in Box 1, during an adverse shock, the additional distance to the dividend payout restriction zone may contribute to a smaller adjustment in the denominator of the capital ratio via deleveraging.

Intuitively, if there is a constraint on banks' leverage, which is occasionally binding, then asymmetric effects are to be expected. If requirements increase when the constraint is slack, but are released when it is binding, then larger effects should be observed during the release episode and in banks with less capital headroom. This intuition is consistent with the empirical evidence around the pandemic and with the theoretical channel explored in Lang and Menno (2023).

FIGURE 2 RELEASE OF THE CCYB AND EFFECT ON CAPITAL HEADROOM



Source: Central Bank of Chile.

[23] See, for example, Basel Committee on Banking Supervision (2022); Mathur et al. (2023); Avezum et al. (2023); Couaillier et al. (forthcoming); San Millán (2024).

3.3 Procyclical effects of micro-prudential regulation

So far, we have focused on the effect that a change in capital requirements can have on the banks' credit supply. However, capital regulations may affect credit supply in the absence of explicit changes by the authorities. Specifically, the literature has analyzed the potential procyclical effects of risk weights, particularly those calculated with time-varying inputs. For example, Basel II introduced the possibility of calculating risk weights as a function of, among other variables, the probability of default on loans, calculated by banks. This type of approach to calculating risk weights is known as an "internal ratings based" methodology, since banks provide some of the information used in the regulatory formulas.

Recessions tend to come with increases in uncertainty (Bloom, 2014), so risk-sensitive weights tend to increase precisely during contractionary episodes (Ayuso et al., 2004). Consequently, during a recession, banks may face higher capital needs due to higher risk weights. This may result in a contraction of credit supply in those periods, which would amplify the effect of a negative shock on the real sector. This is explained in the theoretical framework introduced in Repullo and Suárez (2013).

The procyclicality of risk-sensitive requirements has been analyzed empirically by Behn et al. (2015), who use variation in the adoption of internal ratings based models among German banks and a credit registry to identify changes in credit supply after the collapse of Lehman Brothers. Their paper finds that, over that period and for the same firm, credit subject to internal ratings based models fell by 2.1 to 3.9pp more than credit subject to standard models.

As has been emphasized, the temporary variation of risk weights is more relevant in the case of the adoption of internal ratings based models for the calculation of risk weights, a methodology that has not been implemented in Chile. On the contrary, Chilean banks use fixed weightings for credit risk. However, there are certain segments of market exposures that are sensitive to the risk rating of the assets, so some cyclical sensitivity could be found in some risk weights.

Box 1: Capital objectives, capital headroom and banks' credit supply[24]

This box discusses the relationship between the banks' capital targets, capital requirements and credit supply. The connection between credit supply and capital targets is determined by the adjustment mechanism banks use to converge to their target capital ratio. In normal times the adjustment can be made via changes in the numerator of the ratio, but during crises this type of adjustment is less feasible, due to difficulties in accumulating or issuing capital. The box also analyzes the dependence of the capital target on regulation and how, post-GFC, regulation has become a more important determinant of the banking system's capital structure. It concludes with a description of the evolution of the CET1 capital ratio of Chilean banks.

Adjustments toward the banks' capital target and changes in credit supply

The effects on credit supply of a change in capital regulation are a consequence of a process of adjustment in the banks' capital ratio. The literature notes that banks make the transition to new capital targets by adjusting both the numerator and the denominator of the capital ratio, the latter of which can have the strongest negative effects on the supply of credit.

[24] This box is based on the literature review of Inzunza and Toro (2024).

There are indications that, most of the time, banks adjust their capital level via the numerator of the ratio (Couaillier, 2021), either by capitalizing withheld earnings or by issuing equity instruments. However, adjustments of this kind are especially costly during a crisis, because in those times the banks' profitability is reduced and issuing capital may become unfeasible. Therefore, during a crisis, the adjustment to new capital targets can be expected to be made primarily through changes in risk-weighted assets (denominator).

Additionally, the magnitude of the impact on credit may be influenced by the speed of adjustment towards the new targets. In this sense, the results indicate that banks close the gap to their capital target faster when they are below it than when they are above. Moreover, the greater the distance to the target, the faster the adjustment (Couaillier, 2021). Thus, the evidence is consistent with the presence of nonlinearities in the speed of adjustment to new capital targets.

How dependent are capital targets on capital requirements?

An empirical regularity observed across multiple countries and time periods is that banks maintain voluntary buffers above the required capital. In this regard, the literature has shown that capital requirements are only one of multiple determinants that lead banks to choose a particular capital structure. For example, capital targets may be determined by factors associated with the discipline exerted by debt and equity markets on banks' decisions, different risk management capabilities, or, in general, other idiosyncratic unobservable factors.[25]

Faced with a change in capital requirements, banks are expected to react heterogeneously depending on how their capital targets are changed. Several studies find that, prior to the GFC (and subsequent reforms), the role of regulation in determining the capital structure of banks was of second order (Gropp and Heider, 2010). In contrast, post-GFC studies indicate that higher capital requirements have a significant impact on banks' capital targets. In general, as capital requirements are increased, it is expected that requirements will begin to play a dominant role, as the required capital ratio will be higher than what the bank would choose in the absence of regulation.

Capital buffers at a given point in time may contain information about banks' capital targets, and therefore can help to infer the potential effect that a change in regulation could have on their capital structure. However, buffers should be interpreted with caution. In particular, two banks may have the same level of buffers, but be converging to different capital targets, or, conversely, they may converge to the same target from different initial buffers.

Capital buffers of Chile's banking system

In Chile, banks have maintained CET1 capital buffers ranging historically between 5pp and 6pp above the minimum requirements on risk-weighted assets (RWA). However, as shown in Figure 3, the transition process towards Basel III regulatory capital levels is still in progress and lower buffers are observed from 2022 onwards. The increase in the ratio of CET1 to risk-weighted assets in recent years seems to be consistent with a response to the transition scheme to higher capital requirements.

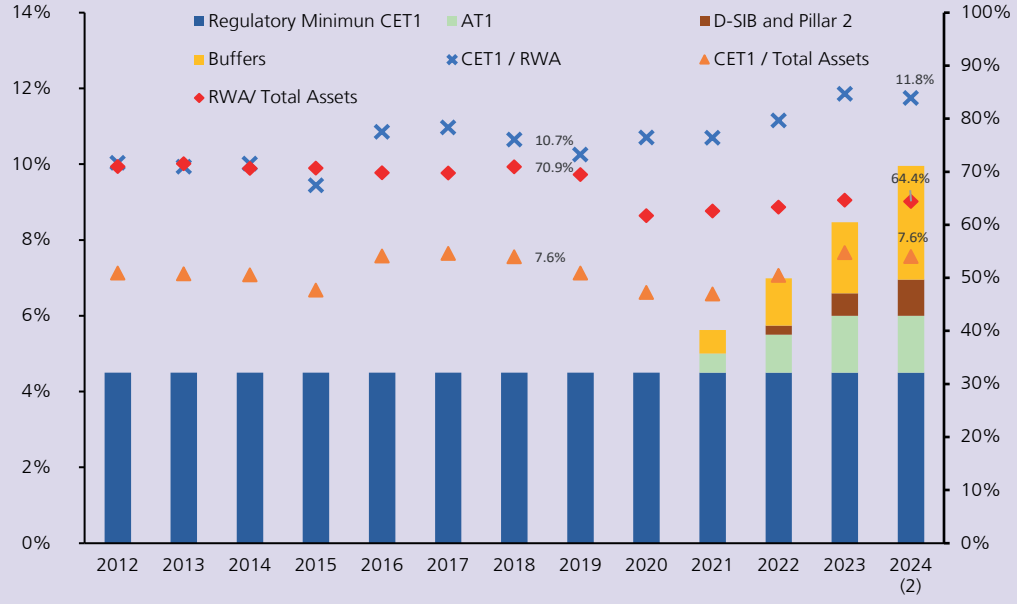
It is important to note that these data are purely descriptive and show an equilibrium result in terms of the behavior of the banks' capital ratio (i.e. they can be explained by changes in both the supply of and demand for credit). However, the figure contains information on the type of adjustments that have been

[25] See, for example, Flannery and Rangan (2008); Berger et al. (2008); Gropp and Heider (2010) and the references cited therein.

observed in the capital ratio of Chilean banks. While the ratio of CET1 to risk-weighted assets has risen from 10% to nearly 12% since 2012, the ratio of CET1 to assets (unweighted), has not grown significantly. In contrast, a drop in RWA density is observed, which could be due to several factors. First, the entry into force of the New General Banking Act and the complementary regulations issued by the FMC for the calculation of risk weightings, resulted in a reduction in RWAs on average.[26] Other factors, though, could have affected the evolution of RWAs in the same period, such as a preference of banks for safer loans and assets in reaction to the pandemic; the change in risk weights associated with Fogape- guaranteed loans; a decision by banks to restructure their portfolios toward assets with lower risk weights in response to regulatory changes, or to changes in the demand for credit from sectors with different risk weights.

In conclusion, although the ratio of CET1 to RWA seems to be increasing coincidentally with the application of higher capital requirements in Chile and there seems to be an adjustment through portfolio risk weights, it is necessary to deepen the study of the effects that the regulatory changes may have had on banks' capital targets, as well as their adjustment mechanisms.

FIGURE 3 CAPITAL RATIOS AND CET1 CAPITAL REQUIREMENTS FOR CHILEAN BANKS (1)



(1) The figure, based on calculations made by the Infrastructure and Financial Regulation Department of the Central Bank of Chile using information from the FMC, shows in the vertical bars the evolution of capital requirements on the CET1 to risk-weighted assets ratio. The term D-SIB refers to the charge applicable to systemically important institutions. The bars corresponding to AT1 refer to the additional Tier 1 capital shortfall to be covered by CET1 capital for those banks that do not have AT1 instruments. Finally, the buffers comprise the capital conservation buffer and the CCyB. The capital requirements and the ratios of CET1 to RWA and CET1 to total assets are shown on the left axis of the graph. The ratio of RWAs to total assets is shown on the right axis. (2) Data at February 2024 with requirements expected by December 2024. Source: Central Bank of Chile.

[26] For details on the recent evolution of capital buffers in Chile and banks' compliance with them, see Central Bank of Chile (2024c).

3.4 Discussion of empirical results: identification, analysis limitations and general equilibrium perspective

3.4.1 Discussion on the identification strategy in the empirical literature reviewed

The empirical studies presented in section 3 aim to identify the effects of regulatory changes on the supply of credit. The main empirical challenge facing researchers is to isolate the effects of changes in credit supply from changes in credit demand that may occur simultaneously with regulatory changes.[27] A subset of studies has access to credit registries where relationships between firms and banks are observed over time. This type of study exploits:

(a) Asymmetrical exposures of banks to regulatory changes:

(i) Banks with lower capital buffers during a regulatory change common to all banks (see Central Bank of Chile, 2024b).

(ii) Requirements applicable to a subset of banks on a quasi-random basis (Mésonnier and Monks, 2015; Gropp et al., 2019).

(iii) Changes in individual requirements for each bank (Jiménez et al., 2017; De Jonghe et al., 2020).

(b) Firms that maintain credit relationships with more than one bank, which allows them to control for changes in their demand for credit at the time of the regulatory change.

This methodology, introduced by Khwaja and Mian (2008), provides a robust way to control for changes in credit demand. In this way, researchers can compare how credit granted to the same firm by banks more or less affected by capital requirements changes, either by looking directly at the requirement applicable to each bank or by segmenting banks into more and less affected groups. This allows them to perform a difference-in-differences type of analysis.

Other studies use data from each bank's balance sheet, without observing credit relationships with individual firms.[28] Some papers control for time fixed effects or some proxy variable for credit demand and exploit a heterogeneous exposure of banks to regulatory measures to assess changes in their credit supply. While these papers attempt to control for credit demand, the proposed identification strategy is weaker than that of studies that can control for firm-specific credit demand. If for instance banks are specialized by sectors, an empirical strategy that controls for changes in aggregate credit demand could produce biased estimators of the effect of the regulatory change, if it coincides with heterogeneous changes in credit demand in different economic sectors.

3.4.2 Potential limitations of the analysis in the empirical literature

Although the literature has made great strides in identifying the effects of capital requirements on banks' credit supply, there are certain limitations in interpreting these results.

[27] For a more thorough review on the identification of credit supply shocks and their real effects, see, for example, Central Bank of Chile (2024a).

[28] For example: Peek and Rosengren (1995): Aiyar et al. (2016); Fang et al. (2022); Capelletti et al. (2024).

To begin with, it is important to note the partial geographic coverage of these studies. Most of the literature focuses on regulatory changes in the European Union, where capital requirements have been used extensively. There are also studies for the United States (Berrospide and Edge, 2024) and, in our review, two papers for Latin American economies (Fang et al., 2022 for Peru and Central Bank of Chile, 2024b for Chile). In other words, although the studies are relatively abundant, their geographic coverage is limited, particularly for emerging economies. Moreover, many studies, especially those related to the CCyB, are recent and are still under revision.

Also, there are limitations in the aggregate extrapolation of the empirical results. The empirical literature typically estimates average effects per bank or per firm in the face of changes in capital requirements. In other words, most of these papers assign the same weight to all observations, irrespective of their share in the credit market.[29] Thus, extrapolating the effect on the aggregate credit supply reported in these studies is no easy task.

Finally, the studies consulted reflect partial equilibrium effects in the face of changes in requirements. This limitation is common to all the studies that, albeit with variations in the empirical specification, estimate the effect on credit supply as a difference between the reactions of banks more and less exposed to the regulation. It is therefore important to complement the empirical analysis with general equilibrium results.

General equilibrium perspective

In the recent literature, a number of studies have been developed whose starting points are models with financial accelerators (e.g., Bernanke et al., 1999; Kiyotaki and Moore, 1997) and which extend them to incorporate dynamics related to the net worth of financial intermediaries. These models allow evaluating the general equilibrium effects of changes in capital requirements on the supply of credit and other macroeconomic variables. The results are consistent with those presented in the previous subsections. Upon an increase in capital requirements, credit supply initially contracts, but gradually recovers. Moreover, the use of countercyclical buffers helps to moderate the fall in credit during a crisis.

The short-term effects of an increase in capital requirements on the economy have been studied by Mendicino et al. (2020) and Elenev et al. (2021), whose results are complementary. The former analyze the impact of a 2.5pp increase in static capital requirements over a two-year horizon. According to their findings, although aggregate credit initially falls, which depresses investment, both recover gradually driven by the accumulation of net worth of entrepreneurs and bankers, which improves their ability to finance projects. Consumption, on the other hand, initially rises due in part to the reduction in fiscal costs associated with the lower probability of bank failures, but then gradually declines. Output follows a similar trajectory: it falls at first, but gradually recovers. The study also notes that, if capital requirements are implemented over a longer horizon, these effects tend to soften.

In a different study, Elenev et al. (2021) consider a more pronounced increase in static capital requirements, from 7% to 15%. Although their study does not report short-term effects on credit or investment, their conclusions on the dynamics of output and consumption qualitatively coincide with those observed by Mendicino et al. (2020).

These two papers also consider the impact of different levels of static capital requirements in the long term. Although both agree on some points, their results present some differences. In the case of Mendicino et al. (2020), higher capital requirements generate two partially offsetting effects: on the one hand, they reduce the probability of bank failures, which lowers the cost of debt financing for banks; on the other

[29] One exception is the case of the Central Bank of Chile (2024b) for Chile, where some regressions are run by using credit size as the weights.

hand, they increase the share of equity financing, which is more costly. When the probability of bankruptcy is high, in the face of small increases in capital requirements, the first effect dominates, resulting in an increase in credit, along with investment and output. However, when the increase in requirements is large enough, the second effect dominates and causes reductions in credit, investment and output.

Elenev et al. (2021), in turn, also find that higher capital requirements increase the share of equity financing, but, unlike Mendicino et al. (2020), the reduction in the cost of financing with debt for banks is a second-order effect.[30] As a result, the effects of higher capital requirements in this study are monotonic: as requirements increase, credit, investment and output decrease.

Beyond their differences, both studies coincide when analyzing levels of capital requirements similar to those established in Basel III, showing similar results in terms of the impact on the economy.

In addition, Elenev et al. (2021) compare the long-term effects of static capital requirements of 7% with countercyclical capital buffers ranging from 5% to 9%.[31] They find that, under a countercyclical regime, both aggregate credit and the probability of bank failure increase, but so do output and investment. This is so because, with countercyclical buffers, the banks' capital constraint becomes binding less frequently, resulting in lower macroeconomic volatility and thus lower credit spreads.

Finally, Mendicino et al. (forthcoming) analyze the effects of capital requirements in times of crisis, focusing on the use of countercyclical buffers. These introduce mutually offsetting effects: on the one hand, by allowing capital requirements to be reduced during recessions, they help mitigate credit and output declines; on the other hand, they also increase the probability of bank failures. However, the authors find that, jointly, the use of countercyclical capital buffers in financial crises leads to a smaller initial drop in credit and output. Moreover, the stabilizing effects of these buffers are stronger when static capital requirement levels are higher, as they allow stabilizing the supply of credit with a lower impact on the probability of bank failures.

[30] In the case of Mendicino et al. (2020), only a fraction of deposits is insured, while the rest of the deposits are valued based on the potential losses associated with the risk of failure of an average bank. Therefore, a lower probability of failure directly impacts the price of banks' uninsured debt. In the case of Elenev et al. (2021), total deposits are insured, so a lower probability of failure does not directly affect the price of debt for banks and the only impact on the price is of general equilibrium.

[31] This should be understood as a 2pp adjustment above and below the static capital requirement level.

Box 2: Interaction between capital requirements and monetary policy

This box examines the available literature on how the implementation of capital requirements interacts with monetary policy, complementing the discussion presented in the Economic and Financial Series 2021. In particular, it delves into how both policies are used according to their objectives, what are the different schemes of simultaneous use and their potential macroeconomic effects at a theoretical level. The structurally estimated effects on credit and the macroeconomy of the interaction of both policies are also reviewed.

Patterns and effects of simultaneous use of financial policy and monetary policy

Carrillo et al. (2021) analyze theoretically and based on simulations, different regimes where monetary policy (MP) and financial policy (FP) interact, in an environment of risk shocks.[32] In this case, FP is an instrument that limits or stimulates the credit granted by banks, which can be considered (in stylized form) as an implementation of capital requirements. Thus, the following cases are considered:

(1) A dual-target policy: Monetary policy, represented by a Taylor rule, extended to consider spreads between loan and deposit rates.

(2) Two policies, two targets (Tinbergen's rule):[33]

(2.1) No coordination: Each policy has an individual target (inflation and financial stability) and acts independently.

(2.2) Leader and follower: MP takes FP as a given (or FP takes MP as a given).

(2.3) Constant coordination: the elasticities of MP and FP to each of their targets are optimized jointly.

Among these possibilities, Carrillo et al. (2021) conclude that the use of two instruments for two policy targets dominates in welfare over a single policy instrument for two targets. Within this use of two policies, a scenario where the MP takes FP as a given generates higher welfare than no coordination between the two policies. This scenario makes sense in practice, because the frequency of changes in capital requirements according to the state of the economy (activation, release, and holding at a constant level) is lower than that of changes in the MPR. Carrillo et al. (2021) show that, theoretically, constant coordination is better in terms of welfare than the other two coordination alternatives. However, this is based on assumptions that there are no adjustment costs to macro-prudential policy.

Acosta-Henao et al. (2020) empirically document that the implementation of macro-prudential instruments in emerging economies exhibits high persistence and low variability, which provides evidence of the costs of adjusting this type of instruments with high frequency. This study also shows, based on calibrations of a theoretical model, that the presence of these costs limits the welfare gains that, in the case of coordination between MP and FP, could result from constant coordination. Thus, when implementing both policies simultaneously, it is more efficient to implement a regime where MP takes FP as a given, and where each instrument aims at achieving a corresponding objective.

[32] A risk shock in this context refers to an increase in the dispersion of returns on a firm's assets, which increases their probability of default and, therefore, widens credit spreads.

[33] Tinbergen's rule is the notion that you can use as many policy instruments as you have policy objectives.

Structural estimations of simultaneous implementation of both policies

Different studies have estimated the effects on macroeconomic and financial variables of the simultaneous implementation of monetary policy, through the monetary policy rate, and capital requirements. Angelini et al. (2014) estimate a DSGE model for the United States with both policy instruments. In line with Carrillo et al. (2021), they find that implementing two policies is better at the macroeconomic and financial stability level than having only one policy with two targets. Also, minimal coordination is superior to a scenario of no coordination, in terms of reducing the volatility of the business cycle and providing greater financial stability. In this sense, when the state of the economy requires economic stabilization, Martinez-Miera and Repullo (2019) document that MP has greater effects than FP. In turn, when the state requires financial stabilization, FP has greater effects than MP. This supports the theoretical result, where each policy targets its corresponding objective, given a certain level of coordination. This in turn dominates in welfare a scenario with no coordination and, even more so, a scenario of a single policy with two objectives.

Challenges and future research agenda

These theoretical results provide valuable lessons for the implementation of the MP and FP, especially capital requirements. In normal times, MP focuses on price stability, for which it relies on the benchmark rate, and FP contributes to financial stability, one of its instruments being the CCyB (Central Bank of Chile, 2021). However, the literature still has room for studying other relevant interactions. Prominent among them is the interaction of MP, capital requirements, and other policies of a non-conventional nature. This is relevant during crises, when the need may arise to implement this type of unconventional policies, such as those adopted during the Covid-19 crisis, seeking to preserve the normal functioning of the financial system, supporting monetary policy transmission and economic recovery (Central Bank of Chile, 2021).Some examples are special conditional credit facilities (such as the FCIC implemented by the Central Bank of Chile during the pandemic) or guarantees granted to credits taken by firms (such as the Fogape-Covid program established by the Chilean government). These unconventional policy tools emerge endogenously in the presence of frictions that justify them, such as financial frictions of banks or households (Céspedes et al., 2017). In this sense, the Central Bank of Chile continues to actively pursue the development and implementation of a research agenda focused on the structural and empirical study of the implementation of these unconventional policy tools in conjunction with the MP via the MPR and capital requirements.

4. POLICY IMPLICATIONS

As an outcome of the above analysis, the following policy implications result from this discussion note:

1. In order for the transition to higher capital requirements (both static and dynamic), such as those contained in Basel III, to be met at the lowest cost in terms of the provision of credit to the real sector, it is desirable that it be done gradually, as has been the case in Chile.

2. According to the evidence, the CCyB is an effective macro-prudential tool that strengthens the resilience of the financial system and preserves its capacity to provide credit to the real sector in the face of adverse shocks, thus contributing to greater financial stability.

3. The evidence is consistent with CCyB having beneficial effects during crises and limited effects during their activation. However, given the considerations presented above, these results should be interpreted with caution.

4. The implementation of two policy instruments, monetary and financial, is better for achieving two objectives (price stability and financial stability) than a single instrument with two simultaneous objectives. Because frequent adjustment costs of macro-prudential tools exist, an implementation where monetary policy takes financial policy as a given for its execution is found to be more appropriate.

REFERENCES

Acosta-Henao, M., L. Alfaro y A. Fernández (2020). "Sticky capital controls". NBER Working Paper No.26997.

Aiyar, S., C.W. Calomiris y T. Wieladek (2016). "How does credit supply respond to monetary policy and bank minimum capital requirements? European Economic Review 82: 142–65.

Angelini, P., S. Neri y F. Panetta (2014). "The interaction between capital requirements and monetary policy." Journal of Money, Credit and Banking 46(6): 1073–112.

Avezum, L., Oliveira, V., y D. Serra (2023). "To use or not to use? Capital buffers and lending during a crisis." Banco de Portugal Economics and Research Department Working Papers No. 202308.

Avezum, L., V. Oliveira y D. Serra (2024). "Assessment of the effectiveness of the macroprudential measures implemented in the context of the Covid-19 pandemic." International Review of Economics and Finance 93: 1542–55.

Banco Central de Chile (2021). "Intermediación financiera y banca central en Chile." Serie Económica y Financiera.

Banco Central de Chile (2024a). "Efecto del crédito en el desempeño de las empresas." Nota de Discusión N°7.

Banco Central de Chile (2024b). "Efectos de políticas recientes en la oferta de crédito comercial bancario". Recuadro III.1, IEF, primer semestre.

Banco Central de Chile (2024c). "Evolución de los requerimientos de capital bancario en Chile y desarrollo de pruebas de tensión basadas en capital básico". Recuadro IV.1, IEF, primer semestre.

Basel Committee on Banking Supervision (2021). Early lessons from the Covid-19 pandemic on the Basel reforms.

Basel Committee on Banking Supervision (2022). "Buffer usability and cyclicality in the Basel framework."

Bedayo, M. y J. Galán (2024). "The impact of the Countercyclical Capital Buffer on credit: Evidence from its accumulation and release before and during Covid-19." Banco de España Working Paper No.2411.

Behn, M., M. Forletta y A. Reghezza (2024). "Buying insurance at low economic cost – the effects of bank capital buffer increases since the pandemic." ECB Working Paper No.2951.

Behn, M., R. Haselmann y P. Wachtel (2016). "Procyclical capital regulation and lending." Journal of Finance 71(2): 919–56.

Berger, A.N., R. DeYoung, M.J. Flannery, D. Lee y Ö. Öztekin (2008). "How do large banking organizations manage their capital ratios? Journal of Financial Services Research 34: 123–49.

Bernanke, B., M. Gertler y S. Gilchrist (1999). "The financial accelerator in a quantitative business cycle framework." Handbook of Macroeconomics, Volume 1C, 1341-93.

Berrospide, J.M. y R.M. Edge (2024). "Bank capital buffers and lending, firm financing and spending: What can we learn from five years of stress test results?" Journal of Financial Intermediation 57: 101061.

Bloom, N. (2014). "Fluctuations in uncertainty." Journal of Economic Perspectives 28(2): 153–76.

Bridges, J., D. Gregory, M. Nielsen, S. Pezzini, A. Radia y M. Spaltro (2014). "The impact of capital requirements on bank lending." Bank of England Working Paper No.486.

Carrillo, J.A., E.G. Mendoza, V. Nuguer y J- Roldán-Peña (2021). "Tight money-tight credit: coordination failure in the conduct of monetary and financial policies." American Economic Journal: Macroeconomics 13(3): 37–73.

Cappelletti, G., A.P. Marques y P. Varraso (2024). "Impact of higher capital buffers on banks' lending and risk-taking in the short-and medium-term: Evidence from the euro area experiments." Journal of Financial Stability 72: 101250.

Céspedes, L. F., Chang, R., y Velasco, A. (2017). "Financial intermediation, real exchange rates, and unconventional policies in an open economy." Journal of International Economics, 108, S76-S86.

Couaillier, C. (2021). "What are banks' actual capital targets?" ECB Working Paper No.2618.

Couaillier, C., M. Lo Duca, A. Reghezza y C. Rodriguez D'Acri (por aparecer). "Caution: Do Not Cross! Distance to Regulatory Capital Buffers and Corporate Lending in a Downturn." Journal of Money, Credit and Banking.

Couaillier, C., A. Reghezza, C. Rodríguez D'Acri y A. Scopelliti (2022). How to release capital requirements during a pandemic? Evidence from euro area banks. ECB Working Paper No.2720.

De Jonghe, O., H. Dewachter y S. Ongena (2020). "Bank capital (requirements) and credit supply: Evidence from pillar 2 decisions." Journal of Corporate Finance 60: 101518.

Diamond, D.W. y P.H. Dybvig (1983). "Bank runs, deposit insurance, and liquidity." Journal of Political Economy 91(3): 401–19.

Dursun–de Neef, H.Ö., A. Schandlbauer y C. Wittig (2023). "Countercyclical capital buffers and credit supply: evidence from the Covid–19 crisis." Journal of Banking and Finance 154: 106930.

Elenev, V., T. Landvoigt y S. Van Nieuwerburgh (2021). "A macroeconomic model with financially constrained producers and intermediaries." Econometrica 89(3): 1361–418.

Fang, X., D. Jutrsa, S.M. Peria, A.F. Presbitero y K, Ratnovski (2022). "Bank capital requirements and lending in emerging markets: The role of bank characteristics and economic conditions." Journal of Banking and Finance 135: 105806.

Flannery, M.J. y K.P. Rangan (2008). "What caused the bank capital build–up of the 1990s?" Review of Finance 12(2): 391–429.

Fraisse, H., M. Lé y D. Thesmar (2020). "The real effects of bank capital requirements." Management Science 66(1): 5–23.

Gropp, R. y F. Heider (2010). "The determinants of bank capital structure." Review of Finance 14(4): 587–622.

Gropp, R., T. Mosk, S. Ongena y C. Wix (2019). "Banks' response to higher capital requirements: Evidence from a quasi–natural experiment." Review of Financial Studies 32(1): 266–99.

Hanson, S.G., A.K. Kashyap y J.C. Stein (2011). "A macroprudential approach to financial regulation." Journal of Economic Perspectives 25(1): 3–28.

Inzunza, A. y P. Toro (2024). "Holguras de capital y efectividad del requerimiento de capital contracíclico." Minuta, Banco Central de Chile.

Jiménez, G., S. Ongena, J.L. Peydró y J. Saurina (2017). "Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the Spanish dynamic provisioning experiments." Journal of Political Economy 125(6): 2126–77.

Juelsrud, R.E. y E.G. Wold (2020). "Risk–weighted capital requirements and portfolio rebalancing." Journal of Financial Intermediation 41: 100806.

Kareken, J.H. y N. Wallace (1978). "Deposit insurance and bank regulation: A partial–equilibrium exposition." Journal of Business 413–38.

Kashyap, A.K. y J.C. Stein (2004). "Cyclical implications of the Basel II capital standards." Economic Perspectives–Federal Reserve Bank Of Chicago 28(1): 18–33.

Kiyotaki, N. y J. Moore (1997). "Credit cycles." Journal of Political Economy 105(2): 211–48.

Khwaja, A. I., y A. Mian (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. American Economic Review, 98(4), 1413-1442.

Lang, J.H. y D. Menno (2023). "The state–dependent impact of changes in bank capital requirements." ECB Working Paper No.2828.

Malovaná, S., M. Hodula, J. Bajzík y Z. Gric (2024). "Bank capital, lending, and regulation: A meta-analysis." Journal of Economic Surveys 38(3): 823–51.

Martinez–Miera, D. y R. Repullo (2019). "Monetary policy, macroprudential policy, and financial stability." Annual Review of Economics 11(1): 809–32.

Mathur, A., M. Naylor y A. Rajan (2023). "Creditable capital: macroprudential regulation and bank lending in stress." Bank of England Working Paper No.1011.

Mendicino, C., K. Nikolov J. Rubio–Ramirez, J. Suarez y D. Supera (por aparecer). "Twin Defaults and Capital Requirements." Journal of Finance

Mendicino, C., K. Nikolov, J. Suarez y D. Supera (2020). "Bank capital in the short and in the long run." Journal of Monetary Economics 115: 64–79.

Mésonnier, J.S. y A. Monks (2015). "Did the EBA capital exercise cause a credit crunch in the euro area?" International Journal of Central Banking 11(3): 75–118.

Myers, S.C. (1977). "Determinants of corporate borrowing." Journal of Financial Economics 5(2): 147–75.

Peek, J. y E. Rosengren (1995). "Bank regulation and the credit crunch." Journal of Banking and Finance 19(3–4): 679–92.

Repullo, R., y J. Suarez (2013). The procyclical effects of bank capital regulation. The Review of Financial Studies, 26(2), 452-490.

San Millán, M. (2024). "Evidencia sobre la Usabilidad de Colchones de Capital Bancario." Minuta, Banco Central de Chile.