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Tomás Gómez
Alejandro Jara
David Moreno

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Tomás Gómez
Central Bank of Chile

Alejandro Jara
Central Bank of Chile

David Moreno
Central Bank of Chile

Abstract

In this paper, we study whether prudential and monetary policy interactions play a role in the dynamic of domestic banks' lending growth rates in Chile. We look at a group of internationally active banks during 2000q1-2017q4. We ask whether the stance of domestic prudential (monetary) policies in Chile changes international monetary (prudential) policy spillovers and if the transmission of domestic monetary policy shocks to bank credit is affected by the stance of domestic prudential policy. We stress the importance of analysing each prudential policy separately, as results may vary due to banks' exposure to such policies as well as different mechanisms of transmission in place. Overall, tight foreign-currency reserve requirements seem to dampen the transmission of foreign monetary policy shocks significantly, while reinforcing that of local monetary policy. However, this result is less robust for other prudential policies considered. Finally, adverse spillovers from tightening capital requirements abroad may be amplified by a tight monetary policy at home.

Resumen

En este artículo, estudiamos si las interacciones entre la política monetaria y macroprudencial juegan un rol en la dinámica de las tasas de crecimiento del crédito bancario en Chile. El análisis se centra en un grupo de bancos internacionalmente activos durante el período 2000q1-2017q4. Nos preguntamos si la orientación de las políticas prudenciales (monetarias) domésticas en Chile cambia los efectos indirectos (spillovers) de la política monetaria (prudencial) internacional, y si la transmisión de las perturbaciones de la política monetaria doméstica al crédito bancario en Chile se ve afectada por la orientación de la política macroprudencial doméstica. Destacamos la importancia de analizar cada política macroprudencial por separado, ya que los resultados pueden variar debido a la exposición de los bancos a dichas políticas, así como a los diferentes mecanismos de transmisión existentes. En general, requerimientos de reservas en moneda extranjera más restrictivos parecen amortiguar significativamente la transmisión de perturbaciones de la política monetaria extranjera, al tiempo que refuerzan el impacto de la política monetaria local. Sin embargo, este resultado es menos robusto para otras políticas prudenciales consideradas. Finalmente, las repercusiones negativas derivadas del endurecimiento de los requisitos de capital en el extranjero pueden verse amplificadas por una política monetaria doméstica más estricta.

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Gómez: tgomez@bcentral.cl; Jara: ajara@bcentral.cl; Moreno: dmoreno@bcentral.cl.

1 Introduction

Under perfect capital mobility and free-floating currency regime, foreign exchange rates adjust to absorb foreign shocks. In consequence, one should not find evidence of domestic variables being affected by any international shock in such an economy. However, this ceases to be the case under financial frictions. For example, Céspedes et al. (2004) shows that if there are currency mismatches in private-sector balance sheets, risk premiums will vary due to foreign shocks regardless of the currency regime in place. Moreover, Rey (2016) challenges the Mundellian trilemma by showing that US monetary policy affects prices in many global markets, even if a floating exchange-rate regime is in place. At the same time, since the Global Financial Crisis (GFC), the consensus has moved towards the use of "macro" and "micro" prudential policies to strengthen the economies to face financial shocks. Nonetheless, their cross-border effects are just beginning to be studied, while its interaction with monetary policy has been even less explored.

In consequence, this article seeks evidence on whether foreign monetary or prudential policy spillovers to domestic banking credit vary with the stance of domestic policies, using confidential bank-level data on cross-border exposures of Chilean banks to such shocks. Chile is a small open economy with inflation targeting, capital mobility, and floating exchange rates, conforming to an adequate laboratory to test these hypotheses on cross-border transmission of shocks. Previous work on the Chilean economy, such as Albagli et al. (2018) and Gajewski et al. (2019), shows evidence of monetary policy spillovers to local bond and credit markets, respectively. However, these effects are small in magnitude, in part due to the stabilising role of institutional investors on local banks' funding (Jara and Moreno, 2018), and a floating exchange-rate regime in place since September 1999 (Albagli et al., 2018). On the part of prudential policy spillovers, Jara and Cabezas (2017) finds evidence of such spillovers through cross-border exposures, although of small magnitude as in the case of monetary policy, and not confined to intra-group cross-border claims and liabilities.

First, we look at the inward transmission of international monetary policy shocks under bank-specific capital requirements, targeting those entities that become systemically relevant as a result of mergers and acquisitions. We also approach uniform prudential policies, i.e., policies that are common to all banks. Among these policies are: (i) an increase on regulatory loan-to-value ratio (LTV) limits on mortgage loans funded through *letras de crédito*, henceforth mortgage notes, and (ii) a change (and posterior reversal) of directions on currencies accepted for the settlement of reserve requirements on banks' foreign-currency deposits. In both cases, we exploit differences across individual banking exposure to such policies, such as foreign-currency deposits and mortgage-note, which we scale by total assets or liabilities of the bank.[1/]

Second, we assess how the inward transmission of international prudential policy varies with the stance of domestic monetary policy. We construct a bank-specific index of foreign prudential policy changes,

[1/] These are the prudential policies included in Cerutti et al. (2017a) database, although other policies not considered by their authors, may be included. For example, in January 2016 the CMF raised provisioning for losses related to mortgage loans for ex-post delinquent borrowers with high leverage (for more details, see Calani, 2019). This was put in place after warnings made by the Banco Central de Chile in 2012 (see Alegría et al., 2017). Another important policy change is the authorisation in September 2012 by the regulators to issue unsecured bonds to finance mortgage loans other than those financed with endorsable mutuals or mortgage notes, although Alarcón et al. (2014) mentions a lack of interest by the mortgage-offering banks.

which are weighted by their cross-border exposure to several jurisdictions and currencies where the policy changes occur. Alternatively, we narrow our sample to foreign-owned banks and examine the transmission of prudential policy changes at the jurisdiction of the parent-bank headquarters.

Lastly, we study the domestic interaction between prudential and monetary policies; specifically, we ask whether the stance of prudential policy alters the transmission of domestic monetary policy to the domestic banking credit, i.e., the bank lending channel. In order to circumvent possible endogeneity problems, we construct measures of local monetary surprises and shocks based on the methodology developed by Vicondoa (2019) and relying on the Survey of Economic Expectations conducted by the Banco Central de Chile (BCCh).[2/]

Our results stress the importance of analysing each prudential policy separately, as results may vary due to banks' exposure to such policies as well as different mechanisms of transmission in place. Overall, tight foreign-currency reserve requirements seem to dampen the transmission of foreign monetary policy shocks significantly, while reinforcing that of local. However, this result is less robust for other prudential policies considered. Finally, negative spillovers from tightening capital requirements abroad may be amplified by a tight monetary policy at home.

In what follows, Section 2 describes the data used for estimation, including banks' characteristics, and prudential and monetary policies (domestic and international). Section 3 outlines the empirical strategies implemented, emphasising the role of the interactions between prudential and monetary policy on the dynamics of domestic banks' credit. Section 4 discusses results, and section 5 concludes.

2 Data and measurement

For our empirical strategy, we combine several data sets for the 2000-2017 period at a quarterly frequency. Bank-level information on credit volume and bank balance-sheet characteristics come from the Financial Markets Commission (CMF) of Chile[3/]; cross-border banking exposures by currency and jurisdiction come from data provided to the BCCh by the CMF, as an input to external sector statistics. Identified international monetary policy shocks for the US, UK, and the euro area are provided by the methodology team of the International Banking Research Network (IBRN), while domestic monetary policy shocks are estimated by the authors as explained in the following paragraphs. Lastly, changes in prudential policies for a large sample of countries come from Cerutti et al. (2017a), updated until 2017Q4.

2.1 The Chilean banking sector

Chilean banks differ in terms of size, business orientation, and funding structure, among other features. Given the cross-border nature of our empirical exercise, we focus on banks that are internationally active

[2/] For details, see Appendix A.

[3/] 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.

and relevant to domestic markets, classified as big and medium banks according to Jara and Oda (2015) taxonomy.[4/] These are the most relevant participants across all market segments, and they have significant cross-border exposures. However, they only differ in terms of size and balance-sheet structure. By the end of 2017, this group of banks totalled 12 institutions comprising more than 95% of total banking sector assets. Although the residence status of the banks (national/foreign) does not imbue significant differences between groups, it is crucial to mention that there are seven domestically-owned banks, while 5 are foreign-bank subsidiaries.

Our database results in an unbalanced panel, as some banks appear and disappear throughout the sample period. Since we do not rely on fictitious merged banks, we construct a binary variable to account for potential overgrowth of credit due to merges and acquisitions.[5/] Table 1 provides summary statistics on variables used in our regressions, such as quarterly credit growth rates across market segments and bank-level control variables. In both cases, the statistics are for the whole sample, as well as the sub-sample of foreign-owned banks.

2.1.1 Dependent variables

Our baseline estimations use the log quarter-on-quarter changes of loans to the private sector as the primary dependent variable.[6/] As robustness checks, we also look at loans to different market segments, such as commercial, mortgages, and consumer loans, as well as loans granted for foreign-trade transactions.[7/] We also aggregate total loans by currency of denomination: (i) pesos, (ii) inflation-adjusted pesos, and (iii) in foreign currencies. For loans in foreign currencies, we adjust them by using the average pesos to US dollars rate of the period instead of end-of-period rates, to remove significant variations due to short currency shocks. To handle outlier observations, we apply a 5% winsorization to our data and drop observations whose effective credit growth rates are either above 100 or below -100.

2.1.2 Control variables

We consider a set of banks' balance-sheet characteristics related to the asset and liability sides as control variables, which we denote as $X_{b,t}$. In particular, we include: (1) a measure of bank size, (2) liquidity ratio, (3) core deposits ratio, (4) capital adequacy ratio, and (5) a dummy equal to 1 for the bank and quarter in which a M&A process took place ($Fusion$ dummy). The size of a bank proxies economies of scale. The liquid ratio measures the capacity of banks to finance additional loans. Higher core deposit ratios and

[4/] The other groups of banks, in terms of Jara and Oda (2015) bank taxonomy, are *retail* banks, which are internationally inactive, and *treasury* banks, which are irrelevant participants in domestic credit markets. The former corresponds to domestically-owned financial institutions, small in size and focused on households' finances (consumer and mortgage loans); the latter corresponds to foreign-bank affiliates specialised on investment-banking services such as corporate-finance business and derivatives.

[5/] 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, as described in Ahumada and Marshall (2001), the most significant mergers and acquisitions occurred during the 1990s and early 2000s, and therefore do not alter the results in this study.

[6/] Although these include lending to the financial sector, particularly interbank loans, they represent a tiny fraction.

[7/] We present foreign-trade loans in three different units: in *UF* (*unidades de fomento*, an inflation-adjusted unit), adjusted by purchasing power parity (PPP), and in pesos using current pesos to US dollars rates.

capitalisation may lower financing costs to the bank, and affect credit provision. Finally, the *fusion* dummy controls for possibles outliers in the credit growth rates after merge. Table 1 provides summary statistics on variables used in our regressions, credit growth across different market segments and the control variables. In both cases, the statistics are presented for the whole sample as well as the sub-sample of foreign-owned banks.

2.2 Policy variables

2.2.1 Monetary policy

For international monetary policy shocks, we use quarter-on-quarter changes in monetary policy rates for the US, UK initially, and the euro area, specifically, quarter averages of daily interest rates targets, collected by the BIS, and its levels as a measure of the stance.[8/] However, to overcome identification issues arising from its use, we move to monetary policy shocks estimated for these economies, based on high-frequency identification techniques within a structural vector autoregression (VAR) setup. Structural shocks are identified using unexpected changes in monetary policy expectations around their announcements. In particular, US monetary shocks were estimated by extending the sample period in Gertler and Karadi (2015). The monetary policy surprise, in turn, corresponds to the change in the three-month ahead Fed Funds futures rate within a 30-minute window around Federal Open Market Committee (FOMC) announcements, which is used in turn to identify structural monetary policy shocks as in Gürkaynak et al. (2005). For the UK, these were estimated by extending the sample period in Gerko and Rey (2017), using monetary policy surprise measures. Finally, the euro area monetary shocks were estimated by applying the same setup as for the US, using the euro area overnight indexed swap rates from Andrade and Ferroni (2018).

For the domestic monetary policy stance, we rely on the TPM (*tasa de política monetaria*), which targets daily interbank interest rates. To account for endogeneity issues, we calculate TPM surprises as the difference between actual and expected TPM using monthly data from the monthly Survey of Economic Expectations, and then identify shocks using new methodology presented by Vicondoa (2019), which relies on OLS estimation allowing simpler calculations, although this same strategy evidences that at shorter horizons, shocks are equivalent to TPM surprises; in other words, it suffices to use TPM surprises to obtain a time series of identified monetary shocks.[9/] Table 2 summarises monetary policy variables used in our empirical analysis. Notice that changes in monetary policy stance are particularly more volatile than the rest of the measures shown. This characteristic is not the case, although for international monetary policy changes and shocks, which present similar degrees of volatility.

[8/] For the US, the monetary policy interest rate corresponds to the mid-point of the Federal Reserve target rate; for the UK, it is the repo rate until 2006 and the official bank rate since that year onward; and for the euro, it is the minimum bid rate.

[9/] For more details on the methodology, see Appendix A.

Table 1: Summary statistics on bank-level data

This table shows statistics for credit growth rates and other characteristics for the 15 medium and big banks in Chile and the subgroup of foreign-owned entities, during the 2000q1-2017q4 period.

	All banks					Foreign-owned banks				
	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max
Credit growth rates										
Total	7.9	7.7	11.3	-14.4	32.1	7.6	7.3	11.7	-14.4	32.1
Commercial	7.5	6.9	12.7	-15.9	34.1	6.5	5.9	13.9	-15.9	34.1
Foreign-trade (in *UF*)	6.3	3.3	53.0	-87.0	108.7	7.8	7.5	55.7	-87.0	108.7
Foreign-trade (at PPP)	3.2	0.8	52.7	-88.8	103.8	4.6	4.5	55.3	-88.8	103.8
Foreign-trade (in USD)	5.4	4.4	43.3	-72.9	91.1	7.1	6.4	46.2	-72.9	91.1
Mortgage	10.1	10.0	13.1	-19.6	36.0	9.0	9.8	12.4	-19.6	36.0
Consumer	9.4	8.2	15.3	-20.8	44.6	9.7	8.1	13.0	-20.8	44.6
In local currency	11.9	10.0	18.5	-21.5	51.6	11.1	10.2	17.8	-21.5	51.6
In inflation-adjusted units	5.3	5.8	14.2	-28.2	37.3	4.7	5.6	13.8	-28.2	37.3
In foreign currency	9.8	7.6	45.8	-71.8	103.5	11.0	10.5	49.8	-71.8	103.5
Bank-level Controls										
Size	12.4	12.4	1.1	9.1	14.2	12.4	12.4	0.9	10.8	14.2
Liquidity ratio	16.6	15.5	7.0	2.6	43.5	15.4	13.7	7.0	4.2	43.5
Deposit ratio	57.0	57.6	8.5	23.3	80.0	54.0	53.7	6.5	39.4	70.4
Capital adequacy ratio	12.8	12.4	2.3	9.2	25.6	13.7	12.9	3.1	10.0	25.6
Fusion dummy	0.0	0.0	0.1	0.0	1.0	0.0	0.0	0.1	0.0	1.0

2.2.2 Prudential policies

As mentioned before, prudential policy changes come from Cerutti et al. (2017a). Table 3 summarises the data included in our sample. LTV limits present only one change (a loosening) during 2000q1-2017q4, which represents less than 1% of the periods, while reserve requirement for foreign-currency deposits changed twice (one tightening and one loosening). Additionally, we include also capital requirements for banks that become systemic after a process of mergers and acquisitions, which are heterogeneous and may provide insights on the effects of tighter capital requirements in the transmission of international monetary-policy spillovers.

When looking at prudential changes overseas, a much higher variation is perceivable for the aggregate prudential index ($PruC$), compared to capital requirements. For the overall sample, banks were exposed to changes abroad in 17% of all country-time observations, while foreign-owned in 13%. Most changes correspond to policy tightening and took place during the second half of the sample (see figure 1).

For the case of Chile, we will focus on the three previously mentioned prudential policies. First, we rely on bank-specific capital requirements, which is higher for banks that have become systemically relevant as a result of a merger, in place since 1995.[10/] Second, we explore an increase in the loan-to-value (LTV) ratios cap on mortgage loans granted by notes (*letras de crédito*, hereafter mortgage notes) from 75% to 100%. This increase occurred in August 2009 and has remained at this level ever since. Also, (ii) a change in the rules about the currency of settlement for reserve requirements on foreign-currency bank deposits introduced temporarily between October 2008 and February 2010, which allowed the settlement with euros and yens, and not only US dollars which are the customary regulation. In these two cases, we exploit differences in banking exposure to those policies, such as the share of deposits denominated in foreign-currency deposits and the share of mortgage loans granted by mortgage-notes.[11/]

2.3 Transmission channels

2.3.1 Domestic channels

In order to identify the effect of homogeneous prudential policies, we evaluate different channels of transmission, which capture the banks' exposure to a specific prudential policy. In particular, for LTV-limit changes, we use banks' balance sheets to calculate the relative importance of mortgage notes (*letras de crédito*), as a percentage of total mortgage loans, and total loans. To measure banks' exposure to changes in foreign-currency deposits reserve requirement, we take the total foreign-currency deposits as a share of core-capital (K) and total assets (A).

[10/] Since January 2002 and July 2002, Banco de Chile and Banco Santander-Chile face a minimum capital ratio of 10% and 12% respectively, compared to an 8% in place for a regular bank. More recently, as of April 2016, Corpbanca absorbed Banco Itaú, and her capital requirement increased to 10%, as was the case with Banco de Chile.

[11/] It is worth mentioning that the share of mortgage notes over total mortgages was sharply decreasing before this change. According to Alegría et al. (2017), a reason is the combination of higher credit demand and larger flexibility offered by non-endorsable mortgage loans in terms of LTV and DTI limits, length of term, interest rates, and minimum down-payment requirements. This shift coincides with the introduction, in November 2002, of a transaction tax exemption to loan re-negotiations.

Table 2: Summary statistics on monetary policy measures

This table presents the main statistics of different measures of monetary policy for Chile, US, UK and the euro area for the 2000q1-2017q4 sample period.

	Mean	Median	St. Dev.	Min	Max
Domestic monetary policy					
Level	3.99	4.00	1.76	0.50	8.25
Change	-0.11	0.00	0.93	-6.00	1.50
Change in 6-month expected level	0.00	0.00	0.22	-0.75	0.75
Shock to 6-month expected level	0.00	0.00	0.19	-0.58	0.64
Surprise in current month	-0.01	0.00	0.12	-0.33	0.31
International monetary policy shocks					
US change	-0.07	-0.06	0.37	-0.88	0.74
US shock	-0.09	0.00	0.45	-1.42	0.54
UK change	-0.02	-0.03	0.36	-0.91	0.92

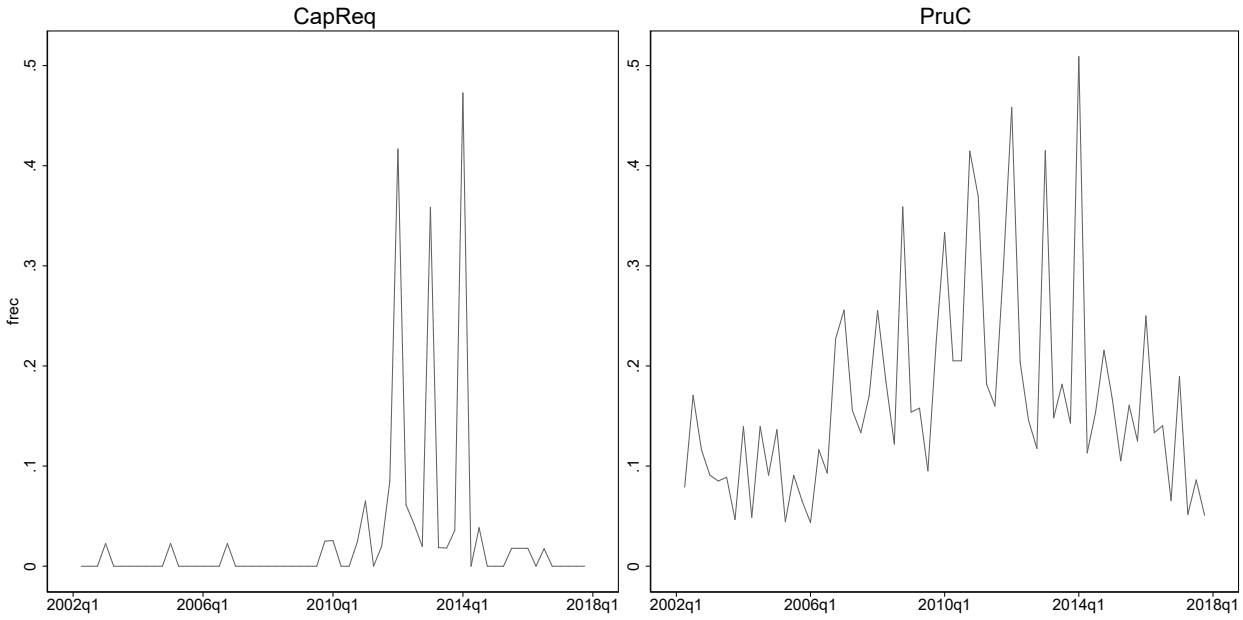
Table 3: Summary statistics on changes in domestic and foreign prudential policy

This table shows the changes in prudential policies between 2002 and 2017. "Origin" refers to country where the headquarters of the foreign bank are located. In the same way, reports the changes of prudential regulation in United States, United Kingdom and the euro area.

	Nr. of country-time changes			Share of non-zero
	Total	Pos.	Neg.	MPP
Domestic (Chile):				
LTV limits	1	0	1	0.01
FX deposits reserve req.	2	1	1	0.03
Foreign:				
Capital requirements	95	93	2	0.03
Aggregate index ($PruC$)	504	344	160	0.17
In country of origin:				
Capital requirements	8	8	0	0.02
Aggregate index ($PruC$)	44	30	14	0.13

Figure 1: Frequency of prudential policy changes

These figures show the share of 62 countries in the sample that implemented prudential policy changes between 2002 and 2017.



Source: Authors' elaboration.

Figures 2 and 3 shows the banks' distribution of these channels over the sample period, before and after the prudential policy changed (see the vertical solid line). Figure 2 shows a systematic decrease in mortgage notes as a funding source for mortgage lending, with a slight deceleration after the LTV limit increases (a prudential policy loosening) by the end of 2009. Figure 3, on the other hand, shows that the share of foreign-currency deposits was increasing before the change in the foreign-currency deposit reserve requirement policy. The first vertical solid line represents the initial loosening in the prudential policy, while the second represents the reversal of such change, i.e., a tightening. The combined effect shows a definite impact, resulting in a lower reliance on foreign-currency deposits as a source of bank funding.

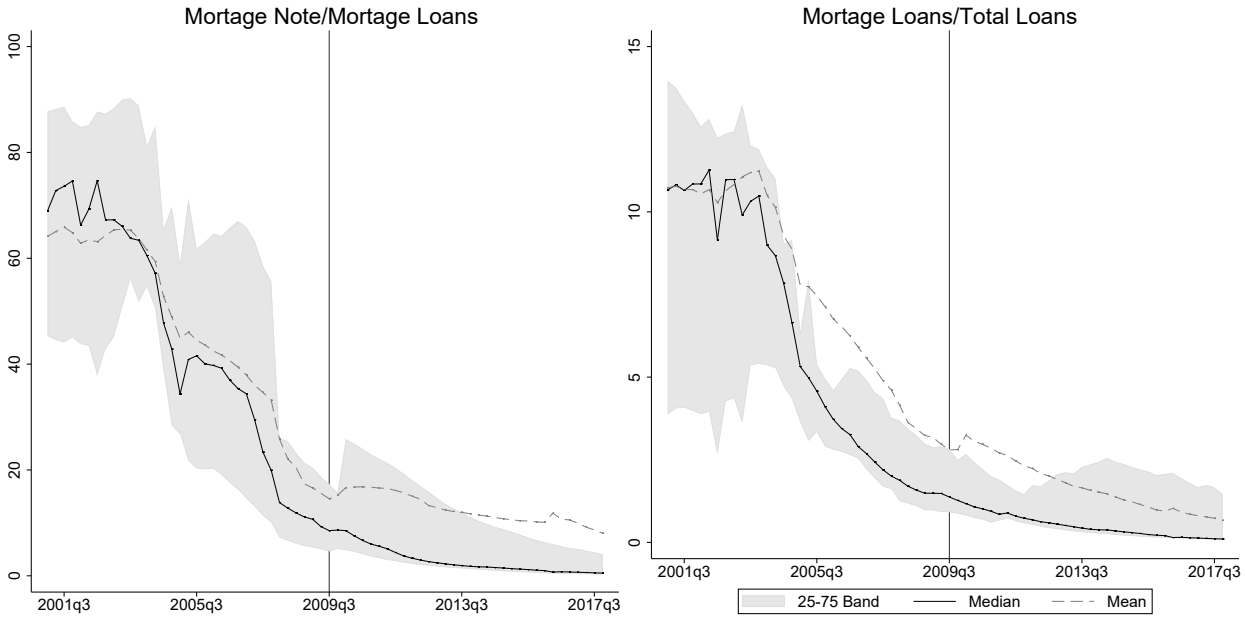
2.3.2 Cross-border channels

To capture banks' cross-border exposure to international monetary and prudential policy shocks, we rely on confidential bank-level data reported quarterly to the Central Bank of Chile. This information is used as an input for Balance of Payments and BIS locational cross-border banking statistics.[12/] This consists of individual bank information on assets, liabilities, and contingent claims held *vis-à-vis* non-residents. This information can be separated into intragroup and total exposures, by counterpart country and currency of denomination, and allows us to construct a ratio of gross liabilities to total activity, which is measured by

[12/] Banks report to the CMF their cross-border exposures using the C17 file. For a description of C17 files, go to page 64 of https://www.sbif.cl/sbifweb3/internet/archivos/norma_203_1.pdf.

Figure 2: Exposure to LTV policy

These figures show the distribution of two transmissions channels for LTV policy changes between 2000 and 2017. The vertical line in 2009q3 represents the loosening of domestic LTV policy.

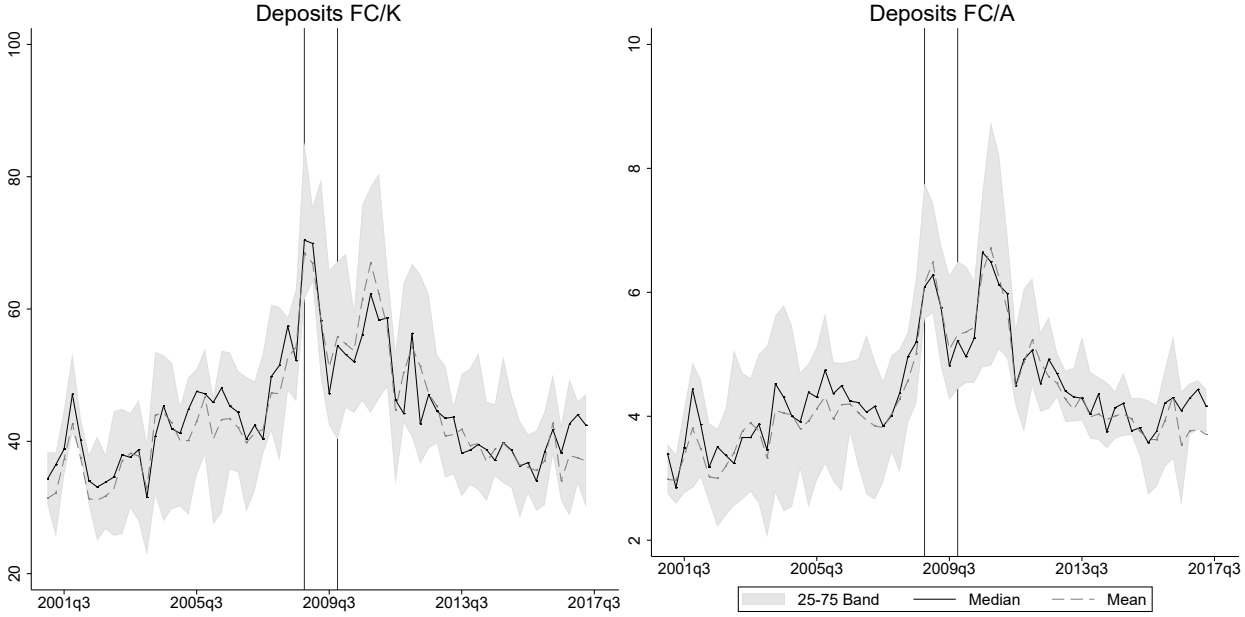


Source: Authors' elaboration.

the relative sum of liabilities and assets that each bank holds in a particular country. It is worth mentioning that, for Chilean banks, 90% of all external exposures are denominated in US dollars, consistent with the paradigm of dominant currency (Gopinath et al., 2019; Gopinath and Stein, 2019).

Figure 3: Exposure to foreign currency deposits

These figures show the distribution of the two transmissions channels for reserve requirements policy changes between 2000 and 2017. The vertical lines in 2008q4 and 2009q4 represents the loosening and subsequent tightening in the local foreign-currency deposit reserve requirement policy.



Source: Authors' elaboration.

Table 4: Summary statistics on bank-specific exposure-weighted foreign monetary and prudential policy

This table presents the main statistics of different measures of exposure weighted monetary and prudential policy indicators (see the Appendix for details). This table is constructed for the 2002q1-2017q4 sample period.

	Mean	Median	St.Dev.	Min	Max
By currency of exposure					
Monetary change	0.00	0.00	0.04	-0.26	0.41
Monetary shock	-0.01	0.00	0.06	-0.72	0.20
By jurisdiction					
Overall capital requirements					
Loans, deposits, and others	2.78	0.00	12.76	0.00	99.67
Loans and deposits	2.81	0.00	12.83	0.00	99.67
Intragroup-weighted capital requirements					
Loans, deposits, and others	0.85	0.00	8.31	0.00	100.00
Loans and deposits	0.74	0.00	7.55	0.00	100.00
Overall *PruC*					
Loans, deposits, and others	4.37	0.21	15.38	-69.18	98.47
Loans and deposits	4.51	0.28	15.90	-72.48	98.47
Intragroup-weighted *PruC*					
Loans, deposits, and others	0.71	0.00	9.29	-100.00	100.00
Loans and deposits	0.70	0.00	9.57	-100.00	100.00

3 Empirical strategy

This section describes the strategies used to analyse the interactions of monetary and prudential policy. Specifically, we explore whether the stance of domestic prudential (monetary) policy alters monetary (prudential) policy spillovers to the resident bank's domestic lending growth rates. Also, we study whether the stance of domestic prudential policy alters domestic monetary policy transmission to resident bank's domestic lending growth rates, i.e., bank-lending channel. To identify these effects, we rely on banks' different exposure to those policies and use monetary policy shocks, estimated using state-of-the-art techniques.

3.1 Inward transmission of external monetary policy and domestic prudential policy stance

A key policy question is whether domestic prudential policy may shield local banks' credit markets from the global financial cycle. To tackle this issue, we analyse heterogeneous and homogeneous domestic prudential policies separately. The former considers requirements that vary across banks, such as systemic bank surcharges, while the latter comprises those that are uniform across banks, such as LTV limits or reserve requirements. To proxy changes in the global financial cycles, we rely on identified monetary policy shocks from centre economies, as in Rey (2015). Since identification relies on banks' heterogeneity, the second type of prudential policy stance requires interacting a particular homogeneous prudential policy with its bank-level exposure.

For notation matters, we denote $Pru^d_{b,t}$ as the bank-specific domestic prudential policy stance, and Pru^d_t as the homogeneous domestic prudential policy stance. $\Theta_{b,t}$ represents the bank's exposure to the latter. Monetary policy shocks from advanced economies are indicated by Δi^c_t, where c corresponds to the economy under study. Finally, $\Delta y_{b,t}$ will refer to domestic banks' quarterly credit growth rates.

3.1.1 Heterogeneous domestic prudential policy stance

Although banking regulation in Chile makes no distinction between banks, in terms of capital requirements and limits to risks' exposures, the General Banking Law reform of 1995 included the possibility of additional capital charges to banks that, after a merger or acquisition, can be considered systemically relevant. In the following specification, $Pru^d_{b,t}$ accounts precisely for this distinction in banks' minimum capital requirements, while the coefficient $\alpha^c_{2,k}$ captures whether the stance of this policy changes the nature of the international monetary policy spillovers to domestic banks' lending:

$$\Delta y_{b,t} = \alpha_0 + \alpha_1 Pru^d_{b,t} + \sum_{c=1}^{C}\sum_{k=0}^{K} \alpha^c_{2,k} Pru^d_{b,t} \Delta i^c_{t-k} + \alpha_4 \mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t}, \quad (1)$$

where Δi^c_{t-k} represents the monetary policy shock from country/region c, lagged k quarters up to $K = 3$, so $k \in \{0, 1, 2, 3\}$ captures the impact of changes in monetary policy contemporaneously and up to three lags. The subindex c refers alternatively to US, euro area, and/or UK; $\mathbf{X}_{b,t-1}$ is a one-quarter lagged vector

of control variables for bank-specific characteristics; f_b and f_t are individual-bank and time fixed effects, respectively. Finally, $\varepsilon_{b,t}$ corresponds to the error term.

3.1.2 Homogeneous prudential policy stance

The analysis of international monetary policy spillovers interaction with homogeneous domestic prudential policy stance Pru_t^d relies on banks' exposures specific to such policies, i.e., $\Theta_{b,t}$. Therefore, we estimate the following equation:

$$\begin{aligned}\Delta y_{b,t} &= \alpha_0 + \alpha_1 \Theta_{b,t-K-1} Pru_t^d + \sum_{c=1}^{C}\sum_{k=0}^{K} \alpha_{2,k}^c \Theta_{b,t-K-1} Pru_t^d \Delta i_{t-k}^c + \\ &\sum_{c=1}^{C}\sum_{k=0}^{K} \alpha_{3,k}^c \Theta_{b,t-K-1} \Delta i_{t-k}^c + \alpha_4 \Theta_{b,t-K-1} + \alpha_5 \mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t}\end{aligned} \tag{2}$$

Here, we focus on the coefficients $\alpha_{2,k}^c$ that capture the international monetary policy shocks impact from a given country c, i.e., Δi_{t-k}^c, on domestic lending, under a the (homogeneous) domestic prudential policy stance Pru_t^d in place, and banks' exposure to that policy.

3.1.3 A bank-specific weighted index of international monetary shocks

As an alternative to the previous specification, which considers the direct impact of international monetary policy shocks, we construct a weighted international monetary policy shock, denoted as $\Delta\widetilde{i}_{b,t}$, using the individual banks' cross-border currency exposure. An advantage of this strategy is that we overcome possible multi-collinearity problems arising from co-movement across the monetary shocks. Therefore, Δi_t^c in equations 1 and 2 is replaced by the following expression:

$$\Delta\widetilde{i}_{b,t} = \sum_{c=1}^{C} \omega_{b,t-1}^c \Delta i_t^c, \quad \omega_{b,t}^c = \frac{A_{b,t}^c + L_{b,t}^c}{A_{b,t}^* + L_{b,t}^*} \tag{3}$$

where $A_{b,t}^c$ and $L_{b,t}^c$ correspond to banks' b cross-border claims and liabilities, respectively, denominated in currency c (US dollars, sterling pounds and euros), while $A_{b,t}^*$ and $L_{b,t}^*$ correspond to total cross-border claims and liabilities, respectively, of bank b in period t. The econometric specification becomes:

$$\begin{aligned}\Delta y_{b,t} &= \alpha_0 + \alpha_1 \Theta_{b,t-K-1} Pru_t^d + \sum_{k=0}^{K} \alpha_{2,k} \Theta_{b,t-K-1} Pru_t^d \Delta\widetilde{i}_{b,t} + \\ &\sum_{k=0}^{K} \alpha_{3,k} \Theta_{b,t-K-1} \Delta\widetilde{i}_{b,t} + \alpha_4 \Theta_{b,t-K-1} + \alpha_5 \Delta\widetilde{i}_{b,t} + \alpha_6 \mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t}\end{aligned} \tag{4}$$

3.2 Inward transmission of foreign prudential-policy changes and the stance of domestic monetary policy

The second approach that looks at how the stance of domestic monetary policy modifies the transmission of international prudential changes, uses the following specification:

$$\begin{aligned}\Delta y_{b,t} \quad = \quad & \alpha_0 + \sum_{c=1}^{C}\sum_{k=0}^{K} \alpha^c_{1,k}\Theta^c_{b,t-K-1} i^d_{t-k}\Delta Pru^c_{t-k} + \sum_{c=1}^{C}\sum_{k=0}^{K} \alpha^c_{2,k}\Theta^c_{b,t-K-1}\Delta Pru^c_{t-k} + \\ & \sum_{c=1}^{C}\sum_{k=0}^{K} \alpha^c_{3,k}\Theta^c_{b,t-K-1} i^d_{t-k} + \sum_{c=1}^{C} \alpha^c_4\Theta_{b,t-K-1} + \alpha_5\mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t}\end{aligned} \tag{5}$$

Here, ΔPru^c_t refers to the quarterly change in the prudential policy of jurisdiction c in period t; recall that, as in Cerutti et al. (2017a), ΔPru^c_t is equal to one if the prudential policy is tightened, minus one if loosened, and zero if unchanged.[13/] The coefficients of triple interactions $\alpha^c_{1,k}$ capture spillovers of changes in international prudential policy of country c denoted as ΔPru^c_{t-k}, transmitted through bank b's exposure to that country c, this is $\Theta^c_{b,t}$, and interacted with the domestic monetary policy stance in Chile, denoted as i^d_t. In principle, we could evaluate the changes in prudential policy from each jurisdiction included in Cerutti et al. (2017a). Instead, we consider those relevant for Chilean banks, according to two criteria. First, we use the geographical distribution of banks' cross-border claims and liabilities in order to construct a weighted international prudential policy index. Second, we focus exclusively on foreign-owned banks and look at changes in the prudential policies from the jurisdictions where headquarters are located.

3.2.1 An international prudential policy weighted index

Let's define $\Delta\widetilde{Pru}_{b,t}$ as the weighted international prudential policy changes for bank b at time t, such that:

$$\Delta\widetilde{Pru}_{b,t} = \sum_{c=1}^{C} \omega^c_{b,t-1}\Delta Pru^c_t, \quad \omega^c_{b,t} = \frac{A^c_{b,t} + L^c_{b,t}}{A^*_{b,t} + L^*_{b,t}} \tag{6}$$

where c refers to the jurisdiction where the prudential policy change has taken place, not the currency of the country as defined in equation 5. Also, $\widetilde{Pru}_{b,t}$ varies across banks, since it uses each banks' cross-border exposure as weight. Therefore, when using weighted international prudential policy changes, equation 5 becomes:

$$\Delta y_{b,t} \quad = \quad \alpha_0 + \sum_{k=0}^{K} \alpha_{1,k} i^d_{t-k} \times \Delta\widetilde{Pru}_{b,t-k} + \sum_{k=0}^{K} \alpha_{2,k}\Delta\widetilde{Pru}_{b,t-k} + \alpha_3\mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t} \tag{7}$$

[13/] Although the implementation presented focuses on changes in capital requirements ($CapReq$), and the aggregate prudential index (Pru) suggested in Cerutti et al. (2017a), this framework can be used to evaluate the impact of any other policy.

3.2.2 International prudential changes in headquarters's jurisdictions

Our second strategy is to estimate equation 5 only for the sub-sample of foreign-owned banks. Here, prudential policy in country c refers to the policy of the country where the headquarters of the foreign bank is located (e.g. Banco Santander-Chile and prudential policy in Spain, or Banco Itaú with that in Brazil). We call this "prudential policy in the country of origin". In the following empirical implementation we use different $\Theta_{b,t}$ capturing cross-border exposures to country c.[14/]

3.3 Domestic transmission of local monetary policy and the domestic prudential stance

Finally, we turn to the question of whether the domestic transmission of local monetary policy shocks is affected by the stance of domestic prudential policy. We evaluate the significance of the heterogeneous prudential policy associated to higher capital requirements in section 3.3.1, and the homogeneous prudential policy associated to LTV and foreign currency reserve requirements, similarly than in section 3.3.2. As previously mentioned, domestic monetary policy shocks are identified using the methodology in Vicondoa (2019) and the data from the Economic Expectations Survey.

3.3.1 Heterogeneous prudential policy

For heterogeneous domestic prudential policies, we estimate the following equation:

$$\Delta y_{b,t} = \alpha_0 + \alpha_1 Pru^d_{b,t} + \sum_{k=0}^{K} \alpha_{2,k} Pru^d_{b,t} \Delta i^d_{t-k} + \alpha_3 \mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t} \tag{8}$$

Our coefficient of interest is α_2, which captures the effect of the interaction between the stance of the domestic prudential policy $Pru^d_{b,t}$, and the domestic monetary shock Δi^d_t.

3.3.2 Homogeneous prudential policy

We finally look at the significance of the interaction between homogeneous domestic prudential policy and domestic monetary policy shocks. As before, we capture banks' heterogeneity through their exposure to each specific prudential policy $\Theta_{b,t}$. Therefore, the focus in on coefficient α_2 of the following equation:

$$\begin{aligned} \Delta y_{b,t} = {} & \alpha_0 + \alpha_1 \Theta_{b,t-K-1} Pru^d_t + \sum_{k=0}^{K} \alpha_{2,k} \Theta_{b,t-K-1} Pru^d_t \Delta i^d_{t-k} + \\ & \sum_{k=0}^{K} \alpha_{3,k} \Theta_{b,t-K-1} \Delta i^d_{t-k} + \alpha_4 \Theta_{b,t-K-1} + \alpha_5 \mathbf{X}_{b,t-1} + f_b + f_t + \varepsilon_{b,t} \end{aligned} \tag{9}$$

[14/] Notice that if $\Theta_{b,t}$ is uniform across banks, i^d_t drops from equation 5 if time fixed effects are present.

4 Results

In this section, we discuss the results of the several econometric specifications layout in previous sections.

4.1 Does transmission of monetary policy abroad depend on domestic prudential policy?

4.1.1 Under heterogeneous domestic prudential policy

Table 5 shows the sum of estimated coefficients $\alpha^c_{2,k}$ from equation 1 which measures the joint effects of the interaction between heterogeneous prudential policy stance and the international monetary-policy shock. The results are presented separately for the US, UK, and euro-area monetary-policy shocks. We also report the jointed impact under the category "All." Finally, we consider two different definitions of monetary policy shocks: (i) changes in the effective monetary policy rate, and (ii) the shock of monetary policy as previously defined.

Table 5: Foreign monetary policy shocks under heterogeneous domestic prudential policy

This table reports results for double interaction coefficients in equation 1. It includes 15 internationally active banks in Chile during the 2000-2017 period. The heterogeneous prudential policy corresponds to additional minimum capital requirements banks that become systemic banks after a merge. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	ΔMP				Shock			
	$	€	£	All	$	€	£	All
Total	-0.06	0.06	0.06	0.06**	-0.92	-1.41	0.06	-2.28
Commercial	-0.06	0.04	0.08**	0.06**	-1.91	-1.92	-1.45	-5.27*
Mortgage	-0.04	0.12*	0.02	0.11***	1.73	-1.90	3.57	3.39
Consumer	-0.07*	0.09	0.03	0.05	1.06	0.68	2.97	4.71
Foreign-trade (in *UF*)	-0.05	-0.06	0.08	-0.02	-2.73	2.47	-4.24	-4.50
Foreign-trade (in pesos at PPP rates)	-0.05	-0.06	0.09	-0.02	-2.96	2.95	-4.51	-4.53
Foreign-trade (in current pesos)	-0.05	-0.07	0.10	-0.03	-4.10	4.64	-3.86	-3.32
Local currency (pesos)	-0.07	0.06	0.08**	0.07**	-2.32	-1.58	-0.74	-4.64
Inflation adjusted (UF)	-0.10*	0.13*	0.05	0.09**	1.72	-4.71	1.98	-1.00
Foreign currency (in current pesos)	-0.17***	0.08	0.13*	0.05	0.30	8.31	5.09	13.70*

At first, it appears that under a tighter capital-requirements stance, there is no robust significant interaction between the monetary policy abroad and higher capital requirements at home. More so for under-identified monetary policy shocks, suggesting that other macro policies might be taking care of stabilising foreign shocks effects. It is essential to acknowledge that there might be some correlation between the centre economies' monetary shocks. With this in mind, we show in Table 6 results using weighted monetary policy shocks, according to banks' cross-border currency exposures to the US, UK, and the euro area. This result shows, on the contrary, that higher capital requirements reduce negative spillovers from foreign monetary policy shocks, particularly to mortgage loans at a 1% confidence level, which is not captured by the effective change in monetary policy.

Table 6: Weighted monetary policy shocks under heterogeneous domestic prudential policy

This table reports results from equation 1 with the weighted monetary shock of the equation 3. Include 15 international active banks in Chile for the 2002-2017 sample period. The heterogeneous prudential policy represents additional minimum capital requirements for systemic banks after merge. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Δ MP	MP shock
Total loans	0.30	2.91**
Commercial loans	-0.39	2.57*
Mortgage loans	1.32	5.01***
Consumer loans	2.44**	1.74
Foreign-trade (in *UF*)	-0.88	1.99
Foreign-trade (in pesos at PPP rates)	-1.01	2.32
Foreign-trade (in US dollars)	-1.58	2.06
In local currency	-0.11	2.29*
In inflation-adjusted units	-0.20	2.27
In foreign currency	1.85	0.13

4.1.2 Under homogeneous domestic prudential policy

The results of estimating equation 2 are presented in Table 7, which delves on LTV stance, and in Table 9, which looks at reserve requirements on foreign-currency deposits. As previously, these tables show the sum of coefficients associated with the triple interaction terms in equation 2. Notice that we evaluate two types of monetary policy shocks, and two types of channels.

In Table 7, it appears that a tighter LTV enhances negative spillovers coming from changes in monetary policy rates of advanced economies for those banks with a higher share of mortgage notes. However, it reduces these spillovers for those banks with a higher share of all mortgages in their lending portfolios. When looking at identified monetary-policy shocks, the effects are robust only for consumer loans, which are more sensitive to economic cycles. Given that the effects are not significant for other market segments, this suggests that these might move towards investment in liquid assets or keep in cash by the bank, instead of doing so directly towards lending.

On the other hand, when looking at weighted international monetary policy shocks shown in table 8, the effects on banks with a higher share of mortgage notes in their mortgage portfolios are no longer significant. Nevertheless, adverse spillovers from monetary policy abroad are enhanced banks with a higher share of mortgages in the lending portfolio, particularly for lending in the local currency, and commercial and mortgage loans. A caveat to these results is that there is only one local prudential policy easing event throughout the sample, which might not suffice to estimate the effects of this policy throughout the cycle adequately.

Turning to the significance of the interaction between reserve requirements on foreign-currency deposits (RRFX) and foreign monetary policy shocks, Table 9 shows that under a stricter RRFX policy, negative spillovers from international monetary policy shocks are reduced. In particular, for local currency lending

Table 7: Foreign monetary policy shocks under homogeneous domestic prudential policy (LTV-regulation stance)

This table shows the sum of triple interactions in equation 2. It includes 15 international active banks in Chile for the 2000-2017 sample period. The homogeneous prudential policy represents maximum LTV ratios allowed for mortgage loans funded by mortgages notes. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Δ MP		MP shock	
	Mortgage notes to mortgage loans	Mortgage loans to total loans	Mortgage notes to mortgage loans	Mortgage loans to total loans
Total loans	-0.03***	0.03***	-0.28	-0.19
Commercial loans	-0.04***	0.05***	0.14	-0.57
Mortgage loans	-0.05***	0.07***	-0.30	0.02
Consumer loans	-0.02**	0.04**	-1.40**	2.90**
In local currency	-0.01	-0.05	0.34	-0.02
In inflation-adjusted units	0.03	0.06*	0.08	-1.31
In foreign currency	0.08	0.42**	-1.71	2.28

and commercial and mortgage loans. Moreover, foreign-currency lending is reduced, local-currency, and inflation-adjusted lending increases. These results for commercial lending are robust to the use of weighted monetary-policy shocks as presented in Table 10. Notice as well, that stricter reserve requirements for foreign-currency deposits do not alter the transmission of international monetary policies significantly shocks to domestic foreign-currency loans, and less so local-currency and inflation-adjusted bank lending.

4.2 Does transmission of prudential policy from abroad depend on domestic monetary policy stance?

Table 11 shows the results of the sum of coefficients $\alpha_{1,k}$ when estimating equation 7. Notice that international prudential policies are weighted by banks' cross-border exposures on the jurisdiction that faces a change in policy. We distinguish between overall claims and liabilities cross border exposures and those on loans and deposits, and also between total and intragroup exposures.

The most significant results are that under tighter domestic monetary policy stance, negative international spillovers coming from tightened capital requirements are amplified through the intragroup exposure, for most market segments.

Table 12 shows similar results for the sub-group of foreign-owned banks. Here, a tightening of capital requirements abroad is amplified by a tight domestic monetary policy stance, when considering their complete expositions to the country of headquarters. In contrast, results diverge when considering the intragroup exposures for overall prudential policy changes abroad, which are significant for this subset of the sample, compared to Table 11. When weighting only by loans and deposits the overall prudential changes abroad, the tightening that results is amplified by a tight monetary policy, while adding other cross-border exposures reverses the sign of the interactions. An interpretation of this result is that when

Table 8: Weighted monetary policy shocks under homogeneous domestic prudential policy (LTV-regulation stance)

This table shows results of equation 2 with the weighted monetary shock of the equation 3. Include 15 international active banks in Chile for the 2002-2017 sample period. The homogeneous prudential policy represents maximum LTV ratios allowed for mortgage loans funded by mortgages notes. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	ΔMP		Shock	
	Mortgage notes to mortgage loans	Mortgage loans to total loans	Mortgage notes to mortgage loans	Mortgage loans to total loans
Total loans	-1.50***	0.34	-0.17	-1.41***
Commercial loans	-1.69**	0.91	-0.17	-1.97**
Mortgage loans	-2.07***	1.87**	0.02	-1.78**
Consumer loans	-0.53	-1.56*	0.04	-0.76
In local currency	-0.78	1.20	0.40	-1.84**
In inflation-adjusted units	-1.86***	1.35	-0.67*	-1.40
In foreign currency	1.06	0.36	0.26	-0.77

prudential policy tightens in the country of origin, other expositions, such as international bonds, helps counteract the expected negative spillover and amplification of a tight local monetary policy, which is the case of cross-border loans and deposits.

Our second method to estimate equation 5 is focused only on foreign banks. Here, prudential policy in country c is the policy of the country where the headquarters of a foreign bank is located (policy at the country of origin). Similarly to the weighted prudential policy approach, we evaluate the channels captured by assets, liabilities, and gross banks' exposure to the country c for total and intra-group exposures.

We implement this approach for the set of prudential policies included in Cerutti et al. (2017a) and different definitions for the domestic monetary policy stance. However, for ease of exposition, we only show in Table 12 results for changes in capital requirements and $PruC$ index, both with the domestic nominal monetary policy. As well, due to the few changes in capital requirements at the moment of considering only the intragroup movements, we decided to present just the $PruC$ results in that case.

Our results show that, under several specifications, capital requirement spillovers from the country of origin of foreign banks are indeed affected by Chile's monetary policy stance. In other words, the negative effect expected on domestic lending of a tight domestic monetary policy is enhanced when banks are exposed to higher requirements at the country of origin. This result is correct for most market segments but particularly significant for consumer loans.

Table 9: International monetary policy shocks under homogeneous domestic prudential policy: reserve requirements on foreign-currency deposits

This table shows the sum of coefficients of triple interactions in equation 2. Include 15 international active banks in Chile for the 2000-2017 sample period. The homogeneous prudential policy represents the reserve requirements for foreign currency deposits. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Δ MP		MP shock	
	FC deposits to bank capital	FC deposits to total assets	FC deposits to bank capital	FC deposits to total assets
Total loans	-0.82*	-8.18*	3.16***	46.03***
Commercial loans	-1.36***	-15.93**	6.14***	90.43***
Mortgage loans	-0.81*	-8.52**	2.74**	36.25**
Consumer loans	0.42	9.68**	-0.91	-14.00
Foreign-trade (in *UF*)	0.82	18.48	-1.21	-11.70
Foreign-trade (pesos at PPP rates)	0.76	17.83	-1.29	-12.87
Foreign-trade (in US dollars)	0.19	11.05	-1.88	-21.01
In local currency	-0.96*	-11.83**	5.45***	78.26***
In inflation-adjusted units	-1.20***	-12.14**	4.70***	67.63***
In foreign currency	0.34	16.31	-3.13**	-44.80***

Table 10: Weighted monetary policy shocks under homogeneous domestic prudential policy (reserve requirements on foreign-currency deposits)

This table shows results of equation 2 with the weighted monetary shock of the equation 3. Include 15 international active banks in Chile for the 2002-2017 sample period. The homogeneous prudential policy represents maximum LTV ratios allowed for mortgage loans funded by mortgages notes. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Δ MP		MP shock	
	FC deposits to bank capital	FC deposits to total assets	FC deposits to bank capital	FC deposits to total assets
Total	8.49***	105.22***	3.20**	35.07
Commercial	14.84***	185.85***	7.65***	97.98**
Mortgage	5.89**	79.77***	1.29*	-14.83
Consumer	-1.53	-22.33	-1.43	-23.41
Foreign-trade (in *UF*)	0.68	-7.85	-3.44*	-51.90
Foreign-trade (in pesos at PPP rates)	0.68	-7.26	-3.30*	-51.38
Foreign-trade (in US dollar)	0.76	-11.48	-3.28*	-55.67
In local currency	13.70***	170.79***	4.30**	61.32*
In inflation-adjusted units	12.27***	161.93***	6.18***	72.19*
In foreign currency	2.11	-8.50	8.73***	58.74

Table 11: Weighted prudential policy shocks ($PruC$) and the domestic MP

This table reports estimations of equation 7 for 15 international active banks in Chile for the 2002-2017 sample period. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Total		Intragroup	
	CapReq	*PruC*	*CapReq*	*PruC*
	Weighted by loans, deposits, and others			
Total	0.11	-0.01	-0.69***	0.06
Commercial	0.35	0.01	-0.50**	-0.04
Mortgage	0.16	-0.01	-0.45***	-0.06
Consumer	-0.18*	0.01	-0.90***	0.19***
	Weighted by loans and deposits			
Total	0.04	-0.01	-0.62***	0.00
Commercial	0.19	0.01	-0.44*	-0.07
Mortgage	0.09	-0.01	-0.48***	0.03
Consumer	-0.15	0.02	-0.88***	0.09

4.3 Does the transmission of domestic monetary policy depend on domestic prudential policy?

4.3.1 Heterogeneous domestic prudential policy

Finally, we turn to the question of whether the transmission of domestic monetary policy shocks depends on the stance of prudential policy. We evaluate the significance of higher capital requirements surcharges for systemically important banks (see equation 8).

Table 13 shows results for different measures of domestic monetary policy changes. In particular, this table shows the joint test results for lagged interactions between monetary policy shocks and the heterogeneous prudential policy. Results are indeed significant for identified shocks and surprises; this is when unexpected monetary policy shocks occur. Under these circumstances, banks subject to higher capital requirements decrease their domestic lending in the foreign currency more after an increase in the domestic monetary policy surprise. In the case of surprise and shock at a 6-months horizon, the increase in credit comes mostly to overall credit. In local currency, some significance is found as well for lending in foreign currency and foreign trade. This result suggests that when markets expect additional tightening in the future, banks subject to higher capital requirements lend more today, to avoid funding loans at higher costs and lower margins in the future.

4.3.2 Homogeneous domestic prudential policy

Finally, tables 14 and 15 look at the significance of homogeneous domestic prudential policies, as we did before.

Table 12: Prudential policy shocks at the origin and domestic monetary policy

This table reports estimations of equation 5 for 5 foreign and international active banks in Chile for the 2000-2017 sample period. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Total		Intragroup
	CapReq	*PruC*	*PruC*
	Weighted by loans, deposits,and others		
Total	-36.73**	-0.11	35.91**
Commercial	-29.28*	-0.06	58.36***
Mortgage	-42.97**	-0.01	22.10**
Consumer	-66.65***	-0.19	29.16
	Weighted by loans and deposits		
Total	-33.11**	-0.13	-2.40**
Commercial	-33.90**	-0.00	-2.18**
Mortgage	-45.87**	-0.10	-0.70**
Consumer	-62.62***	-0.17	-1.84*
	Unweighted		
Total	2.87*	-1.30	
Commercial	-1.83	1.55	
Mortgage	7.22***	-0.92	
Consumer	6.32**	-0.83	

First, a tighter prudential policy stance in the form of LTV caps, reinforces the transmission of monetary policy at the domestic level, for banks holding a higher share of mortgage notes in their mortgage portfolio, mainly when there is a surprise in 6-month horizon monetary policy. However, interactions at shorter periods are much less robust across various segments of credit.

As for RRFX prudential policy, Table 15 shows results are significant for commercial lending -which comprises the majority of total bank credit provision- and is consistent across the various measures of monetary policy changes. This result can be interpreted as if a tighten prudential policy may help offset the transmission of monetary policy tightening at the six-month horizon while enhancing them under surprises (shocks) to current local monetary policy rates.

Table 13: Heterogeneous domestic prudential policy and domestic monetary policy shocks

This table reports the coefficient associated to $\sum_{k=0}^{K} \alpha_{2,k} \Delta i_t^d Pru_{b,t}^d$ estimations of equation 8 for 15 international active banks in Chile for the 2000-2017 sample period. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Total loans	-0.32	4.17*	6.16**	-92.16
Commercial loans	0.24	3.61	6.49*	-105.16
Mortgage loans	-0.63	-0.11	-0.31	-76.65
Consumer loans	-1.34	3.36	3.00	-68.15
Foreign-trade (in *UF*)	0.52	11.16**	15.12*	-128.99**
Foreign-trade (in pesos, at PPP rates)	0.69	11.57**	15.59*	-127.11**
Foreign-trade (in US dollars)	0.98	12.13**	16.04*	-123.33**
In local currency	0.52	4.42*	7.73**	-104.71*
In inflation-adjusted units	-1.13	0.20	1.86	-116.63
In foreign currency	0.20	13.94**	17.02*	-149.51*

Table 14: Domestic monetary policy shocks under homogeneous domestic prudential policy (LTV-regulation stance)

This table shows results of estimating $\sum_{k=0}^{K} \alpha_{2,k} \Delta i_{t-k}^d Pru_t^d \Theta_{b,t-K-1}$ from equation 9. Include 15 international active banks in Chile for the 2000-2017 sample period. The homogeneous prudential policy represents maximum LTV ratios allowed for mortgage loans funded by mortgages notes. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Mortgage notes to mortgage loans			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Total	-0.10	-1.69***	-1.29**	1.99
Commercial	-0.14	-1.57***	-1.08	3.54
Mortgage	-0.25	-1.73**	-1.31	0.18
Consumer	-0.13	-1.31**	-0.92	5.75**
	Mortgage loans to total loans			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Total	0.44*	0.37	0.92	-1.47
Commercial	0.61**	1.30	2.16**	-1.76
Mortgage	0.58**	1.31	1.50	-2.36
Consumer	0.55*	1.71**	1.44	-9.07*

Table 15: Domestic monetary policy shocks under homogeneous domestic prudential policy (cum RRFX)

This table shows results the results of $\sum_{k=0}^{K} \alpha_{2,k} \Delta i_{t-k}^{d} Pru_{t}^{d} \Theta_{b,t-K-1}$ from equation 9. Include 15 international active banks in Chile for the 2000-2017 sample period. The homogeneous prudential policy represents the reserve requirements for foreign currency deposits. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Foreign-currency deposits to bank capital			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Total	-0.04	7.77**	43.70**	-56.75
Commercial	-0.31*	13.89***	84.81***	-163.88***
Mortgage	-0.26	4.73*	30.25*	-55.87
Consumer	0.08	-0.40	-3.62	6.42
	Foreign-currency deposits to total assets			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Total	-1.12	111.84**	688.68**	-1100.34*
Commercial	-5.47**	196.63***	1256.64***	-2561.21***
Mortgage	-4.80*	58.85	395.31*	-873.49*
Consumer	0.73	-15.64	-99.15	117.49

5 Concluding remarks

In this article, we explore several specifications to study the role played by the cross-border and local interactions between prudential policy and monetary policy in explaining the dynamics of domestic bank lending in Chile.

In doing so, we explore the interactions between international monetary policy shocks and domestic prudential policy stance, global prudential policy changes and domestic monetary policy stance, and domestic prudential policy stance and local transmission of monetary policy to bank credit.

Our results suggest, first of all, that it is essential to analyse results by type of prudential policy, whether because different sectors are targeted, or due to different mechanisms of action in place. For example, under unexpected foreign monetary policy shocks, capital requirements, and foreign-currency reserve requirements may mitigate cross-border spillovers. On the other hand, LTV policy seems to do the opposite; in the case of changes in prudential policy abroad, spillovers are magnified by a tight monetary policy at home in most cases.

For the domestic transmission of monetary policy, foreign-currency reserves policy seem to reinforce the transmission of current shocks, while mitigating shocks to higher-horizon expectations of monetary policy rates.

We acknowledge several caveats in our analysis. First, prudential policy shocks are not identified, and usually take much longer to be in effect compared to monetary policy rate targets, which may lead to anticipation effects not captured in these regressions; second, LTV policy has undergone only one change (an easing) during the period under consideration, was targeted to an already irrelevant type of mortgage loan (those financed through notes) and hence, the effects over the business or financial cycle might not be well captured by our specification.[15/] And finally, to check the robustness of results, we expect to incorporate demand controls. For example, as measured by banks' perception of credit demand from the Survey of Loan Officers ran quarterly by the Banco Central de Chile, which contains questions on how the demand for different market segments changed compared to previous periods.

[15/] Of course, additional policies for the housing sector, not considered by Cerutti et al. (2017b), may be included. For example, the increase in provisioning requirements for mortgage mutuals in 2016 Calani (2019), as well as the warnings issued by the Banco Central of Chile in 2012 (Alegría et al., 2017). Both can be considered as tightening since they elevated standards for mortgage originations.

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Appendices

A Shocks and surprises to the Monetary Policy Target Rate in Chile

Identification of monetary shocks is a common hurdle encountered in empirical work. The bias in estimations using effective monetary policy measures (interest rates, excess reserves, etc.) stems from simultaneity and omitted variables, being the first particularly relevant under domestic settings.

Based on recent work by Vicondoa (2019), we estimate a time series of monetary policy shocks for Chile, using as instruments the unanticipated movements on monetary policy target rate, among other macroeconomic variables, based on the Survey of Economic Expectations (EEE in Spanish) carried out monthly by the Central Bank. Although Vicondoa (2019) estimates US monetary policy shocks based on Fed Funds Future contracts and projections in the Survey of Professional Forecasters, previous work, such as Larraín (2007), has found that using either future contracts or the EEE provides similar results.[16/]

In this work, we estimate the shocks for the period starting in August 2001 until March 2019. The reason is that until July 2001, the Central Bank conducted monetary policy using as instrument a real interest rate target, as opposed the nominal rate currently being set. Also, since 1999, the macroeconomic framework is consistent with inflation targeting and floating exchange rate regime. Thus, we avoid structural breaks in the sample.

In order to construct the series of surprises on monetary policy interest rate (TPM), inflation and real output growth, we rely on the EEE, which records the average expectations of market participants on several macroeconomic variables, such as monetary policy target rate, inflation, real GDP growth, exchange rates and long-term interest rates of fixed income instruments issued by the Central Bank.[17/] Monthly macroeconomic time series come from the Statistical Database (BDE) of the Central Bank of Chile.

As in Vicondoa (2019), the identification of anticipated (news) and unanticipated (surprise) TPM shocks proceeds as follows. First, we compute anticipated and unanticipated movements in the TPM using the information from the EEE. However, movements in the rate capture partially the expected reaction of the Central Bank to anticipated changes in the Chilean business cycle conditions. Afterwards, we use the EEE expectations regarding main macroeconomic variables to obtain pure monetary shocks. We define an anticipated movement in the interest rates as follows:

$$\Delta i^{a}_{t,t+j} = \mathbb{E}_{t-1}\left(i_{t+j} - i_{t+j-1}\right) \qquad \text{for } j = \{0, 2, 5, ..., 23\}$$

[16/] Another recent work for the case of Chile is Ceballos (2014), which estimates the effects of local surprises and announcements on the nominal yield curve.

[17/] For intermediate horizons, we estimate the projected value using spline interpolation over the term considered by the survey. This allows us to use end-of-year and average-of-year projections.

and an unanticipated movement in i_t (or surprise) as:

$$\Delta i_t^u = i_t - \mathbb{E}_{t-1} i_t$$

Shocks to the policy target interest rate are estimated as the residuals of an OLS regression of surprises on annual inflation and output growth. The unanticipated shock for the current period $s_{t,t}^u$ is given from:

$$\Delta i_t^u = \alpha_0 + \alpha_1 i_{t-1} + \alpha_2 \left(\hat{y}_t - \mathbb{E}_{t-1}\hat{y}_t\right) + \alpha_3 \left(\hat{\pi}_t - \mathbb{E}_{t-1}\hat{\pi}_t\right) + \underbrace{\left(\epsilon_t - \mathbb{E}_{t-1}\epsilon_t\right)}_{s_{t,t}^u} \tag{10}$$

and for next periods, i.e. $s_{t,t+j}^a$:

$$\begin{aligned} \Delta i_{t,t+j}^a &= \gamma_{0,j} + \gamma_{1,j}\mathbb{E}_{t-1}\left(i_{t+j-1}\right) + \gamma_{2,j}\mathbb{E}_{t-1}\left(\hat{y}_{t+j} - \hat{y}_{t+j-1}\right) + \\ &= \gamma_{3,j}\mathbb{E}_{t-1}\left(\hat{\pi}_{t+j} - \hat{\pi}_{t+j-1}\right) + \underbrace{\mathbb{E}_{t-1}\left(\epsilon_{t+j} - \epsilon_{t+j-1}\right)}_{s_{t,t+j}^a} \quad \text{for } j = \{0, 2, 5, \cdots, 23\} \end{aligned} \tag{11}$$

As mentioned previously, equations are estimated by OLS. A rationale given by Vicondoa (2019) for the case of United States, is the lagged response of real variables to monetary policy which reduces the likelihood of simultaneity bias in estimated coefficients. In this context, the identified series of shocks, i.e. $s_t^u \equiv \epsilon_t$ and $s_{t,t+j}^a \equiv \mathbb{E}_{t-1}\left(\epsilon_{t+j} - \epsilon_{t+j-1}\right)$, capture a variety of factors such as perceived overreaction or under-reaction, and/or temporary shifts in the priorities of the monetary authority.[18/]

The results in table A.1 show that unanticipated movements in interest rates are not usually due to surprises in inflation and output growth at shorter term horizons (less than 2 quarters). For the medium and longer term, anticipated shocks are due to changes in anticipated shocks to inflation, and to a lesser extent, to output growth, as it can be seen in figure A.0, the unanticipated movement in interest rates for the current period coincides with the unexpected movement after cleaning for unexpected movements in inflation and output growth.

[18/] Given the lag of publication of output series (*IMACEC*), for current period shocks, we use the surprise in previous-period annual output growth instead of current quarter and the corresponding National Accounts vintage as effective growth, i.e. 1986, 1996, 2003, 2008, and 2013 base years. Results are robust to the use of the current month/quarter of both output and inflation, however.

Figure A.0: Movements in monetary policy target interest rate (%)

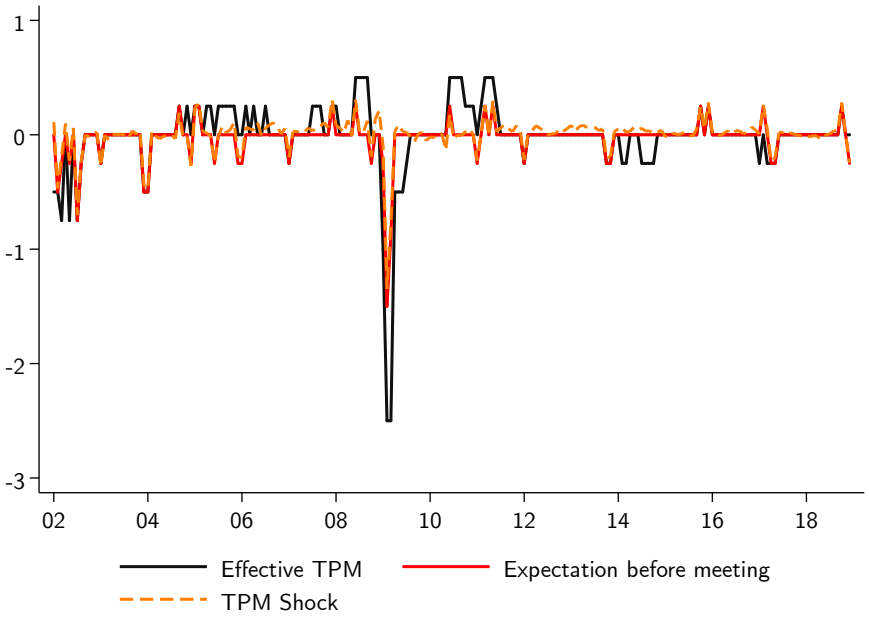

Table A.1: Estimation of monetary policy shocks at several months horizons

	(1) Δi_t^u	(2) $\Delta i_{t,t+2}^a$	(3) $\Delta i_{t,t+5}^a$	(4) $\Delta i_{t,t+8}^a$	(5) $\Delta i_{t,t+11}^a$	(6) $\Delta i_{t,t+14}^a$	(7) $\Delta i_{t,t+17}^a$	(8) $\Delta i_{t,t+20}^a$	(9) $\Delta i_{t,t+23}^a$
Lagged *TPM*	-0.01	-0.01	-0.01**	-0.02***	-0.01*	-0.01**	-0.01*	-0.01*	-0.01*
	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
Inflation	0.03	-0.05	0.13***	0.15***	0.23**	0.37***	0.80***	0.79***	0.32*
	(0.04)	(0.03)	(0.02)	(0.02)	(0.09)	(0.11)	(0.13)	(0.14)	(0.14)
Output	0.02	-0.04	0.01	0.01	0.03	0.12***	0.07*	0.00	-0.02
	(0.01)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.05)
Obs.	208	208	202	202	202	202	202	202	202
F	1.3	1.4	24.2	45.6	19.1	50.0	62.1	31.9	5.7
p-value	0.28	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	0.06	0.04	0.31	0.34	0.23	0.38	0.44	0.35	0.08

Standard errors in parentheses
$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

B Additional results

Table B.2: Weighted prudential policy shocks ($PruC$) and the domestic monetary policy stance

This table reports estimations of equation 6 for 15 internationally active banks in Chile for the 2002-2017 sample period. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Total		Intragroup	
	$CapReq$	$PruC$	$CapReq$	$PruC$
	Weighted by loans, deposits, and others			
Foreign-trade (in UF)	-1.46**	-0.08	-1.10	0.64**
Foreign-trade (in pesos, at PPP rates)	-1.46**	-0.08	-1.10	0.64**
Foreign-trade (in US dollars)	-1.46**	-0.07	-1.14	0.65**
In local currency	0.13	0.02	-0.50**	0.11
In inflation-adjusted units	0.22	-0.00	-0.15	-0.09***
In foreign currency	-0.35	0.09	-1.64**	0.26
	Weighted by loans and deposits			
Foreign-trade (in UF)	-1.28**	-0.09	-1.00	0.24
Foreign-trade (in pesos, at PPP rates)	-1.29**	-0.09	-0.99	0.24
Foreign-trade (in US dollars)	-1.29**	-0.08	-1.03	0.23
In local currency	0.01	0.02	-0.47**	0.04
In inflation-adjusted units	0.15	-0.00	-0.14	-0.01
In foreign currency	-0.36	0.07	-1.66***	0.07

Table B.3: Weighted prudential policy shocks at the origin and the domestic monetary policy

This table reports estimations of equation 4 for 15 international active banks in Chile for the 2002-2017 sample period. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Total		Intragroup
	CapReq	*PruC*	*PruC*
	Weighted by loans, deposits, and others		
Foreign-trade (in *UF*)	28.47	-0.59	73.47
Foreign-trade (in pesos, at PPP rates)	28.38	-0.58	65.52
Foreign-trade (in US dollars)	16.95	-0.51	71.49
In local currency	-1.01	-0.08	-60.88
In inflation-adjusted units	-18.02	-0.19	-57.73
In foreign currency	-84.65	-0.02	-199.27
	Weighted by loans and deposits		
Foreign-trade (in *UF*)	72.22*	-0.90	-6.32*
Foreign-trade (in pesos, at PPP rates)	72.00*	-0.88	-6.54*
Foreign-trade (in US dollars)	60.50	-0.58	-7.20*
In local currency	-1.66	-0.02	-2.18**
In inflation-adjusted units	-23.71	-0.27	-1.42
In foreign currency	-64.04	0.45	-4.53
	Unweighted		
Foreign-trade (in *UF*)	3.50	-14.98**	
Foreign-trade (in pesos, at PPP rates)	3.62	-15.73**	
Foreign-trade (in US dollars)	6.03	-15.97**	
In local currency	-4.80	-3.90	
In inflation-adjusted units	-11.12	0.46	
In foreign currency	-2.81	-13.34**	

Table B.4: Domestic monetary policy shocks under homogeneous domestic prudential policy (LTV-regulation stance)

This table shows results of $\sum_{k=0}^{K} \alpha_{2,k} \Delta i^{d}_{t-k} Pru^{d}_{t} \Theta_{b,t-K-1}$ from equation 8 and includes 15 international active banks in Chile for the 2000-2017 sample period. The homogeneous prudential policy represents maximum LTV ratios allowed for mortgage loans funded by mortgages notes. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Mortgage notes to mortgage loans			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
In local currency	0.06	-1.45**	-0.76	0.58
In inflation-adjusted units	-0.26*	-0.59	-0.28	4.04
In foreign currency	-0.02	-2.59**	-2.72**	-2.86
	Mortgage loans to total loans			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
In local currency	0.64*	2.45***	3.12***	2.35
In inflation-adjusted units	0.18	-1.90*	-1.84**	-8.79*
In foreign currency	-0.86	-2.97	-2.02	-0.27

Table B.5: Domestic monetary policy shocks under homogeneous domestic prudential policy (reserve requirements on foreign-currency deposits)

This table shows results of $\sum_{k=0}^{K} \alpha_{2,k} \Delta i^{d}_{t-k} Pru^{d}_{t} \Theta_{b,t-K-1}$ from equation 8. Include 15 international active banks in Chile for the 2000-2017 sample period. The homogeneous prudential policy represents the reserve requirements for foreign currency deposits. Standard errors are robust to cross-sectional dependence in panel estimation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Foreign-currency deposits to bank capital			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Foreign-trade (in *UF*)	0.74**	0.17	-5.34	126.19***
Foreign-trade (in pesos, at PPP rates)	0.77**	0.16	-6.34	135.63***
Foreign-trade (in US dollars)	1.01***	-0.09	-14.30	188.77***
In local currency	-0.11	13.14***	78.64***	-141.96***
In inflation-adjusted units	-0.25	10.25***	71.32***	-137.77**
In foreign currency	0.99**	-0.99	-12.58	152.24***
	Foreign-currency deposits to total assets			
	Δ *TPM*	Surprise in 6m *TPM*	Shock in 6m *TPM*	*TPM* surprise
Foreign-trade (in *UF*)	9.53***	16.41	178.61	526.14
Foreign-trade (in pesos, at PPP rates)	9.94***	16.33	167.90	637.61*
Foreign-trade (in US dollars)	13.62***	11.36	48.06	1432.08***
In local currency	-3.13	189.23***	1207.59***	-2368.22***
In inflation-adjusted units	-3.72	148.02***	1054.78***	-2055.37***
Foreign currency loans	10.13*	-74.82**	-411.94***	1827.61***

Table B.6: Summary statistics on transmission channels for domestic prudential policy

This table shows statistics for transmission channels for the 15 medium and big banks in Chile during the 2000q1-2017q4 period.

	Mean	Median	St. Dev.	Min	Max
For LTV regulations (in %)					
Mortage notes to mortgage loans	32.02	17.02	32.58	0.14	99.80
Mortage loans to total loans	20.32	19.63	11.42	0.21	44.68
For FC deposits reserve requirements (in %)					
FC deposits to bank capital	43.26	42.47	18.28	0.01	128.49
FC depositos to total assets	4.21	4.27	1.70	0.00	10.98

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