The effect of warnings published in a financial stability report on loan-to-value ratios ☆

Andrés Alegría [a], Rodrigo Alfaro [b,*], Felipe Córdova [c], Central Bank of Chile

[a] Financial Policy Division, Central Bank of Chile, Agustinas 1180, Santiago, Chile
[b] Financial Policy Division, Central Bank of Chile, Agustinas 1180, Santiago, Chile
[c] Financial Policy Division, Central Bank of Chile, Agustinas 1180, Santiago, Chile

A R T I C L E   I N F O

A B S T R A C T

This paper shows how central bank communications can play a role in macroprudential supervision. We document how specific warnings about real estate markets, published in the Central Bank of Chile's Financial Stability Reports of 2012, affected bank lending policies. We provide empirical evidence of a rebalancing in the characteristics of mortgage loans granted, which led to a reduction in the number of mortgage loans with high loan-to-value ratio.

Introduction

Since the onset of the Great Recession, heated debate on ways to prevent the risk of instability due to propagating across financial markets and how best to assure financial stability in the future. Central banks, which have taken a central role in this discussion, have made increasing use of communications as an additional policy tool to restore stability. In particular, through the publication of Financial Stability Reports (FSRs) as well as in speeches and interviews, policymakers have made efforts to convey their views on the potential risks faced by the financial system. Considering the relevance of the effective design and implementation of macroprudential policies to central banks, the relative novelty of these tools, and the breadth of the definition of macroprudential policies, it is natural to investigate the degree to which they have been successful in conveying their messages and achieving the intended effects.

The primary aim of this paper is to measure the effect that the Central Bank of Chile's communication tools have on the local housing market. By using a detailed administrative database of every housing transaction in the country, we studied the extent to which warnings issued in the central bank's FSRs had an effect on house prices, lending standards, and the volume of mortgage loans.

Since the onset of the subprime crisis, the real estate sector has received increasing attention from academics and policymakers, for at least three reasons. First, the bursting of the housing bubbles in several economies initiated a process of deleveraging that led to deep macroeconomic adjustments. Second, because housing is the main asset of the average household, changes in property values considerably affect total household wealth. Third, a significant amount of home purchases is financed with mortgage loans, so that banks are significantly exposed to this sector. Since 2010, the Central Bank of Chile, through its FSRs, has documented a sustained and above-trend rate of growth in house prices. Again, through the FSRs, the central bank has analyzed the various constituent components of housing prices and warned that recent developments in house price trends should not be extrapolated for future investment decisions (i.e. that agents should not expect the recent trends to continue unchanged in the future).

The paper begins by looking at the evolution of aggregate variables related to the real estate sector around the time of the issued warnings. Included in this analysis are housing debt decomposed by financing instrument, the number of mortgage loans granted,

Table 1

Total loans and mortgage loans by bank.[*]

BANK	TOTAL LOANS		MORTGAGE LOANS	
	US$ Millions	Percent	US$ Millions	Percent
Banco Bice	4,516	2.7%	473	1.2%
BBVA	12,277	7.4%	3,342	8.1%
Consorcio	257	0.2%	52	0.1%
De Chile	32,888	19.8%	6,144	15.0%
BCI	20,377	12.2%	4,030	9.8%
BancoEstado	23,647	14.2%	9,762	23.8%
Falabella	1,421	0.9%	482	1.2%
Internacional	1,381	0.8%	7	0.0%
Itaú (Chile)	5,895	3.5%	1,181	2.9%
Paris	383	0.2%	28	0.1%
Ripley	419	0.3%	119	0.3%
Santander - Chile	35,739	21.5%	9,796	23.9%
Security	4,621	2.8%	633	1.5%
Corpbanca	12,504	7.5%	2,144	5.2%
HSBC Bank (Chile)	686	0.4%	2	0.0%
Scotiabank Chile	8,195	4.9%	2,837	6.9%
Others	1,149	0.7%	1	0.0%
Total	**166,355**	**100%**	**41,032**	**100%**

[*] Data as of December 2010Source: Central Bank of Chile.

average housing debt, house prices, and volume of home sales. In principle, the warnings did not seem to have any effect on these broad variables, supporting the view that the evolution of these variables was consistent with macroeconomic fundamentals. However, when looking more closely at the distribution of loan-to-value (LTV) ratios of loans granted, the messages conveyed through the FSRs seem to have had an influence. Using a detailed administrative database for mortgage loan transactions, this paper shows that FSR warnings had an effect on bank lending policies between 2011 and 2014. In particular, following the FSR warnings, the number of loans granted with high LTV ratios noticeably reduced. Later, the analysis is formalized using probit and quantile regressions; these estimations confirm the previous findings. The warnings had a statistically significant effect, reshaping the distribution of LTV ratios for loans granted. Therefore, evidence during the period shows a shift out of mortgages with high LTVs into lower ratios.

Chilean real estate market

Housing finance

Since the early 1990s, the Chilean housing market has experienced significant developments in several aspects. For instance, Micco et al. (2012) show that (i) the percentage of overcrowded houses[1] dropped from 24% to 9% between 1990 and 2009 and (ii) the housing deficit[2] decreased from 540 thousand units to 410 thousand units. In addition, the Survey of Housing Finance conducted by the Central Bank of Chile indicates in its 2014 wave that the homeownership rate was about 70%. According to Warnock (2014), this figure is at the top among Latin American countries. A key element of this homeownership rate is the access to housing finance. Several elements must be considered to understand the Chilean mortgage market. First, there is a unit of account[3] indexed to inflation (UF) in which banks and financial institutions can grant long-term (20-30 years) loans. Second, most of this market is dominated by banks, having a share of 88% of mortgage loans as of 2010 and a historical average of 90% since early 2000. Given these facts, the following description will be focused on the banking sector. Among banks, a big player is BancoEstado (BE), a state-owned bank with a participation of 24% over the total stock of banking mortgage loans (Table 1).

Third, a number of mortgage instruments are available for financing the purchase of a house: mortgage notes, endorsable mortgage loans, and non-endorsable mortgage loans. Mortgage notes can be used to finance a fraction of the value of the property, having a maximum allowed LTV of 75%; there is also a limit on the Dividend to Income (DTI) ratio of 25% for small and medium size loans. Endorsable mortgage loans have a maximum LTV of 80% and no limit on DTI. Finally, non-endorsable mortgage loans have no limit on LTV nor on DTI. During the early 2000s, most housing funding was granted through mortgage notes, but since 2004, the participation of non-endorsable mortgage loans has increased. One reason behind this composition change is the combination of an increased credit demand and the relatively larger flexibility of non-endorsable mortgage loans in terms of LTV and DTI limits, length of term, interest rates, and minimum down payment requirement. The shift also coincides with the introduction, in November 2002,

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[1] According to the National Socioeconomic Characterization (CASEN) Survey, conducted in Chile and used by Micco et al. (2102). *Overcrowded houses* are defined as those where the ratio of residents over the number of bedrooms in a house exceeds 2.5.

[2] Micco et al. (2012) define *housing deficit* as the difference between total population and the stock of habitable permanent houses (excluding mobile units and those located in slums).

[3] "Unidad de Fomento (UF)" is a unit of account used in Chile. Its value in Chilean pesos is indexed to total inflation. It is widely used in determining the value of real estate, housing associated costs, and secured loans.
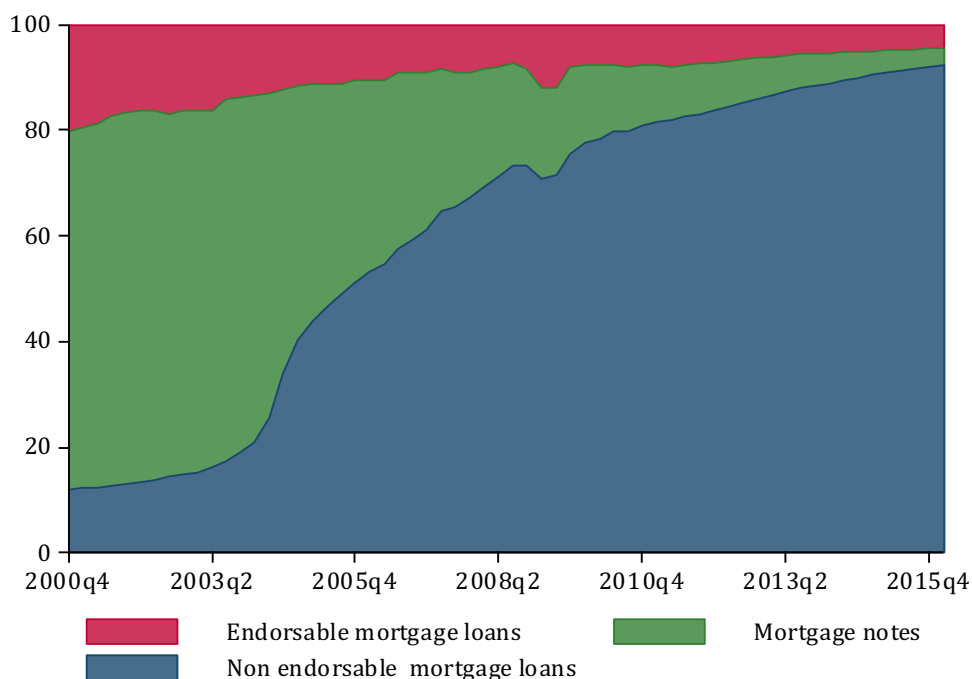
Fig. 1. Banking debt for housing by instrument (percent)
Source: Superintendency of Banks.

of a transaction tax exemption to loan renegotiations. According to Flores (2006), both new and existing mortgage loans financed through mortgage notes rapidly switched to non-endorsable mortgage loans after the implementation of the tax exemption mentioned above (Fig. 1).

In addition to the stock Fig.s presented in Table 1, information on flows between 2011 and 2014 (period under study) shows that eight banks accounted for about 95% of the total transactions and 93% of the total amount lent (Fig. 2). This distribution allows us to focus on this subset of banks for our methodological framework. It should be noted that BE's participation in the total number of loans is about 33%, but weighted by amount it is only 17%. The weighted value implies BE tends to grant loans of relatively small size. In general, BE has a different mandate from private banks, and for that we exclude it from the remainder of our analysis[4].

Focusing on the period between years 2011 and 2014, mortgage debt showed steady growth, reaching real annual variations close to 9%. This growth was mainly due to the increase in average debt, as opposed to the number of debtors (Fig. 3). This is consistent with both the evolution of housing prices discussed below and with an increment in the number of mortgage loans by debtor (Fig. 4). The latter is behind the buy-to-rent strategy observed during that time.

Housing price index

The Chilean Tax Authority maintains a detailed administrative database of every housing transaction in the country. The database includes information related to the transaction: price, location of the house, etc. It also includes information about the characteristics of the house, such as size (measured in square meters) or type (i.e., apartment or town house). Finally, the database contains information related to the conditions of the loan (if applicable), such as maturity and bank name. With this information, computing the LTV ratio per transaction is straightforward.

Using the Chilean Tax database, the Central Bank of Chile calculates the housing price index (HPI) using a methodology known as the stratified or mix-adjustment method[5]. This methodology measures the variations of prices of different types of houses by splitting the sample into groups according to characteristics such as price, geographical location, and size. Therefore, this methodology controls for changes in the composition of the sold houses between periods not in groups. We compute the average price for each group and obtain an aggregate index by weighting averages across groups. Further, the sample is divided into seven geographic zones: North, Center, South, and the Metropolitan Area (M.A.), which is divided into M.A. East, M.A West, M.A Downtown, and M.A South[6]. Moreover, each zone is divided between town houses and apartments, resulting in 14 groups. This allows distinctions in the HPI by

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[4] Main results do not change when this bank is included. Details are available from the authors upon request.

[5] For more details about methodology, see Central Bank of Chile (2013).

[6] The M.A. is the most densely populated area in Chile. For additional details about the subdivision into zones, see Central Bank of Chile (2013). A detailed map depicting the different zones is included for reference in the Appendix.

Fig. 2. Number of loans by bank in sample
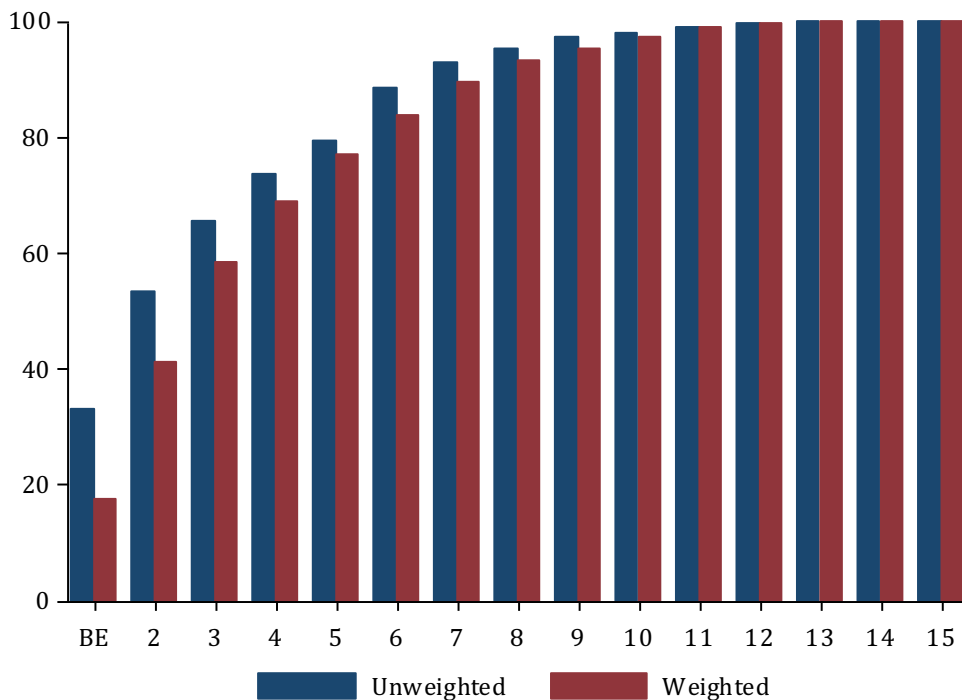(cumulative percent)
(*) The unweighted value is the cumulative percentage of number of loans granted by each bank. Weighted is the cumulative percentage of the number of loans granted, weighted by the total sum of loan flows corresponding to each bank.
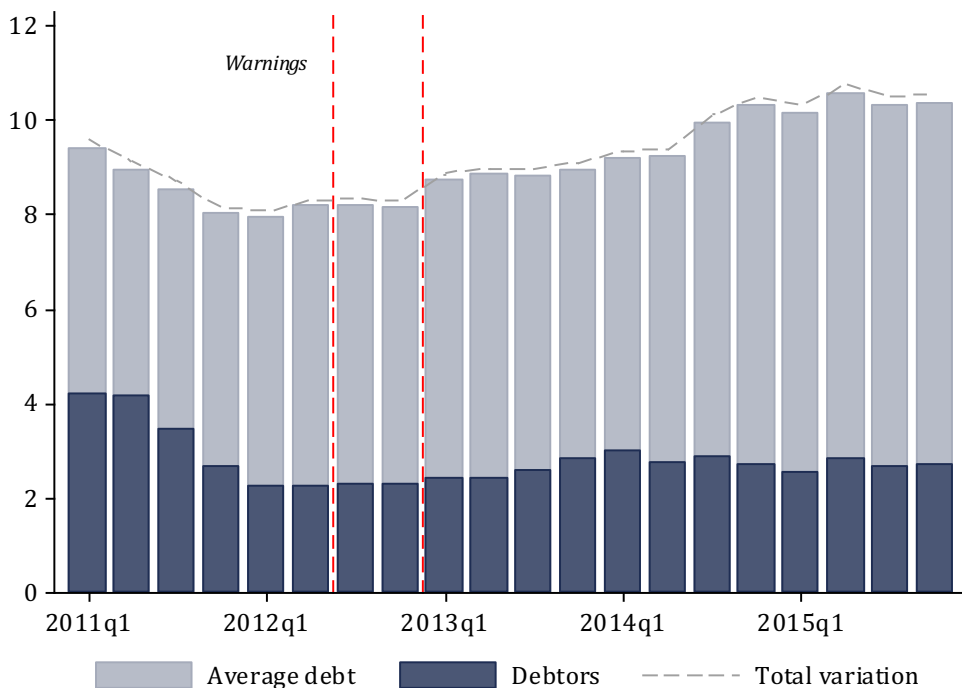Source: Chilean Tax Authority.

Fig. 3. Mortgage loans
(real annual variation, percent)
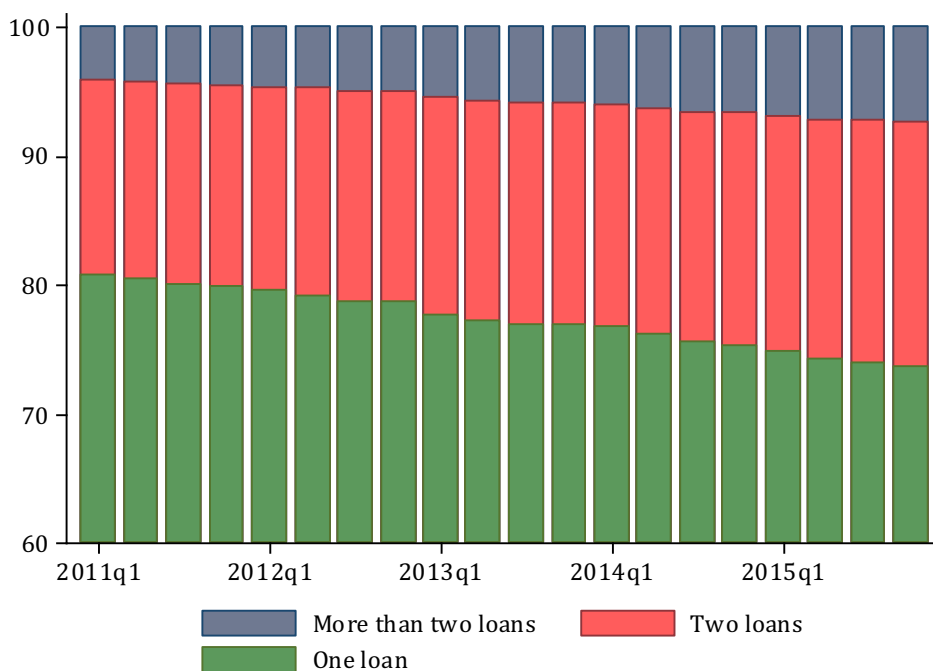Source: Central Bank of Chile.

Fig. 4. Mortgage loans by debtor
(percent)
Source: Superintendency of Banks.

zone and type of house, and the aggregation is performed by weighting these values by squared meters. In addition to this index, the Chilean Chamber of Construction (CChC) has generated its own estimate of house prices. The latter is computed only for M.A. and is based solely on new houses. In addition, the index includes houses that are still under construction (promises). We use this additional source because the latter information is not available in our Chilean Tax database.

According to the sources mentioned above, aggregate prices have shown growth rates consistent with increasing national private income and low long-term interest rates (Fig. s 5 and 6). However, the national Fig.s hide substantial heterogeneity across zones. Such heterogeneity is probably influenced by differences in the behavior of demand and the relative supply in each of zone. Del Negro and Otrok (2007) documented this heterogeneity in the United States. Their findings indicate that the factors driving house prices switch over time from local to national sources; the national variation does not seem to be linked to monetary policy changes. Allen et al. (2009) also explored this regional price heterogeneity using Canadian data. They found little evidence of long-run correlation between various cities and documented a disconnection between house prices, interest rates, and other macroeconomic variables. Local factors such as union wage levels, new housing prices, and the number of building permits issued seem to be more closely related to local house prices. Regarding our data set, despite differences in the methodologies of both indexes, they show similar trends. However, the CChC index shows fewer fluctuations, most likely because it is based on a fitted model.

Warnings in the financial stability report

Twice a year, the Central Bank of Chile publishes its FSR. The half-yearly report's objective is to provide information to the public concerning recent macroeconomic and financial events that could affect the financial stability of the Chilean economy. In addition, the FSR presents policies and measures that support the normal operation of the internal and external payment system. In the first and second halves of 2012, two warnings associated with the real estate market and its developments were published in the FSR (Table 2). Both referred to the existence of potential risks in the housing market, and the second warning explicitly mentioned lending standards. The warnings were also included in the reports' summaries, not just within the corresponding chapters. Regarding the resonance of the warnings in the media, they were widely covered in newspapers, television news, and specialized websites. These messages were also delivered by the members of the board in their presentations and speeches in the days following the issuance of a report. It is hard to quantify the intensity of the messages just by reading the warnings, which is why we take a quantitative approach to achieve this goal.

As we showed in the previous section, these warnings do not seem to have had an effect on aggregate house prices or the total volume of mortgage loans granted. The warnings issued in June 2012 are marked in Fig. 5 (left); the effect on aggregate housing prices is not noticeable. The same lack of variation is observed when house prices are decomposed by zone (Fig. 6). The second warning (Table 2, right column) does not appear to have had an impact on prices either. Fig. 3 shows the accelerated growth rate of
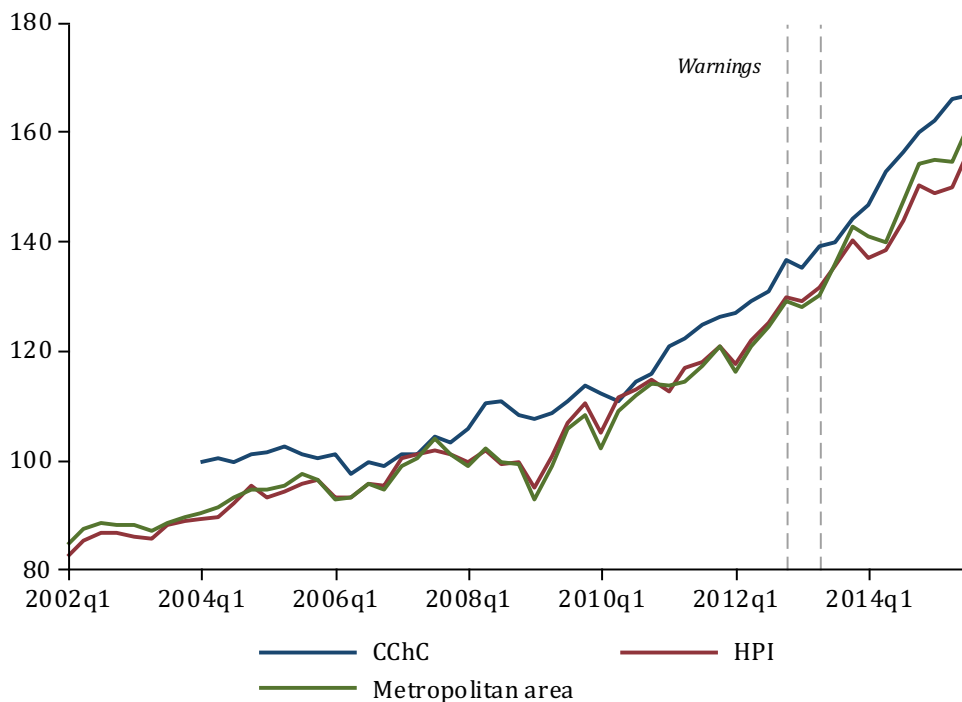
Fig. 5. Comparison of HPI (*)
(index; 100 = 2008)
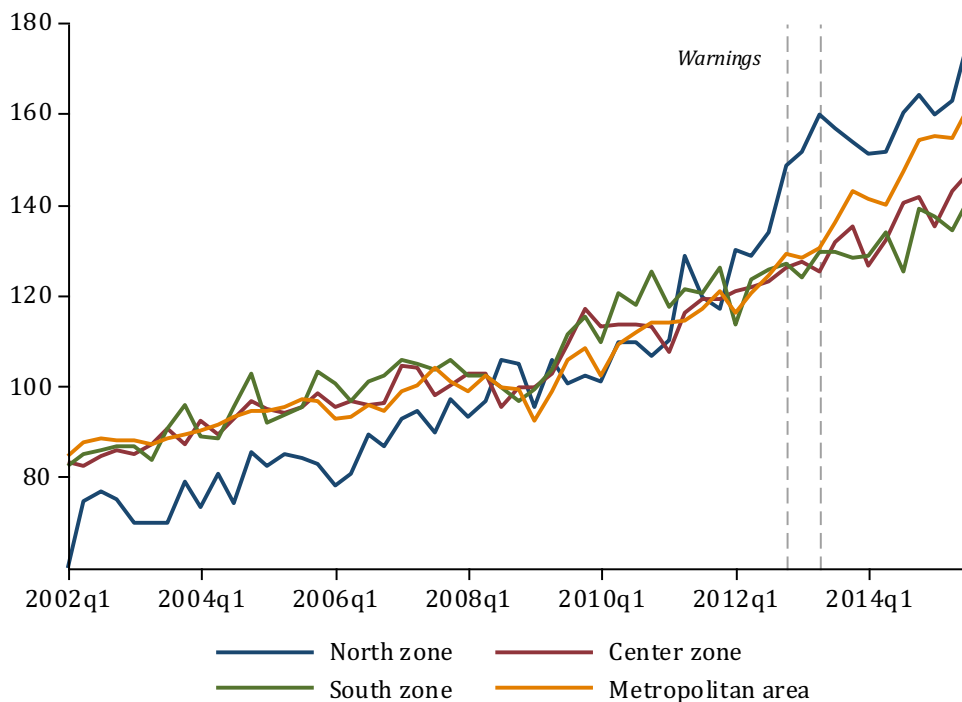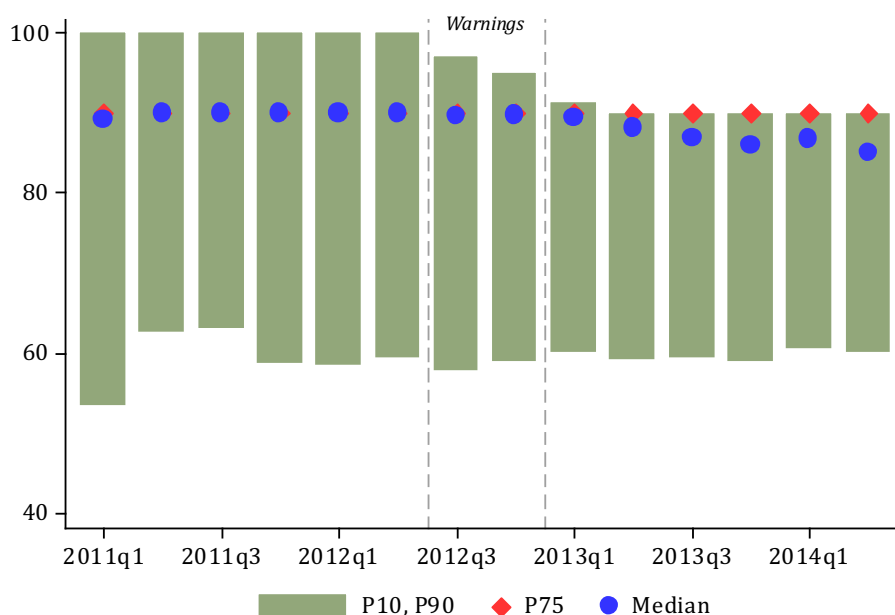Sources: Central Bank of Chile and CChC.

Fig. 6. House price index by zone (*)
(index; 100 = 2008)
(*) Central Bank of Chile information as of June 8, 2016.
(**) CChC uses a hedonic methodology to calculate the index, as opposed to the other indices that use a stratified methodology.
Source: Central Bank of Chile.

Table 2
FSR warnings.

First Half 2012(June 18, 2012)	Second Half 2012(December 18, 2012)
"Aggregate housing prices move in tandem with the economy's level of interest rates and income. At some districts in the central and eastern area of the Santiago Metropolitan Region prices are outgrowing their historic trends, possibly due to constraints in the land available. It is important to keep in mind that the materialization of the risk scenario described in this Report could lead to a breakdown in current price trends. The potential implications of this are price adjustments influencing the profits of executed projects and, additionally, the collaterals backing mortgage loans".	"The Report highlights that aggregate housing prices indices have maintained their pace of expansion, in line with the dynamism of the economy, and that in many districts prices are rising above historic trends. These increases occur in a context of high growth in housing demand and a significant expansion of activity in this sector. [...] This, together with somewhat less stringent lending standards for mortgage credit. These developments could lead to financial vulnerabilities in the real estate and construction industry, or in those households searching for a home".

Source: Central Bank of Chile.

Fig. 7. LTV full sample (*)
(percent)
(*) Vertical lines indicate the warning dates.
Source: Central Bank of Chile.

mortgage loans following the issuance of warnings. Thus, the aggregate figures suggest that warnings had no effect, and Central Bank communication through the FSR was ineffective as a macroprudential tool. Two possible explanations for this are possible. First, the warnings may not have had enough power because market participants did not value the messages delivered in the FSR. Second, these warnings may have had no effect on these aggregate variables because the warnings did not point to an existing imbalance in the market, but rather to the tail risk of such an imbalance. Thus, it is expected that warnings of this sort would affect the lending policies of banks (e.g., the LTV ratio).

By considering the information of the seven largest private banks in this market, the distribution of LTV ratios for newly originated mortgages showed some variation around the two warning events. In particular, the high-end of the LTV distribution (90th percentile) fell after the first warning and then dropped again after the second warning (Fig. 7). It is worth noting that the 75th percentile did not react to these warnings, being a compression of high LTVs. Prior to the first warning, about 10% of mortgage loans were granted with an LTV of 100%; after the warnings, around 10% of loans were granted with an LTV of 90%.

Table 3
Probit regression (LTV 90% or higher = 1).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012Q3	-0.216	-0.059	-0.044	-0.036	-0.060	-0.060	-0.024
	(0.007)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
2013Q1		-0.210	-0.217	-0.208	-0.207	-0.210	-0.208
		(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
Constant	-0.188	-0.188	0.019	-0.312	-0.207	-0.195	-0.155
	(0.004)	(0.004)	(0.007)	(0.013)	(0.008)	(0.006)	(0.016)
Bank FE			X				X
Income FE				X			X
Area FE					X		X
Type FE						X	X
N	157,985	157,985	157,985	157,985	157,985	157,948	157,948

Note: 2012Q3 is a dummy variable with a value of 1 from 2012Q3, and 2013Q1 is a dummy variable equal to 1 from 2013Q1 onwards. Standard error is in parenthesis.

In the next section, we use quantile regressions to evaluate the statistical significance of the change in the 90th percentile we illustrated graphically. That exercise will also allow us to control for bank fixed-effects. A probit analysis will also be conducted to evaluate the statistical significance of these findings from a slightly different approach.

Empirical results

As previously mentioned, a large fraction of loans (more than 30% as of 2012Q1) was granted with an LTV ratio of 90% or higher. Furthermore, about 10% of these loans were associated with an LTV ratio of 100%. The graphical evidence suggests the Central Bank of Chile's warnings in the FSR about real estate market vulnerabilities had an effect on the high end of the LTV distribution. To document whether these warnings had a significant influence, two different methodologies are used in this section. First, a binary probit model is estimated to quantify the effect public warnings about potential housing market vulnerabilities had in diminishing the probability that a high-LTV ratio loan was granted. In this model, a positive outcome is defined as the granting of a loan with an LTV ratio exceeding a given threshold. Second, as we showed in the previous section, the central moments of the LTV ratio distribution remained unchanged with the effects concentrated on its upper tail. Thus, a quantile regression is estimated to compute the effect of the public warnings on the median and several other percentiles of the LTV ratio distribution. In the estimations below, we use the Chilean Tax Authority data. Regarding our implicit counterfactual scenario, following others in the related literature such as Best et al. (2015), Wong et al. (2015), and Price (2014), we define an implicit counterfactual of no change in the LTV distribution after the issuance of the warnings. Our counterfactual scenario underlies the definition of our dummy variables. The pre-warning level can be computed as the case in which the corresponding dummy variable is equal to zero. The sample includes all mortgage loan transactions that took place between 2011 and 2014 with daily frequency.

Binary modeling for loan-to-value ratio

In this section, we estimate a probit model. Our dependent variable is binary: It is equal to 1 when the LTV ratio associated with a transaction is higher than a given threshold and 0 otherwise. We construct two dependent variables for two LTV thresholds, namely LTV90 and LTV80 for 90 and 80% thresholds, respectively. All the results corresponding to probit models are estimated coefficients, not marginal effects.

As independent variables, we construct two dummy variables, one for each FSR warning. The first one was issued in 2012Q2, and the second in 2012Q4. Each of the corresponding dummy variables is equal to 1 after the respective warning is issued and 0 otherwise[7]. In Tables 3 and 4, results are presented for the sample containing all seven private banks. For the LTV90 estimation, we can see in column 1 that the first warning reduced the probability of a loan being granted with an LTV higher than 90%. In column 2, we report that the second warning also had a significant negative effect on the probability of occurrence. The size of the first warning is reduced; however, the joint effect of both warnings remains negative and statistically significant. We add other controls in columns 3 to 6: (i) banks dummies, (ii) buyer's level of income, (iii) area of the house, and (iv) type of house. The main result remains the same; the first warning was significant but the second one was relevant in terms of the effect. Next, we show the estimation results for the 80% threshold in Table 4. For the model in column 1, with the first warning only, the effect is also negative, but smaller than the one observed for the 90% threshold. Adding the second warning, we observe a similar effect for the first warning as the previous threshold. The direct effect of the second warning is negative, as is expected, but at smaller magnitude than that observed for the 90% threshold. This result remains the same when further controls are included in the probit equation. Thus, the main effect of the second warning is on the high level of LTV. Using quantile regressions, we will explore this finding in detail in the next section.

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[7] In the result tables (Tables 3 and 4), the dummy variables are labeled 2012Q3 and 2013Q1, respectively, to reflect the fact that they are equal to 1 starting on the quarter that follows the issuance of each warning.

Table 4

Probit regression (LTV 80% or higher = 1).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012Q3	**-0.121**	**-0.081**	**-0.059**	**-0.045**	**-0.074**	**-0.087**	**-0.027**
	(0.007)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
2013Q1		**-0.053**	**-0.073**	**-0.059**	**-0.050**	**-0.057**	**-0.066**
		(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Constant	**0.622**	**0.622**	**0.693**	**0.505**	**0.518**	**0.563**	**0.430**
	(0.005)	(0.005)	(0.008)	(0.013)	(0.008)	(0.006)	(0.017)
Bank FE			X				X
Income FE				X			X
Area FE					X		X
Type FE						X	X
N	157,985	157,985	157,985	157,985	157,985	157,948	157,948

Note: 2012Q3 is a dummy variable with a value of 1 from 2012Q3, and 2013Q1 is a dummy variable equal to 1 from 2013Q1 onwards. Standard error is in parenthesis.

Table 5

Quantile regression (90th percentile).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012Q3	**-9.480**	**-3.890**	**-1.070**	**-2.750**	**-3.780**	**-3.890**	**-1.420**
	(0.030)	(0.050)	(0.180)	(0.080)	(0.050)	(0.050)	(0.150)
2013Q1		**-6.060**	**-5.000**	**-5.040**	**-5.900**	**-6.060**	**-4.050**
		(0.050)	(0.190)	(0.090)	(0.050)	(0.050)	(0.160)
Constant	**100.00**	**100.00**	**100.00**	**97.82**	**100.00**	**100.00**	**99.04**
	(0.020)	(0.020)	(0.120)	(0.100)	(0.030)	(0.030)	(0.230)
Bank FE			X				X
Income FE				X			X
Area FE					X		X
Type FE						X	X
N	157,985	157,985	157,985	157,985	157,985	157,948	157,948

Note: 2012Q3 is a dummy variable with a value of 1 from 2012Q3, and 2013Q1 is a dummy variable equal to 1 from 2013Q1 onwards. Standard error is in parenthesis.

Quantile regression

The main objective of the analysis in this section is to study how the FSR warnings affected the distribution of LTV ratios for newly originated mortgage loans, focusing on the upper tail of this distribution. In particular, we consider quantile regression analysis for the 90th and 75th percentiles[8]. As dependent variable, we use the LTV ratio of granted mortgage loans. Independent variables are the same ones we used when estimating the probit model (i.e., dummy variables for each of the two warnings the Central Bank of Chile issued). As we showed above, the median and 75th percentile LTV ratios remain almost constant after both warnings. This is a desirable outcome because the warnings did not aim towards correcting a misalignment in the less risky brackets of LTV. Instead, the second warning explicitly mentioned the somewhat less stringent lending standards for mortgage credit, which in turn is associated with the upper tail of the LTV ratio distribution.

Our results in Table 5 suggest that the FSR warnings were relevant to reducing the LTV of loans granted with ratios above 90%. Column 2 shows how both warnings significantly reduced the 90th percentile of the LTV ratio distribution. The effect of both warning remains similar when we add other control variables (columns 3 to 6).

Then, we estimate the model for the 75th percentile, looking for movements distinct from those in the 90th percentile in an a priori less-risky bracket. As shown in Table 6, the magnitude of the effect is very small with respect to those previously obtained for the 90th percentile. This is consistent throughout different specifications that include additional controls. Indeed, when we add bank-level fixed effects in column 3, the warning coefficients are no longer statistically significant.

At the median, the warnings' effects are somewhat stronger than they are at the 75th percentile, but still significantly smaller than they are at the right tail of the LTV distribution. With the inclusion of different combinations of fixed effects, the incidence of the first warning becomes very similar to the ones found at the 75th percentile. However, for the second warning, the effects at the median are relatively larger; this discrepancy disappears when the model is saturated with all fixed effects in column 7 of Table 7. In fact, under the saturated model, the warnings' coefficients are no longer statistically different from zero.

Besides the exercises presented here, we estimate three additional variations in the working paper version of this document (available here). First, we redefine the warning issuance dummy variable to be equal to 1 from the day the FSR is presented to Congress and released to the public. This variation is implemented to isolate other contemporaneous developments that could also

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[8] We consider the quantile regression framework, as opposed to linear regression, because our focus is on upper-tail events.

Table 6

Quantile regression (75th percentile).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012Q3	**-0.040**	**-0.020**	**-0.010**	**-0.020**	**-0.020**	**-0.020**	**-0.030**
	(0.000)	(0.000)	(0.060)	(0.000)	(0.000)	(0.000)	(0.060)
2013Q1		**-0.020**	**-0.020**	**-0.030**	**-0.020**	**-0.020**	**-0.050**
		(0.000)	(0.060)	(0.000)	(0.000)	(0.000)	(0.070)
Constant	**90.04**	**90.04**	**90.97**	**90.05**	**90.04**	**90.04**	**90.98**
	(0.000)	(0.000)	(0.040)	(0.000)	(0.000)	(0.000)	(0.090)
Bank FE			X				X
Income FE				X			X
Area FE					X		X
Type FE						X	X
N	157,985	157,985	157,985	157,985	157,985	157,948	157,948

Note: 2012Q3 is a dummy variable with a value of 1 from 2012Q3, and 2013Q1 is a dummy variable equal to 1 from 2013Q1 onwards. Standard error is in parenthesis.

Table 7

Quantile regression (50th percentile).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012Q3	**-1.270**	**-0.140**	**-0.010**	**-0.010**	**-0.020**	**-0.100**	**-0.010**
	(0.040)	(0.090)	(0.130)	(0.050)	(0.110)	(0.100)	(0.090)
2013Q1		**-1.800**	**-1.150**	**-0.380**	**-1.690**	**-1.830**	**-0.120**
		(0.090)	(0.140)	(0.060)	(0.110)	(0.100)	(0.090)
Constant	**89.95**	**89.95**	**90.00**	**85.43**	**89.74**	**89.73**	**85.72**
	(0.030)	(0.040)	(0.090)	(0.060)	(0.080)	(0.050)	(0.130)
Bank FE			X				X
Income FE				X			X
Area FE					X		X
Type FE						X	X
N	157,985	157,985	157,985	157,985	157,985	157,948	157,948

Note: 2012Q3 is a dummy variable with a value of 1 from 2012Q3, and 2013Q1 is a dummy variable equal to 1 from 2013Q1 onwards. Standard error is in parenthesis.

affect the LTV distribution. Second, we aimed towards refining the identification of the effect; we re-estimate the models using a tighter window of periods around the issuance of the warnings, just one quarter after and before the warnings to be more precise. Finally, we estimate the quantile regression, including the two refinements just described together. The results are roughly the same as in the original estimations, confirming that the warnings had a statistically significant effect on the 90th percentile of the LTV distribution, with the second warning having a larger effect than the first one did.

Final remarks

The structure and behavior of the mortgage market are crucial elements to consider when analyzing the home purchasing decision. In 2012, given the developments in the housing market, the Central Bank of Chile through its Financial Stability Report raised concerns regarding potential vulnerabilities in certain geographical areas. For the overall real estate market at the aggregate level, these warnings do not seem to have had an effect on the volume of home sales or loans granted. However, at the micro level, empirical evidence suggests that the number of loans granted with high LTV ratios was significantly reduced after the relevant warnings were published in these reports. The mechanism underlying the latter result is one of coordination among banks, where initially they did not internalize the potential social cost of granting high-LTV loans. The warnings served as a way of alleviating this market failure through communication. After the warnings were published, discussions on the adjustment of the loan-loss provision policy had started by the end of 2013. The new regulation explicitly takes into account the LTV ratio and it went into effect in January 2016.

Based on different methodologies, we conclude that the issued warnings had a significant effect on bank lending policies. This finding is in line with the central bank's decision to point out the existence of potential risks arising from less stringent lending standards in the extremes of the distribution.

Declaration of Competing Interest

No conflict of interest.

Appendix

Chilean geographic zones
Source: Authors' elaboration.

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