INTERNATIONAL MONETARY FUND

IMF Country Report No. 25/38

CHILE

SELECTED ISSUES

February 2025

This Selected Issues paper on Chile was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on January 16, 2025.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
PO Box 92780 • Washington, D.C. 20090
Telephone: (202) 623-7430 • Fax: (202) 623-7201
E-mail: publications@imf.org Web: http://www.imf.org
Price: $18.00 per printed copy

International Monetary Fund
Washington, D.C.

INTERNATIONAL MONETARY FUND

CHILE

SELECTED ISSUES

January 16, 2025

Approved By
Western Hemisphere Department

Prepared by Si Guo (WHD) and Tatsushi Okuda (MCM).

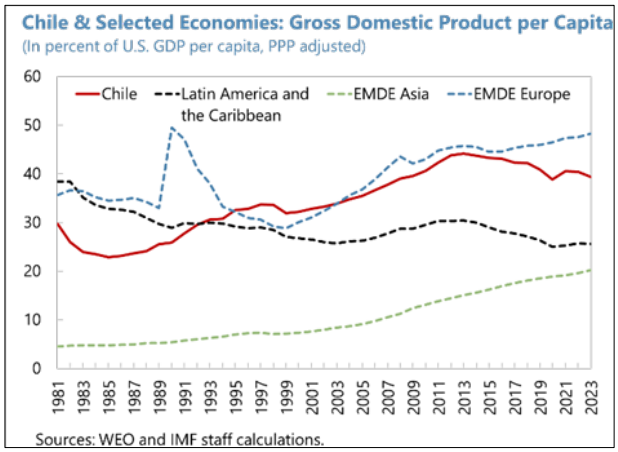
CONTENTS

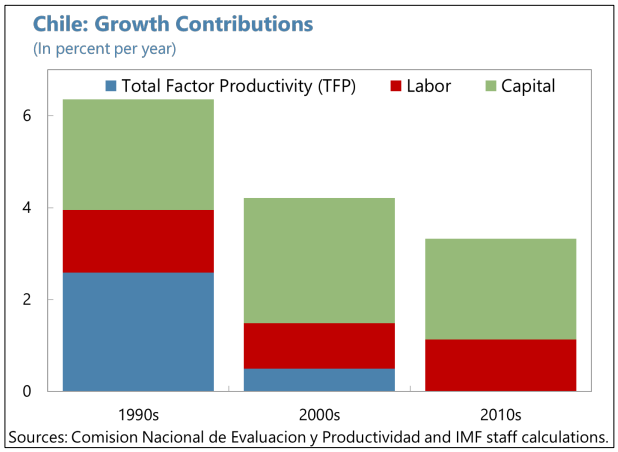
GROWTH AND PRODUCTION NETWORK IN CHILE[1]

Productivity growth depends not only on technological innovation but also on the production networks that amplify the impact of technological progress. Theory and cross-country evidence indicate a positive relationship between productivity growth and the use of intermediate inputs, a measure of network connectedness. Our analysis reveals that Chile's intermediate input utilization is significantly lower than that of OECD peers, such as Korea and Czech Republic, and declined during 2008-21. This lower intensity is primarily due to weak connections among domestic producers and limited export contributions to the strength of the production network linkages. We argue that better contract enforcement and diversifying exports from mining could strengthen production network linkages and boost potential growth.

A. Growth Slowdown in Chile

1. Chile's economic growth slowed down considerably after the 2000s. The average annual real GDP growth rate fell from 6.2 percent during 1991-99 to 4.2 percent during 2000-09, and further to 3.3 percent during 2010-19.[2] For the 2020s, the growth rate averaged 1.9 percent during 2020-23, which is close to the central bank's projected potential growth rate of around 2 percent for the next ten years (Central Bank of Chile 2024). Although the global slowdown in economic growth has played a role, Chile's stalled income convergence with higher-income countries suggest that country-specific factors are also contributing to this trend.



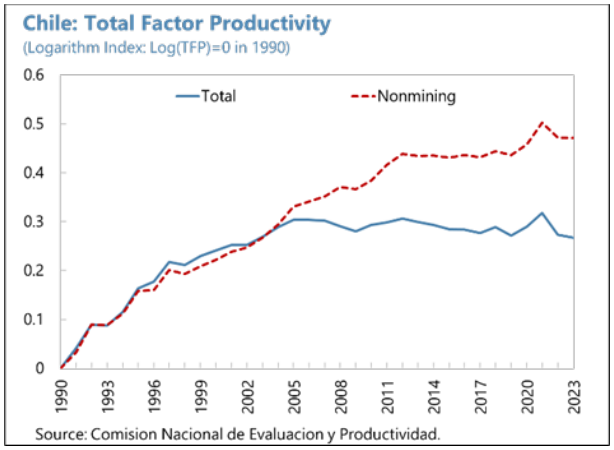


2. The main driver of this deceleration has been a marked slowdown in total factor productivity (TFP) growth. According to the estimates of National Commission of Evaluation and Productivity (CNEP), compared to the 1990s, the average annual contribution of TFP to growth declined by 2.5 percentage points in the 2010s, while the contributions of labor and capital each fell by just 0.2 percentage points.

[1] Prepared by Si Guo.

[2] Data from IMF World Economic Outlook.

Additionally, the slowdown in capital accumulation is likely also linked to sluggish TFP growth. For instance, in a simple Solow growth model with a capital share of 0.5, a 2.5 percentage point drop in TFP growth would predict a 5-percentage point reduction in capital accumulation along the balanced growth path. However, actual annual capital growth only decelerated by 0.2 percentage points between the 1990s and 2010s, outperforming this prediction.



3. A few studies have explored the causes of productivity growth slowdown at the industry level in Chile. For example, CNEP (2017) highlights declining productivity in the copper mining sector and recommends improvements in project permit timelines, as well as the establishment of standards for suppliers, contractors, and labor training. CNEP (2020a) documents the inefficiencies in the construction sector, including the planning of public works, uncertainty around building permits, and the low adoption of digital tools. Additionally, CNEP (2020b) identifies suboptimal utilization of surgical rooms, which contributes to longer wait times for surgeries. Asturias et al. (2023) highlight the impact of entry barriers on manufacturing sector productivity growth in Chile. Most of these studies emphasize policies to enhance sectoral and industrial productivity instead of the interconnectedness of these industries and its impact on aggregate productivity growth.

4. This paper examines economic growth through the lens of cross-industry input-output linkages. Aggregate productivity growth is influenced not only by productivity improvements of individual industries and producers, but also by the structure of the production network that can amplify the effects of individual producers' productivity changes. We compare Chile's production network with that of other OECD peers, such as Korea and Czech Republic, and analyze how Chile's production network has evolved over time. Due to data limitations, our focus is the input-output matrix, which details transactions among producers but is aggregated by industry. Most of our analysis will concentrate on intermediate input use as share of gross output, and its one-to-one mapping, gross output-to-value added (VA) ratios, as these metrics best summarize the input-output linages at the aggregate level.

B. Input-Output Linkage and Growth: Theoretical Background

5. Input-output linkages could amplify the impact of firm or industry-level productivity changes on aggregate productivity growth. For illustrative purposes, take a simplified example of agricultural production, e.g., rice, to demonstrate how input-output linkage impact growth. Assume fertilizer ($x_{fertilizer}$) is used as the only intermediate input, alongside labor l_{rice}, in a Cobb-Douglas production function: $q_{rice} = a_{rice} l_{rice}^{1-\sigma} x_{fertilizer}^{\sigma}$. Technology progress in rice production, represented by an increase in a_{rice}, not only enhances the productivity of famers but also that of the fertilizer.

With the quantities of labor and intermediate inputs held constant, a one percentage point rise in a_{rice} would result in a one percentage point increase in the rice producer's real gross output. Because the amount of fertilizer (intermediate input) remains unchanged, the real value added of this rice producer will increase by $1/(1-\sigma) > 1$ percentage points. Therefore, the use of fertilizer as an intermediate input creates a multiplier effect: for every one percent increase in technology a_{rice}, the value-added increases by more than one percentage point.

Box 1. Growth Multiplier Under Cobb-Douglas Production Function

For each producer i, assume its production function is given by:

$$q_i = a_i l_i^{1-\sigma_i} x_i^{\sigma_i}$$

where l_i represents the quantity of labor input and x_i denotes the quantity of intermediate inputs used by producer i. Taking the logarithm of both sides and then differentiating over time, yields:

$$\Delta \log(q_i) = \Delta \log(a_i) + (1-\sigma_i)\Delta \log(l_i) + \sigma_i \Delta \log(x_i) \qquad (1.1)$$

Let y_i represent the real value-added of producer i. Under the Cobb-Douglas production function assumption, the share of intermediate inputs is fixed at σ_i. Therefore, we can also express the growth of output as:

$$\Delta \log(q_i) = (1-\sigma_i)\Delta \log(y_i) + \sigma_i \Delta \log(x_i) \qquad (1.2)$$

By combining equations (1) and (2), we obtain:

$$\Delta \log(y_i) = \Delta \log(a_i)/(1-\sigma_i) + \Delta \log(l_i)$$

Hence, the TFP growth of producer i, following conventional growth accounting, is:

$$\Delta TFP_i = \Delta log(a_i)/(1-\alpha_i)$$

With an economy with multiple producers (i=1, 2, …, N), the aggregate TFP growth is:

$$\Delta TFP = \sum (Y_i/Y) \cdot \Delta TFP_i = \sum (Q_i/Y) \cdot \Delta log(a_i) \qquad (1.3)$$

In the second equality, we use the fact that $Q_i = Y_i/(1-\alpha_i)$.

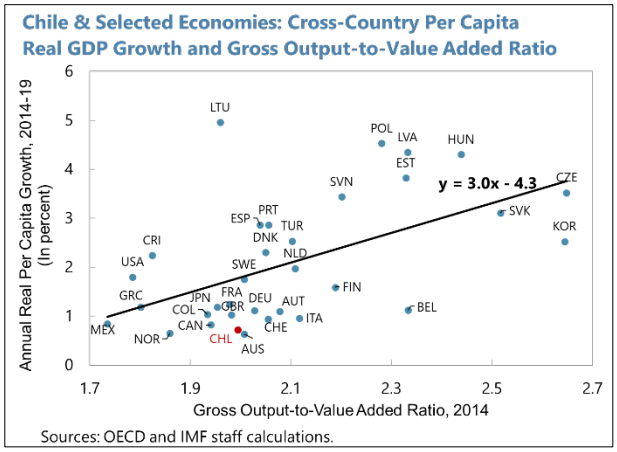
Equation (1.3) shows that aggregate TFP growth is a weighted average of individual producers' technology improvements, with producer i's contribution weighted by its *gross output* as a share of aggregate GDP, rather than its value-added as a share of GDP. Generally, the term $\sum Q_i/Y > 1$ due to the use of intermediate inputs, which implies that the production network amplifies the effect of technological progress of individual producers on aggregate TFP growth.

6. More formally, theoretical studies have shown that gross output-to-GDP ratio serves as a measure of the production network's multiplier effect on aggregate productivity growth. This line of research dates to Hulten (1978) and is further generalized by Baqee and Farhi (2020). These studies demonstrate that, to a first-order approximation, if each producer i's production function is $q_i = a_i F_i(k_i, l_i, x_i)$ where a_i is the Hicks-neutral technology, (k_i, l_i) are the factor inputs, and x_i is the vector of intermediate inputs used by producer i, the aggregate TFP can be proved to be the weighted sum of each producer's technological changes:

$$\Delta \log(TFP) = \sum_i \lambda_i \Delta \log(a_i) \qquad (1)$$

where $\Delta \log(a_i) = \log(a_{i,t+1}) - \log(a_{i,t})$ is the growth rate of i's technology; $\lambda_i = Q_i/\mathrm{Y}$ is the ratio of producer i's nominal gross output (Q_i) to the economy-wide nominal value-added (Y), commonly referred as the "**Domar weight**" of producer i. It should be noted that the sum of Domar weights, $\sum_i \lambda_i$, equals to the economy-wide gross output-to-GDP ratio (Q/Y) and is typically greater than one, due to the use of intermediate inputs. This implies that when the technology improves by 1 percent for every producer, the economy wide TFP will increase by $\sum_i \lambda_i$ percentage points. This is why $\sum_i \lambda_i$ is considered a measure of the multiplier effect of the production network. Box 1 provides a formal derivation or of this property under a special case of Cobb-Douglas production function with a single type of intermediate input, following the setup in Basu and Fernald (2002).

7. The positive correlation between the gross output-to-value added (Q/Y) and economic growth is also supported by cross-country data. The text chart compares the gross output-to-GDP ratio in 2014 with real GDP per capita growth during 2014-19 for OECD countries.[3] As predicted by theory, countries with a more interconnected production network experienced faster growth. Text Table 1 presents the cross-country OLS regression results, with each country's real GDP per capita growth rate during 2014-19 as the dependent variable and the gross output-to-value added ratio as the independent variable. The coefficients in Column (1) of Text Table 1 imply that a 0.1 increase in the gross output-to-GDP ratio is associated with an around 0.3 percentage point increase in real GDP per capita growth. This relationship remains robust even after controlling for countries' income per capita levels proxied, as shown in Column (2) of Text Table 1.[4] There are also significant cross-country variations in gross output-to-GDP ratios: Korea and several Eastern European countries had ratios ranging from 2.4 to 2.7 in 2014, while Chile and G7 countries had ratios around 2.0, slightly higher than Mexico and Costa Rica, which were around 1.8.



Sources: OECD and IMF staff calculations.

Text Table 1. Dependent Variable: Average Real GDP per capita Growth Rates 2014-19

Independent Variables	(1)	(2)
Gross output-to-VA	3.04***	2.90***
Log(GDP per capita) in 2014, PPP adjusted	-	-1.13**
Constant	-4.29	7.79

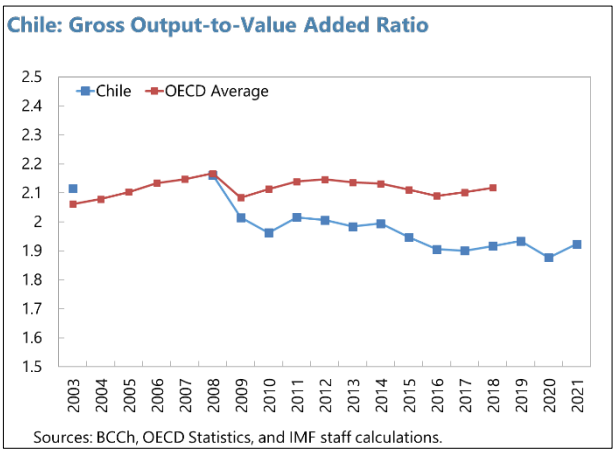
Note: *** (**) stands for p value<1% (5%).

Source: IMF staff estimations.

[3] The data for Chile is provided by the BCCh. Annex I provides the details of the data sources of gross output-to-value added ratio and real GDP per capita growth rate for other countries.

[4] As a robust check for the reference years and country coverage, McNerny et al. (2022) also find the positive correlation between gross output-to-GDP ratio in 1995 and real GDP per capita grow during 1995-2000, using a sample 40 countries covered by the WOID dataset (which includes non-OECD countries such as China and Brazil but excludes a few OECD countries such as Chile and Colombia).

C. Input-Output Linkages in Chile: An Overview



8. Chile's input-output linkage, measured by gross output-to-GDP ratio, is slightly weaker than the OECD average. In the 2010s, Chile's gross output-to-output ratio (Q/Y) averaged around 2.0 based on the input-output tables compiled by the BCCh, compared to the OECD's 2.1 during the same period.

9. Moreover, Chile's intermediate input use is significantly less intensive compared to Korea and Czech Republic, both of which experienced faster income convergence. In 2018, Chile's gross output-to-value added ratio was lower than that in Korea (Czech Republic) by 0.47 (0.62). The reason we choose Korea and Czech Republic as comparators is that their income levels are closer to Chile than most other OECD countries. The relevance of income level stems from the fact that as a country's income increases, its economy typically shifts from industrial sectors to service sectors, which tends to result in a decline in the measured aggregate Q/Y ratio.[5] The gap could be quantitatively relevant: based on the elasticity (2.9) in Column (2) of Text Table 1, the lower Q/Y ratio in Chile would translate into a slower annual real GDP per capita growth than Korea (Czech Republic) by 1.4 (1.8) percentage points. Obviously, this does not mean that intermediate input use is the sole factor behind the growth per capita differences between Chile, Korea, and Czech Republic. Other factors, such as business dynamism, innovation, and technology adoption, could also play a significant role. The cross-country elasticity between Q/Y and real GDP growth rate presented in Text Table 1 also does not necessarily represent an empirically causal relationship, although the theory in Box 1 predicts a causal relationship between Q/Y and real GDP per capita growth rate. Still, the comparison of production networks highlights that the impact of intermediate input use on growth can potentially be substantial.

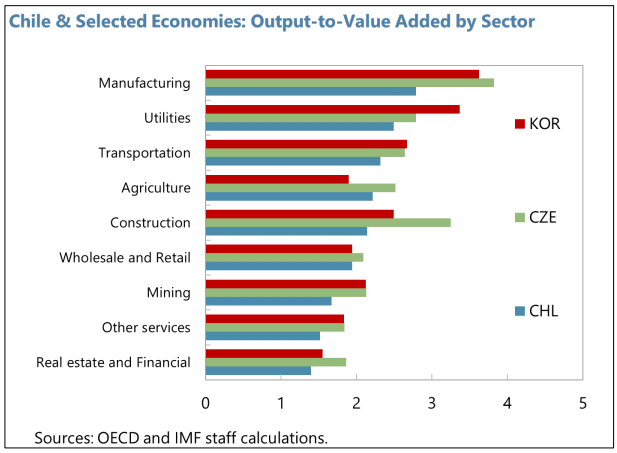
10. Moreover, Chile's input-output linkage has been on a declining trend. From 2008 to 2021, the gross output-to-value added ratio in Chile fell from 2.16 to 1.92, based on the input-output tables complied by the BCCh. While high fossil fuel price in 2008 may have contributed to the high gross output-to-value added to some extent, the declining trend since 2009 remains clear.[6]

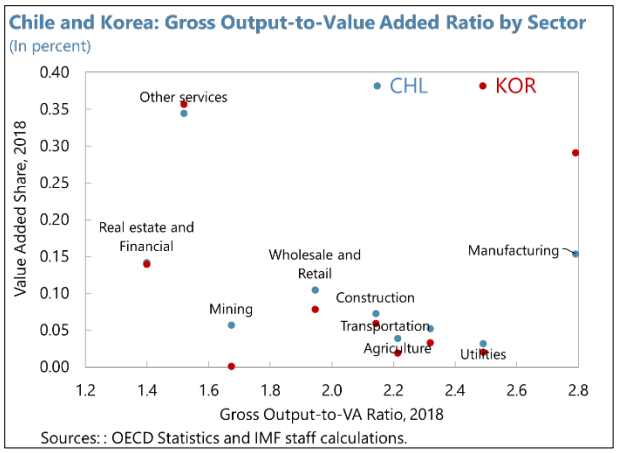
[5] Ideally, we would also like to compare Chile's production networks with countries like Australia who has a more substantial mining sector. According to data from the Penn World Table, Chile's GDP per capita (PPP adjusted) in 2019 is comparable to Australia's GDP per capita (PPP adjusted) in the early 1980s. Unfortunately, we do not have input-output data for Australia from that period.

[6] To exclude the impact of copper and oil prices on the calculated output-to-value-added (Q/Y) ratio, we also computed the Q/Y ratio for a hypothetical economy without the mining and utility sectors. In such a non-mining and non-utility economy, the Q/Y ratio would have declined by 0.19 between 2008 and 2013, compared to a 0.18 decline in the actual economy that includes all sectors. This comparison indicates that fluctuations in copper and oil prices combined were not the primary drivers of the decline in the aggregate Q/Y ratio in Chile over time.

The elasticity in Text table 1 implies that the lower intensity of intermediate input use in 2021 compared to 2008 would translate into a deceleration in annual real GDP per capita growth by 0.7 percentage points.

11. Chile's lower use of intermediate inputs, compared to Korea and Czech Republic, stems from its smaller manufacturing share and less input usage across several industries. The left chart shows the gross output-to-valued added ratio by sector in the three countries, with the sectors on the horizontal axis ordered by their gross output-to-value ratios. While the manufacturing sector has the highest ratio among all sectors, Chile's manufacturing sector plays a much smaller role for its economy than in Korea (right text chart) and Czech Republic, and this difference in manufacturing share contributes to Chile's lower gross output-to-value added ratio. Additionally, except for agriculture, Chile's producers demonstrate a lower intermediate input intensity, particularly for manufacturing production.





12. The weakening of input-output linkage over time mainly reflects producers' reduced use of intermediate inputs over time instead of a compositional shift of sectoral shares. We can decompose the change in aggregate Q/Y ratio between t and t+1 as follows with nominal gross output at time t denoted as Q^t and value-added at time t as Y^t:

$$\Delta(Q/Y) = \sum_i \Delta(Q_i/Y_i) \cdot \left(Y_i^{t+1}/Y^{t+1}\right) + \sum_i Q_i^t/Y_i^t \cdot \Delta(Y_i/Y) \qquad (2)$$

The first term on the right-hand side of Equation (2) captures the change in the aggregate Q/Y driven by changes to the gross output-to-value added ratio at the sector level, weighted by sectoral value-added shares. The second term accounts for changes to sectoral composition, holding each sector i's Q_i/Y_i constant, reflecting the "composition shift" effect. Using this decomposition, the change in aggregate Q/Y during 2008-2019 (-0.24) was mainly driven by the fewer intermediate input use at the sector level (-0.52), while the changes to sectoral composition contributed to an increase in aggregate Q/Y (by +0.28) over time.

D. Input-Output Linkages in Chile: Demand Side Decomposition

13. What explains the cross-country differences in input-output linkages? In vector term, we show that the Domar weights have to satisfy

$$\lambda = \Psi(\beta + \tilde{e}\delta) \qquad (3)$$

Where $\lambda = \{\lambda_i\}$, $\beta = \{\beta_i\}$, and $\delta = \{\delta_i\}$ for i=1, 2, 3, ..., N.[7] For each i, $\beta_i = C_i/C$ is i's share in total final demand. The term $\tilde{e}\delta$ represents export's contribution to Domar weights, with $\tilde{e} = \mathrm{E/Y}$ standing for the economy-wide export-to-VA ratio and $\delta_i = \mathrm{E}_i/\mathrm{E}$ representing export composition over different products. The term $\Psi = (I - \Omega')^{-1} = I + \Omega' + \Omega'^2 + \Omega'^3 + \cdots$, where Ω is the input-output coefficient matrix with its (i,j)th element defined as $\Omega_{ij} = X_{ij}/Q_i$. Ψ is also called the Leontief inverse, measuring the input-output linkages among domestic producers and is readily available from input-output tables along with Ω. Because the gross output-to-VA ratio is simply the sum of Domar weights across all producers, with the help of Equation (3), we can decompose the differences in Q/Y ratios between Chile and Korea (or Czech Republic) into three components: the differences in domestic input-output linkages (captured by $\Psi = (I - \Omega')^{-1}$), differences in final demand distribution over industries (captured by β), and differences in total exports and export composition (captured by $\tilde{e}\delta$). Annex II provides the detailed deviation of this decomposition.

14. There are several key distinctions between the demand-side decomposition in equation (3) and the supply side decomposition in equation (2). First, the demand-side decomposition breaks down changes in the gross output-to-value added ratio into domestic final demand, domestic intermediate demand, and exports, all of which can be better linked to exogenous factors. For example, the distribution of domestic final demand across different industries is influenced by household consumption and investment patterns, as well as government expenditure composition. Such a demand-side framework enables the possibility of conducting counterfactual policy experiments. Second, the demand-side decomposition accounts for each industry's impact on the sizes of its upstream industries. For instance, a robust basic metal industry typically boosts the growth of its upstream sectors, such as electricity and mining. In contrast, the supply-side decomposition abstracts from the interconnectedness of industries and treats the value-added share of each industry as exogenous.

15. A cross-country comparison indicates that Chile's lower intermediate input use mainly reflects its less intensive input-output linkages among domestic producers. In 2018, Korea's economy-wide gross output-to-value added ratio was 2.42, about 0.47 higher than that of Chile. Of this difference, 0.34 can be attributed to the variations in the intensity of domestic demand for domestically produced intermediate input (captured by Ω); 0.16 is due to Chile's lower total export-to-value added and smaller share of manufacturing exports that tend to have stronger input-output linkages than other industries. The final demand composition in Chile is slightly more favorable to the use of intermediate input than Korea (-0.03). This is because Chile's public consumption as share

[7] Annex II provides the derivation of Equation (3).

of total final demand is smaller than that in Korea, and public consumption tends to concentrate on service sectors with the lowest input output linages. The comparison to Czech Republic yields a broadly similar pattern: the difference in the economy-wide gross output-to-value added ratio was 0.62 in 2018, of which 0.2 is explained by the differences in domestic demand for domestically produced intermediate inputs, 0.61 by exports, and -0.2 by domestic final demand distribution (Text Table 2, first two rows).

Text Table 2. Differential in Gross Output-to-Value Added (Q/Y) Ratio

	Total Q/Y differential	Explained by domestic IO linkages (ψ)	Explained by exports and exports composition (eδ)	Explained by final demand distribution (β)
Korea, 2018 - Chile, 2018	0.47	0.34	0.16	-0.03
Czech, 2018 - Chile, 2018	0.62	0.20	0.61	-0.20
Chile, 2021 - Chile, 2008	-0.23	-0.09	-0.13	-0.01

Sources: OECD Statistics and IMF staff calculations.

16. Comparisons across time suggest that domestic input-output linkages and exports account for the decline in aggregate intermediate input use in Chile between 2008 and 2021. Of the total decline of 0.23 in the gross output-to-value added ratio, approximately 0.09 can be attributed to changes in less domestic intermediate input demand (i.e., changes to Ψ). Exports explains a 0.13 decline in gross output-to-value added ratio, as export-to-value added ($\tilde{e}$) declined by 9 percentage points. Export composition (δ) also shifted further shifts industries with weaker input-output linkages: mining's share in total exports increased by 12 percentage points while manufacturing's export share decreased by 5 percentage points. Finally, shifts in the distribution final demand over industries only has a minor impact (0.01) on the cross-time changes to gross output-to-value added ratio during 2008-21 (Text Table 2, last row).

E. Policy Implications

17. Our analysis suggests that stronger input-output linkages within the production network could enhance productivity growth. Efforts to raise intermediate input use hinge on the three components of Equation (3): domestic input-output linkage (Ψ), exports and export composition ($e\delta$), and the composition of final demand (β). Admittedly, there could be many policies that affect either one or more of these factors. For example, transportation infrastructure and trade costs, as highlighted by Clark et al. (2004), are critical for promoting exports (e). Additionally, enhancing competition and reducing monopolistic power, achievable through streamlining the permit process to lower the entry barriers, would also have a profound impact on domestic input-output linkage (Ψ), as highlighted in Baqaee and Farhi (2020). For the scope of this paper, we complement these studies by focusing on two specific aspects: contract enforcement, which is likely to influence Ψ, and export composition that directly targets δ.

Domestic Input-Output Linkage and Contract Enforcement

18. In theory, improved contract enforcement could facilitate the use of intermediate inputs by reducing transaction costs. Weaknesses in the contract enforcement system increase

costs for both buyers (when sellers' products do not fully meet standards) and sellers (when buyers default or delay payments), raising the prices of intermediate inputs and incentivizing in-house production. For instance, Boehm and Oberfield (2020) document that in India, plants tend to shift to in-house production when courts are more congested.

19. Whether contract enforcement is a relevant factor for intermediate input use in Chile remains to be examined. For Chile, World Bank Doing Business Survey (2020) points out a few *de jure* weaknesses related to contract enforcement in "court structure and proceedings" (e.g., whether there is a dedicated court division for hearing commercial cases) and "mediation and conciliation". However, a key question is whether contract enforcement is a de facto factor for the use of intermediate inputs in a country with a relatively strong institutional framework.

20. We follow Boehm (2022) to examine whether contract enforcement *de facto* reduced the use of intermediate inputs in Chile. Boehm (2022) constructs an industry-specific contract litigation frequency index and shows that this index, when interacted with the World Bank's country-specific contract enforcement score, significantly predicts intermediate input intensity in cross-country regressions. We apply the litigation index to classify industries into two groups: those with a high likelihood of contract litigation and those with a low likelihood (H and L groups). We then compare the use of intermediate inputs by industry in the U.S. and Chile, based on the assumption that Chile has weaker contract enforcement than the U.S. In particular, we calculate

$$\Delta = (\lambda_H^{US} - \lambda_H^{CHL}) - (\lambda_L^{US} - \lambda_L^{CHL})$$

where the first (second) term on the right-hand side is the difference in median gross output-to-value added ratio between the U.S. and Chile in high(low) litigation industries. A positive Δ would indicate that contract enforcement lowers the intermediate input use intensity in Chile.

21. Our analysis shows that contract enforcement has had an impact on Chilean producers' intermediate input use. Economy wide, Chile's gross output-to-GDP ratio in 2018 is higher than the U.S. by 0.09. Matching the industry classification used in Boehm (2022) with the OECD industry classification, we rank of 24 industries by litigation index and define the top (bottom) 12 industries as the "high" ("low") litigation industries. For Chilean producers in high-litigation industries, their gross output-to-GDP ratio gap (using U.S. producers in the same industries as a benchmark) is 0.21 lower than those in low-litigation industries (Δ = 0.21), suggesting that contract enforcement indeed has had a tangible impact on intermediate input use in Chile.

Policies Related to Exports and Export Composition

22. The concentration of exports on mining output places Chile at a disadvantage regarding the growth multipliers of its production network. Mining exports account for around 50 percent of Chile's total exports. However, the sector's input-output linkages with other industries are weaker than the economy-wide average, as it uses fewer intermediate inputs. Based on the simulations of the model in Annex III, in 2021, for every dollar of mining output, only 31 cents and 4 cents are spent on intermediate inputs produced by domestic and foreign producers, respectively. In

contrast, for every dollar of manufacturing exports, 49 cents and 23 cents are spent on domestic and imported intermediate inputs. Moreover, there is a compounding effect: manufacturing producers often source intermediate inputs from other manufacturing firms, creating additional multiplier effects. For instance, a one-dollar increase in manufacturing demand results in an increase of $2.60 in total domestic output, whereas a one-dollar increase in mining output only leads to an increase of $1.90 in total domestic output, derived from the 2018 input-output table.

23. Counterfactual analysis reveals that growth differences can be attributed to export composition. Using a general equilibrium model[8] with input-output linkages, we simulate the equilibrium changes resulting from a hypothetical shift in export composition from the actual composition observed in 2021 (60 percent mining, 27 percent manufacturing) to 100 percent manufacturing. Such a shift, which is chosen for illustrative purposes, would lead to an increase of 0.24 in the gross output-to-value added ratio, corresponding to a 0.7 percentage point difference in annual real GDP per capita growth rate based on the coefficients in Table 1. In addition, the manufacturing output-to-aggregate value-added ratio would rise by 0.39, and the export-to-value added ratio (which mirrors the import-to-value added ratio due to the balanced trade assumption in the long-run) would rise by 0.07, reflecting the higher export (and import) intensity of the manufacturing sector. Conversely, if all exports were shifted to mining, the gross output-to-value added ratio would decline by 0.07, due to the mining sector's lower multiplier effect than manufacturing (Text Table 3).

24. Developing high-value service exports is unlikely to significantly boost long-term growth rates. In a counterfactual exercise where all exports are shifted to financial and business services, the gross output-to-VA ratio would decline by 0.4 compared to the current level, and the export-to-VA ratio would decrease by 0.26. This outcome is largely due to the low interconnectedness of service industries with their upstream sectors: a one dollar increase in financial and business services would only result in a 1.5 dollar increase in aggregate output. This does not imply that service industries are not important in helping countries catch up to higher-income levels: facilitating more low-skilled workers to move toward higher-skilled and higher-salary professions (even in service sector) would still contribute to the increase in income per capita. Rather, the analysis suggests that, on a balanced growth path, an economy with a concentration of exports in services that have weak linkages with other industries is likely to experience lower growth rates compared to a country with exports focused on manufactured goods or the other high-interconnectedness industries.

[8] Annex III provides the detail of the model used for counterfactual analysis.

Text Table 3. Counterfactual Exercises

Scenarios	Export composition (δ)	Gross output-to-GDP (Q/Y)	Export-to-GDP (E/Y)	Sectoral output as share of aggregate GDP (λi)			Implied Changes to Annual Real GDP Per Capita Growth (in percentage point) 1/
				Manufacturing	Mining	Business services	
Actual Data in 2021	Mining (60%), Manufacturing (27%), Business Services (1%)	**1.88**	34%	34%	24%	14%	-
Full manufacturing exports	Manufacturing (100%)	**2.12**	43%	73%	3%	14%	**0.7**
Full mining exports	Mining (100%)	**1.80**	31%	23%	35%	13%	**-0.2**
Full business service exports	Business service (100%)	**1.76**	31%	22%	1%	45%	**-0.3**

Source: IMF staff calculations.

1/ The growth effect is calculated based on the simulated changes in Q/Y ratio (compared to the actual 2021 level) in Column 3 and the elasticity estimated in Table 1.

25. A larger and more diversified export sector could enhance interconnectedness and boost potential growth. While Chile's remote geographic location may pose challenges to its trade, the country's ongoing efforts in negotiating trade agreements, along with maritime concessions, coastal shipping reforms, and the promotion of standardizations and certifications, have the potential to reduce trade costs and increase interconnectedness.

Annex I. Data

Input-Output Matrix

There are three data sources for the input-output tables used in this paper. The BCCh compiles annual input-output tables for the years 2008-2021 with 111 industries and 12 sectors. The OECD Statistics provides input-output tables for all OECD countries, with transactions aggregated into 45 industries. The World Input-Output Dataset (WIOD) includes input-output tables for the 40 largest economies globally (excluding Chile), aggregated into 56 industries. Notably, WIOD's cross-border input-output transaction data captures bilateral transactions, such as Chile's imports of textiles from Korea.

The selection of different input-output table sources reflects a balance between data availability, comparability, and the level of industry disaggregation. For Chile-specific analyses, such as the cross-time changes in the gross output-to-value added (VA) ratio, we primarily rely on the BCCh data. For comparisons involving Chile, Korea, and Czech Republic, we utilize the input-output tables from the OECD Statistics to ensure a consistent industry classification across these countries. In calculating the gross output-to-GDP ratios, we primarily use the input-output tables from the WIOD dataset, supplemented by OECD Statistics for countries not covered by WIOD and Chilean input-output tables complied by the BCCh.

Note that the input-output tables are compiled based on establishment or enterprise-level gross transactions without consolidation. Consequently, while the data is aggregated by industry, the transaction amounts still capture the input-output linkages at the enterprise or establishment level, including the transactions among producers within the same industry.

Real GDP Per Capita Growth Rate

The real GDP per capita growth rates are sourced from OECD Statistics, with the reference period set from 2014 to 2019. This timeframe is chosen to exclude the effects of the global financial crisis (which affected growth rates prior to 2014) and the COVID-19 pandemic (which impacted growth rates after 2019). Ireland has been excluded from the sample due to the potential distortions of the large presence of multinational enterprises assets on its GDP growth rates.

Annex II. Demand-Side Decomposition of Domar Weights $\{\lambda_i\}$

For each product i, the market clearing condition requires that the total supply of output q_i equals the sum of final demand c_i, the intermediate input demand of all other domestic producers, $\sum_j x_{ji}$, and export demand e_i:

$$q_i = c_i + \sum_j x_{ji} + e_i$$

In nominal terms, this turns to

$$Q_i = C_i + \sum_j X_{ji} + E_i$$

Making use of $\Omega_{ji} = X_{ji}/Q_j$, which represents intermediate input i's share in the production of output j, we have

$$Q_i = C_i + \sum_j \Omega_{ji} Q_j + E_i$$

Divided by aggregate nominal value added Y, we get the Domar weight for producer i,

$$\lambda_i = \beta_i + \sum_{\mathrm{j}} \Omega_{ji}\, \lambda_i + \tilde{e}_i$$

where $\beta_i = C_i/C$ is i's share in total final demand. The term $\tilde{e}\delta_{\mathrm{i}}$ represents export's contribution to Domar weight, with $\tilde{e} = \mathrm{E/Y}$ standing for the economy-wide export-to-VA ratio and $\delta_{\mathrm{i}} = \mathrm{E_i/E}$ representing export composition over different products.

In vector terms, define $\lambda = \{\lambda_{\mathrm{i}}\}$, $\beta = \{\beta_{\mathrm{i}}\}$, and $\delta = \{\delta_{\mathrm{i}}\}$, where i=1, 2, …, N, we can solve the Domar weights as

$$\lambda = \Psi(\beta + \tilde{e}\delta)$$

where $\Psi = (I - \Omega')^{-1} = I + \Omega' + \Omega'^2 + \Omega'^3 + \cdots$ is the Leontief inverse.

Economy wide gross output-to-GDP ratio is simply the sum of Domar weights over i:

$$Q\backslash Y = \sum_i \lambda_i$$

To compare the gross output-to-VA ratios in Korea and Chile, we can decompose the difference between the two countries' sums of Domar weights into:

$$\sum_{\mathrm{i}} \lambda_i^K - \sum_i \lambda_i^C = \sum_{\mathrm{i}} \left(\beta_{\mathrm{i}}^{\mathrm{C}} + \tilde{\mathrm{e}}\delta_{\mathrm{i}}^{\mathrm{C}}\right)\Delta\Psi_{(\mathrm{i})} + \sum_{\mathrm{i}} \Psi_{(\mathrm{i})}^{\mathrm{K}}\, \Delta\tilde{\mathrm{e}}\delta_{\mathrm{i}} + \sum_{\mathrm{i}} \Psi_{(\mathrm{i})}^{\mathrm{K}}\, \Delta\beta_{\mathrm{i}}$$

where the term $\Psi_{(i)}$ stands for the sum of the i^{th} row of Leontief inverse Ψ.

The first term on the right-hand side of the equation above reflects the difference in Korea and Chile's gross output-to-VA ratios explained by the variation of Ψ, the second term reflects the contribution variation in exports and export composition over different industries, and the third term reflects the variations in final demand composition over different industries.

Annex III. A Structural Model for Counterfactual Analysis

Our model is built upon Jones (2011) and Fadinger et al., (2022).

Production Network

Final goods sector. There is one final good c produced by competitive producers using domestically produced intermediate inputs and imported good c_f.

$$\mathrm{c} = c_1^{\beta_1} c_2^{\beta_2} \dots c_N^{\beta_N} c_f^{\beta_f}$$

where $\sum_i \beta_i + \beta_f = 1$.

Given the prices of intermediate goods and imports $\{\mathrm{p_i}\}$ and p_f, the final good producers choose the quantities of inputs to maximize their profits:

$$\text{Max } \pi_C = \mathrm{pc} - \sum_i p_i\, c_i - p_f c_f$$

Intermediate goods producers. Producers of the ith type of intermediate goods maximize their profits

$$\text{Max } \pi_i = p_i q_i - \sum_{\mathrm{j}} \mathrm{p_j\, x_{ij}} - p_f x_{if}$$

Subject to the production function

$$q_i = a_i l_i^{\sigma_{iL}} x_{i1}^{\sigma_{i1}} x_{i2}^{\sigma_{i2}} \dots x_{iN}^{\sigma_{iN}} x_{if}^{\sigma_{if}}$$

Where weights $\sigma_{iL} + \sum_j \sigma_{ij} + \sigma_{if} = 1$.

Market clearing conditions require that for each domestically produced intermediate goods i, we have

$$q_i = c_i + \sum_j x_{ji} + e_i$$

International Trade. We assume there is a "trading" sector whose inputs are the exports of other sectors while its output is the economy's imports.

$$q_f = a_f e_1^{\sigma_{f1}} e_2^{\sigma_{f2}} \dots e_N^{\sigma_{fN}}$$

Where $\sum_j \sigma_{fj} = 1$.

Nominal exports and imports in this economy are hence $p_e \mathrm{e} = \sum_i p_i\, e_i$ and $P_f Q_f$. Because our analysis focuses on long-term growth, we assume balanced trade: $p_e e = p_{\mathrm{f}} \mathrm{q_f}$. Imported household consumption is used as a residual term to ensure the balanced trade holds.

Characterization of the Equilibrium

Firms' profit maximization problems lead to

For the price of final good: $\log(p_c) = \sum_i \beta_i log(p_i)$

For the price of intermediate good i: $log(p_i) = -a_i + \sigma_{Li}\log(w) + \sum_j \sigma_{ij}\, log(p_j) + \sigma_{if} log(p_f)$

For the price of imports: $\log(p_f) = -a_f + \sum_i \sigma_{fi} \log(p_i)$.

Define the Domar weight $\lambda_i = \frac{Q_i}{C}$, we have

$$\lambda_i = \beta_i + \sum_j \sigma_{ji}\, \lambda_j + \sigma_{fi}\lambda_f$$

$$\lambda_f = \beta_f + \sum_j \sigma_{jf}\, \lambda_j$$

In vector expression,

$$\lambda = (I - \Omega')^{-1}(\beta + e_y \sigma_f)$$

Calibration. The model is calibrated to match the key data moments in Chile in 2018. The domestic input-output coefficients, Ω, and the export-to-VA ratio, e_y, are readily available from the input-output table. The consumption distribution over industries (captured by β) is pinned down by the industrial share in final demand. The export distribution over industries (captured by σ_f) is pinned down by each industry's share in total exports.

Counterfactual analysis. In the counterfactual exercise to switch the composition of export demand from the current composition to all manufacturing exports, we let $\sigma_{fi} = 1$ for i=manufacturing and $\sigma_{fi} = 0$ for i=other industries, while keeping (Ω, β) unchanged. Exports-to-GDP ratio e_y is endogenous.

References

Asturias, J., S. Hur, S., T.J. Kehoe, and K. Ruhl (2023) "Firm Entry and Exit and Aggregate Growth". *American Economic Journal: Macroeconomics*, vol. 15(1), Pages 48-105.

Baqaee, D., and E. Farhi (2019) "The Macroeconomic Impact of Microeconomic Shocks: Beyond Hulten's Theorem," *Econometrica*, vol. 87(4), Pages 1155-1203.

Baqaee, D., and E. Farhi (2020) "Productivity and Misallocation in General Equilibrium," *Quarterly Journal of Economics*, vol. 134(1), Pages 105-63.

Basu, S., and J. G. Fernald (2002) "Aggregate Productivity and Aggregate Technology," *European Economic Review*, vol. 46, Pages 963-91.

Boehm, J. (2022) "The Impact of Contract Enforcement Costs on Value Chains and Aggregate Productivity." *Review of Economics and Statistics*, vol. 104(1), Pages 34-50.

Bohem, J., and E. Oberfield (2020) "Misallocation in the Market for Inputs: Enforcement and the Organization of Production." *Quarterly Journal of Economics*, vol. 135(4), Pages 2007-58.

Central Bank of Chile (2024) Monetary Policy Report, September.

Clark, X., D. Dollar, and A. Micco (2004) "Port Efficiency, Maritime Transport Costs, and Bilateral Trade." *Journal of Development Economics*, vol. 75(2), Pages 417-50.

CNEP (2017) "Large Copper Mining Productivity in Chile", Technical Report, Comision National de Evaluacion y Productividad.

CNEP (2020a) "Productivity in the Construction Sector", Technical Report, Comision National de Evaluacion y Productividad.

CNEP (2020b) "Efficiency in Operating Rooms and Prioritization of Patients for Elective Surgery", Technical Report, Comision National de Evaluacion y Productividad.

McNerney, J., C. Savoie, F. Caravelli, V. M. Carvalho, and J. D. Farmer (2022) "How Production Networks Amplify Economic Growth," *Proceedings of the National Academy of Sciences,* vol. 119(1).

REAL ESTATE SECTOR AND FINANCIAL STABILITY RISKS IN CHILE[1]

The Chilean real estate sector has recently undergone adjustments which have increased the risks for the financial sector, but the system remains overall resilient to such risks. In the baseline, the residential real estate market is expected to modestly recover as the past cuts to monetary policy rates gradually spill over to the sector and global financial conditions loosen; there are initial signs of recovery in the weaker office segment; and several factors mitigate credit risk. Should risks materialize, such as persistently high long-term interest rates and structural shifts in the struggling commercial real estate segment, the buffers in the financial sector currently appear broadly adequate to absorb such stresses as well as those from the tail risk of a real estate crisis. Nevertheless, supervisors should monitor these risks closely, keep advancing in closing data gaps (commercial real estate price indices), and continue to extend stress test models to comprehensively capture real estate-specific risk factors.

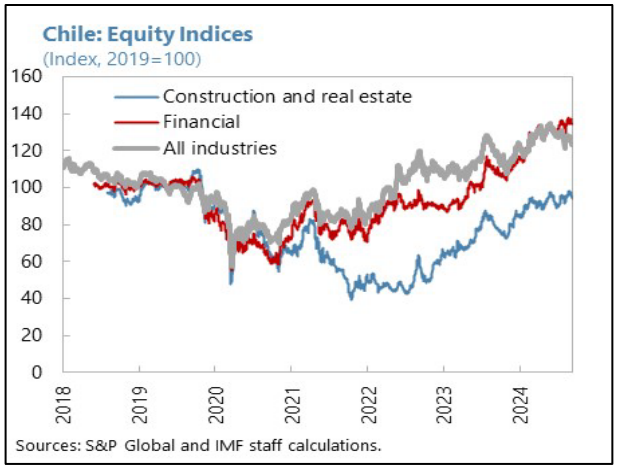
A. Introduction

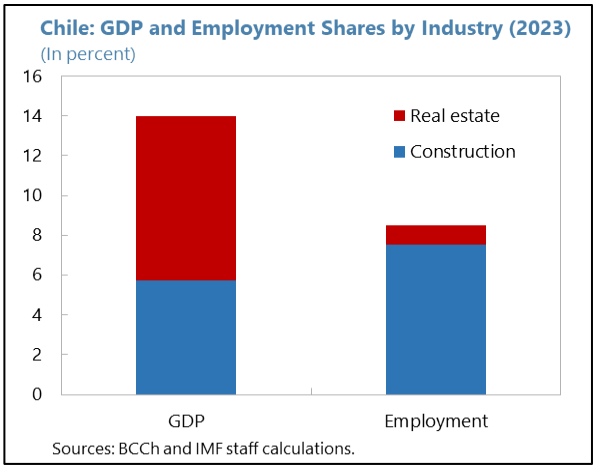
1. Investors have viewed the Chilean real estate sector as weak since the pandemic. Before the pandemic, stock prices in the construction and real estate sectors closely tracked those of other sectors. Particularly since mid-2021, however, their stocks have lagged the rest of the economy.

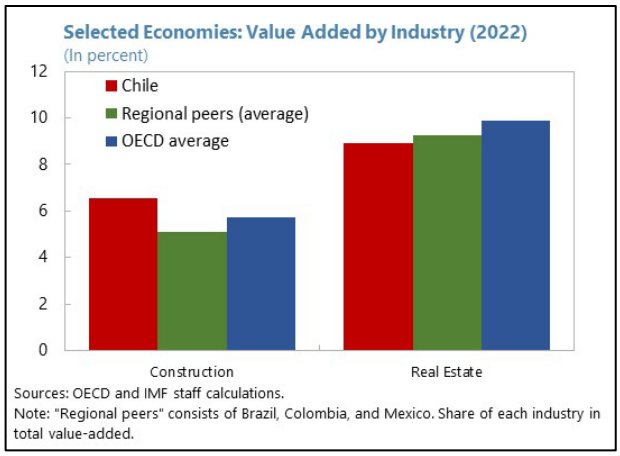
2. The Chilean real estate sector has a significant presence in the economy. The construction sector accounts for about 6 percent of nominal GDP and around 8 percent of total employment, reflecting its labor-intensive nature[2]. The real estate sector contributes even a bit more to nominal GDP (about 8 percent), but its share in total employment is only 1 percent. Compared to regional peers, the size of the construction sector relative to the economy is larger than regional and OECD peers, consistent with fact that Chilean construction firms hold substantial presence in the region, while that of the real estate sector is similar to reginal peers, but moderately smaller than OECD peers.

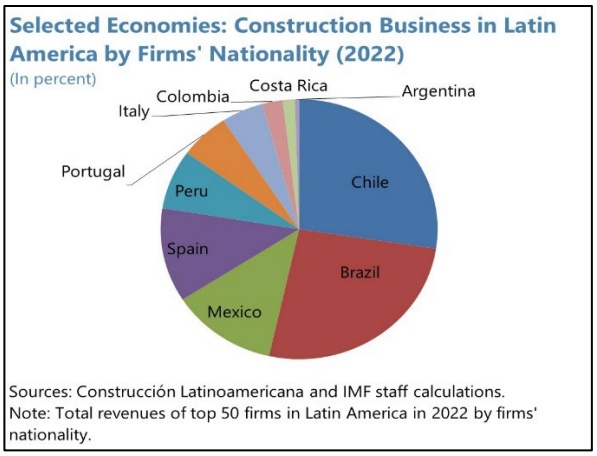
[1] Prepared by Tatsushi Okuda. The author would like to thank BCCh and CMF staff for the helpful discussions.

[2] Moreover, construction represents 63 percent of total investment in 2023, of which housing and infrastructure construction, respectively, represents one-third and two-third.





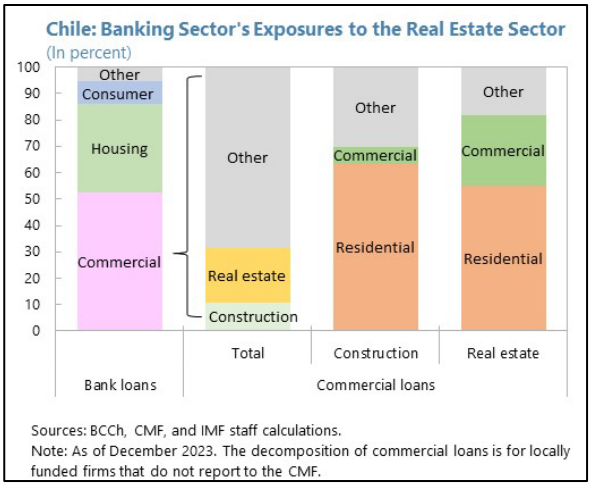


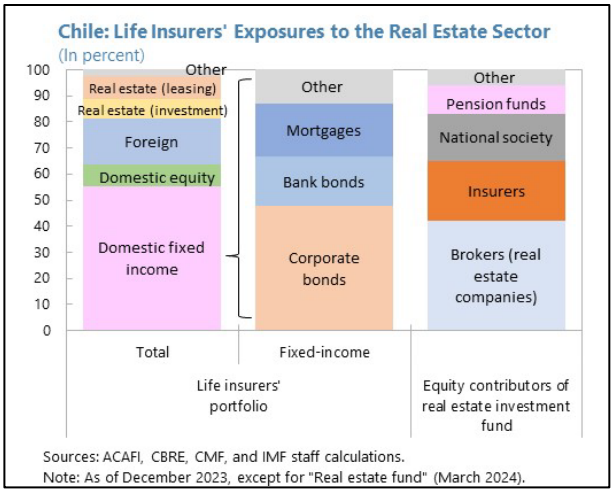


3. The Chilean financial sector has significant exposure to the real estate sector. Mortgage loans account for about 30 percent of banks' loan portfolios, and construction and real estate firms represent around 10 percent and 20 percent of commercial loans for locally funded firms, respectively,[3] while banks have gradually reduced their exposures to these firms. Most of these loans are related to residential real estate rather than commercial real estate. Life insurers' exposure now reaches about 28 percent, with 8 percent real estate investment mostly in commercial real estates such as offices and shopping centers, 8 percent leasing, and the remaining 10 percent for mortgages[4]. They also serve as major investors in real estate funds, while the amount is limited for their portfolio.

[3] "Locally funded firms" refers to firms that do not report to the CMF. Construction and real estate firms account for about 8 percent and 14 percent of total commercial loans, including those from globally funded firms (which report to the CMF).

[4] Life insurers invest in mortgage letters and loans (letras and mutuos hipotecarios) within fixed-income category.





4. In general, developments in the real estate sector can have implications for financial stability. The first channel is a direct channel or partial equilibrium effects. Specifically, a) an increase in the Probability of Default (PD) of borrowers related to real estate activities, and b) an increase in Loss Given Default (LGD) due to changes in the values of real estate property collateral, could lead to higher credit costs, ultimately harming banks' capital, absent mitigation factors (e.g., adequate provisions and collateral requirements). The second channel is an indirect channel or general equilibrium effects, involving feedback from real estate-related businesses to the macroeconomy and the PD of general borrowers. In this context, in addition to the first-round effects, potential feedback loops could occur. The specific channels indicated in the literature are, on the demand side, a) housing wealth effect on consumption (Campbell and Cocco 2007; Iacoviello and Neri 2010; Aladangady 2017; Guren et al. 2021) and b) financial accelerator (net worth) channel on investment (Bernanke, Gertler, and Gilchrist 1996, 1999 and Christensen and Dib 2008). Moreover, on the supply side, input-output linkages on intermediate goods demand could be sources of the feedbacks. Against the backdrop, IMF's past Global Financial Stability Reports (IMF 2019 and 2021) focused on this sector.

5. This study examines risks within the Chilean real estate sector, the financial sector's resilience to the risks, and the authorities' supervisory toolkits.[5] It builds on earlier work by the Central Bank of Chile (BCCh) and IMF, e.g. the BCCh's Financial Stability Reports (e.g., Box IV.1 2011H2, Box IV.1 in 2012H1, Chapter IV in 2018H2), which analyzed the financial stability implications of the residential real estate sector, the FSRs coverage of developments in the sector and banks' preparedness for the associated risks, and the 2023 Article IV staff report (IMF 2024) on vulnerabilities in the financial sector.

[5] In the context of the channels indicated above, Annex I shows that the estimated housing wealth effects via the collateral channel in Chile are non-negligible. Additionally, Annex II indicates that the spillovers from the construction and real estate sectors to other sectors, through input-output linkages, are similar to the OECD average.

B. Developments in the Real Estate Sector

Residential Real Estate

6. Homeownership in Chile is around 60 percent. This is moderately lower than the OECD average (about 70 percent) but is comparable to that of regional peers (BCCh's 2018H2 FSR). In terms of the structure of housing supply, around two-thirds are houses and one-third are apartments, with more than half of these concentrated in Santiago. Mortgage loans are less frequently used to purchase homes compared to OECD peers despite use of grant to home buyers of nearly 0.5 percent of GDP which exceeds the OECD average (data are as of 2022 in OECD Affordable Housing Database).

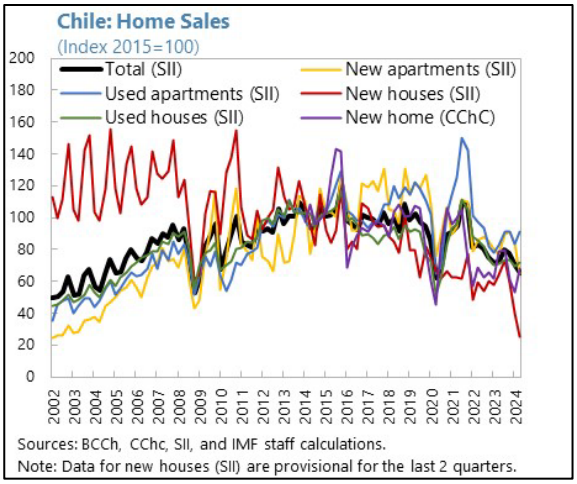
7. Stagnated demand has led to an excess supply of houses post-pandemic. Home sales, for both houses and apartments, have stagnated while stock of supply has increased corresponding to 3-4 years' worth of typical sales, although it has recently begun to slowly decrease.[6] As a result, (real) house prices have modestly declined and have not recovered to their peak levels in 2021.[7] With rent prices also declining, the recovery of demand for housing properties could take time.[8] Against this backdrop, the government has implemented supporting programs for housing.[9]

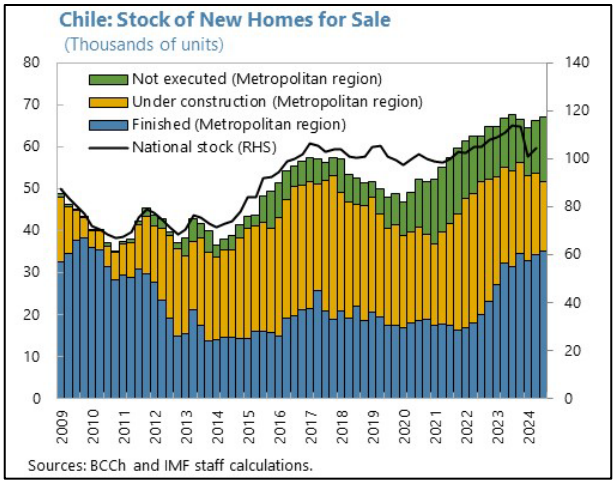
[6] In parallel, the gap between the number of pre-sales (gross sales) and of final contracts (net sales) has expanded as cancellation rates have increased. The weak demand may reflect lower affordability amid still high house prices as the estimates by the Chilean Chamber of Construction (CChC) indicate that the ratio of house price to annual income in Chile is 11.4 as of 2024. This is higher than in most advanced economies. Moreover, the supply of houses has shifted to higher-end properties. Regarding the stronger demand for apartments than houses pre-pandemic, it was likely related to demographic factors, including strong immigrant flows (for details, see Box IV in the BCCh's 2019H1 FSR).

[7] The consistent increase in house prices until 2021 appears to have been partly driven by strong demand, increases in costs to address regulatory requirements in terms of quality, safety, and sustainability of houses, and during 2021-22, increases in material and labor costs.

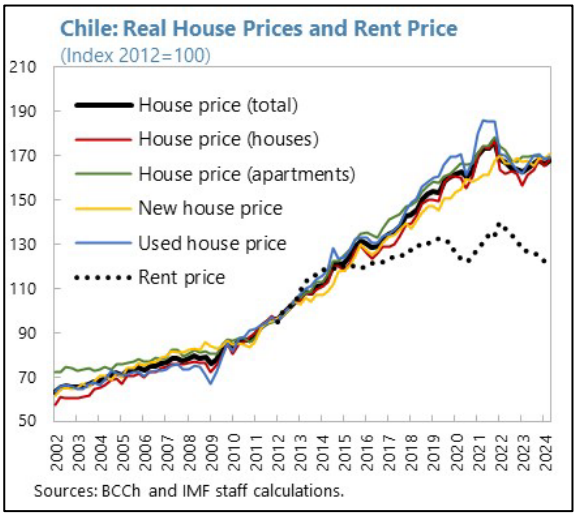
[8] The rent index used in this paper is the marginal rent index, developed by Córdova et al. (2023) and provided by the BCCh. This ensures consistency in the comparison between (marginal) house price and rent indices. The author thanks the BCCh for providing the data. Note that house prices, house and office rents, and mortgage loans in Chile are typically in the Unidad de Fomento (UF) terms, indexed to inflation. The UF is an inflation-indexed unit of account, calculated and published by the BCCh, and it is authorized for pricing credit operations in national currency by banks. For details on the calculation, see the BCCh's document.

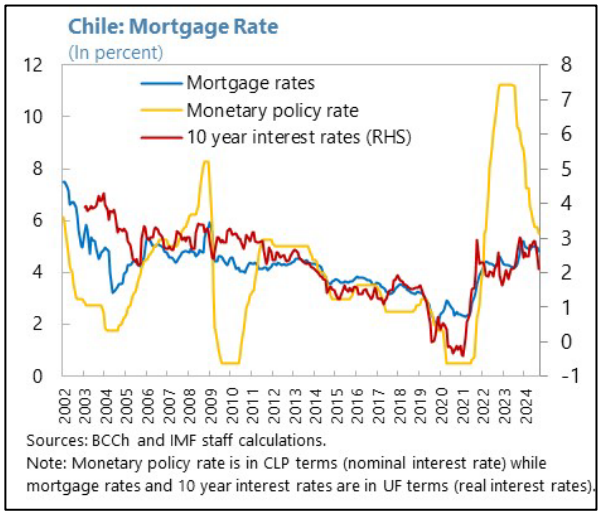
[9] For example, in the context of the housing subsidy program, the government increased the maximum eligible home price from 2,200 UF to 3,000 UF and raised the subsidy from 250 UF to 400 UF (July 2024), with doubled savings requirements to facilitate mortgages with an LTV below 80 percent. Moreover, it introduced FOGAES, providing partial guarantees for construction loans, focusing on social housing projects, and FOGAES Vivienda (until December 2024), offering state-backed guarantees up to 10 percent of the mortgage loan for first homes (up to 4,500 UF), reducing provisioning costs for financial institutions. In October 2023, it also introduced a temporary tax benefit for new home purchases via mortgages, applicable from 2024 to 2029.





8. In the baseline scenario, the market is expected to moderately recover as recent cuts in monetary policy rates gradually spill over to mortgage rates and global financial conditions ease. The decomposition of housing investment and prices, based on the estimated DSGE model (Iacoviello and Neri 2010), indicates that the current price and investment adjustment aligns with the elevated mortgage rates, caused by shocks on the rate, likely reflecting global financial conditions (see Box 1). Chilean mortgage rates closely comove with long-term interest rates, which depend not only on the (current and expected path of) monetary policy rates, but also on global long-term interest rates. Therefore, one can expect the market to modestly recover as global financial conditions loosen, supported also by the feed-through of past monetary policy rate cuts.

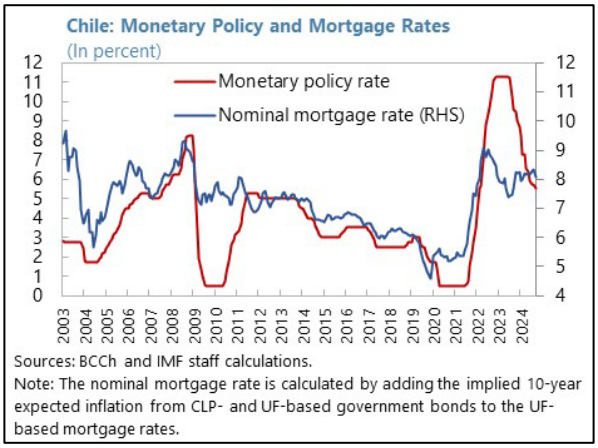




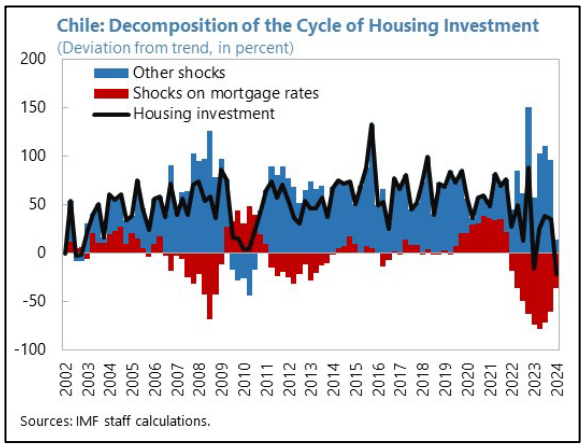
Box 1. Structural Analysis on Housing Investment and House Prices

The cyclical fluctuations of housing investment and house prices are decomposed into contributions from structural shocks, based on the estimated macroeconomic model. Specifically, the Dynamic Stochastic General Equilibrium (DSGE) model with a housing sector—developed by Iacoviello and Neri (2010)—is fitted to Chilean data from 2002Q1 to 2024Q1 (Annex I). Deviations from the trend of real housing investment and real house prices are decomposed into contributions from structural shocks, including shocks on mortgage rates.[1]

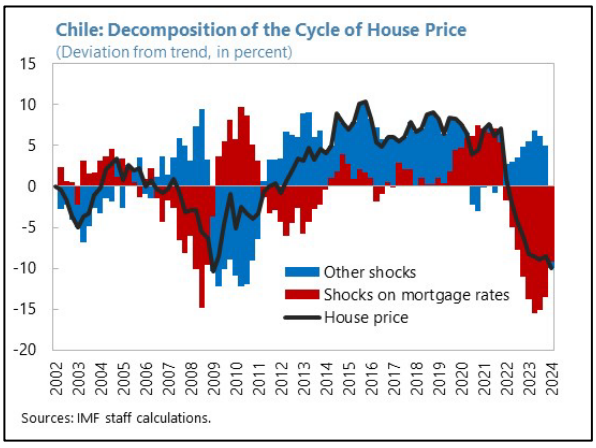
The estimation results indicate that the current adjustment can be explained by the contributions of the shocks on mortgage rates. The text charts display the decomposition results, grouping the structural shocks into two categories: shocks on mortgage rates and net of other shocks. On both housing investment and house prices, shocks on mortgage rates had a negative impact prior to the Global Financial Crisis (GFC) and since 2022, while they supported these variables during the GFC and the pandemic. Importantly, the changes in the contribution of shocks on mortgage rates from 2021 to 2023 fully explain the declines in housing investment and house prices.



Sources: BCCh and IMF staff calculations.
Note: The nominal mortgage rate is calculated by adding the implied 10-year expected inflation from CLP- and UF-based government bonds to the UF-based mortgage rates.



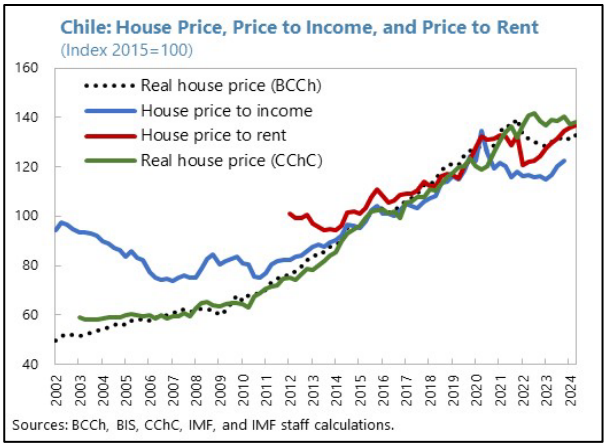
Sources: IMF staff calculations.

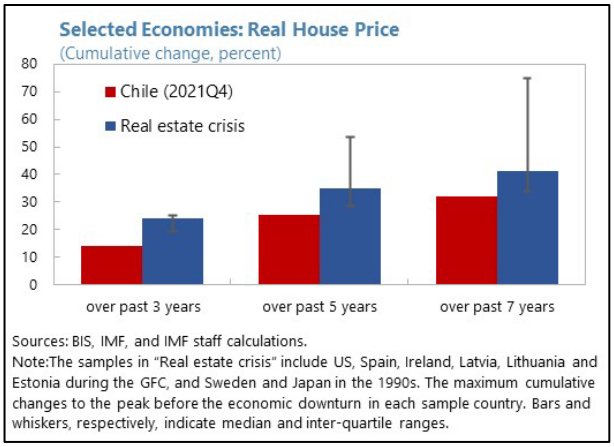


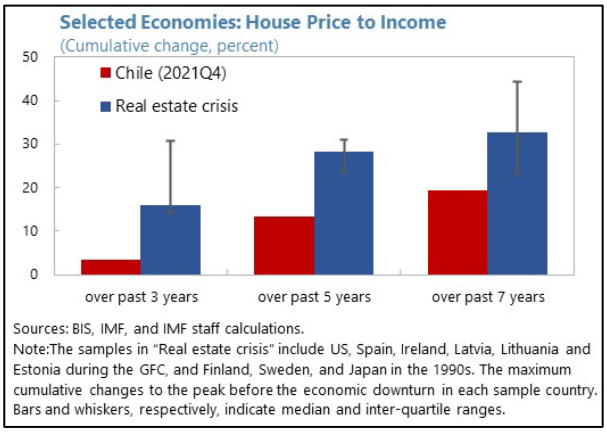
Sources: IMF staff calculations.

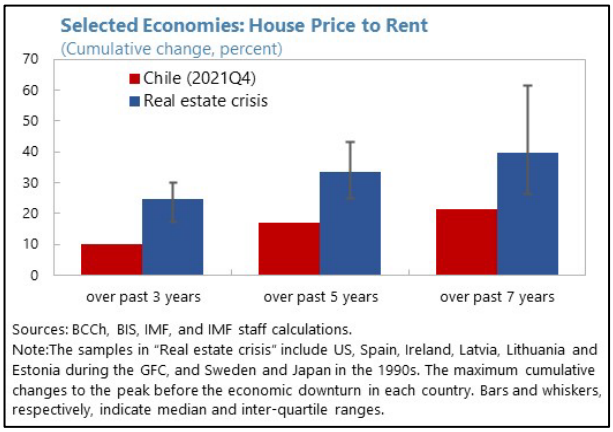
1/ The shock on mortgage rates represents the deviation of nominal mortgage rates from the estimated Taylor rule, indicating changes in mortgage rates that are exogenous to domestic macroeconomic conditions (net of the contributions from i.i.d. shocks and persistent shocks). While the original model uses short-term (30-day) rates as funding costs for households to purchase homes, this estimation replaces short-term rates with mortgage rates, and regards the i.i.d. monetary policy shock and shocks on inflation objectives as i.i.d. and persistent shocks on mortgage rates, respectively. This adjustment enables the model to capture the weak connection between monetary policy rates and mortgage (long-term interest) rates, as well as potential structural shifts in the relationship between monetary policy rates and long-term interest rates, especially following pension fund withdrawals and the subsequent decline in capital market depth.

9. House prices do not appear to be misaligned. Real house prices and standard misalignment measures, price-to-income and price-to-rent ratios[10], increased for over a decade until the pandemic and have since then moderated and stabilized, respectively.[11] The cumulative increases in these variables over the past three, five, and seven years leading up to the peak in real house prices in Q4-2021 are still smaller than those in countries that experienced real estate market imbalances and ultimately real estate crises. Specifically, Chile's cumulative increase of price-to-income and price-to-rent ratios during the past five years were about half of the median five-year increase in real estate crises countries prior to their crises event. The BCCh's 2010H1 FSR (Box 3) finds that over 40 percent of the growth in housing prices is explained by macro-financial factors, including household income, GDP growth, mortgage interest rates, and the IPSA stock index (for similar results see also Idrovo-Aguirre et la. (2021), the BCCh's 2018H2 FSR, and the BCCh's 2024H2 FSR (Box II.1), including the role of demographic variables and construction costs).







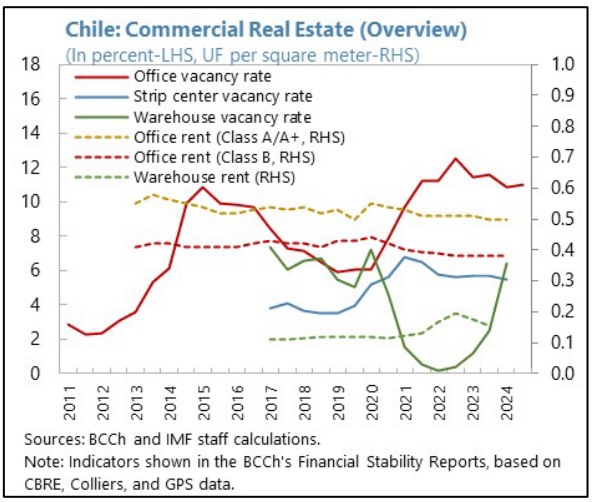


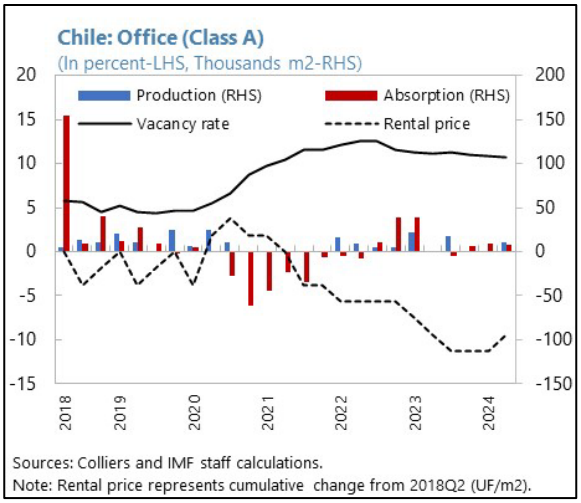
[10] The house price-to-rent ratio for Chile is calculated by dividing general (marginal) house price index (published by the BCCh) by the marginal rent index, developed by Córdova et al. (2023) and provided by the BCCh. Córdova et al. (2023) also show the house price to rent ratios by type of properties and by region. The rental yield (annual rent-to-price ratio) had moved in parallel with mortgage rates until the recent rise in long-term rates (BCCh 2024).

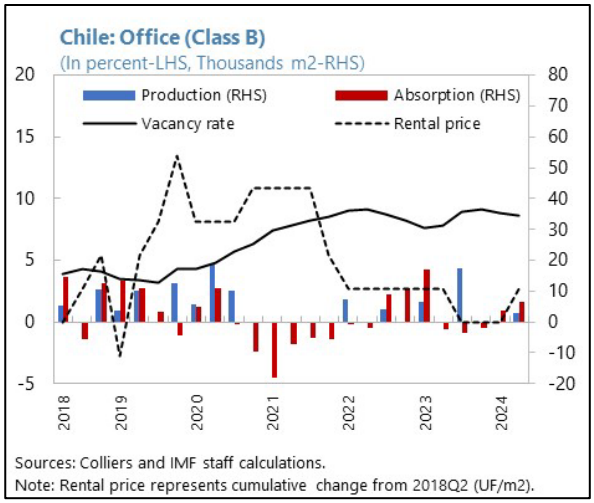
[11] The increase in real house prices relative to rent prices in Chile until 2021 could be attributed to the low ratio of mortgage burden (principal repayment and interest payments) to rent burden, due to long average maturity in mortgage loans (approximately 25 years) and consistent declines in mortgage rates. According to OECD Affordable Housing Database, as of 2017, median of the mortgage burden and rent burden (private market and subsidized rent) as a share of disposable income was, respectively, 15 and 24 percent.

Commercial Real Estate

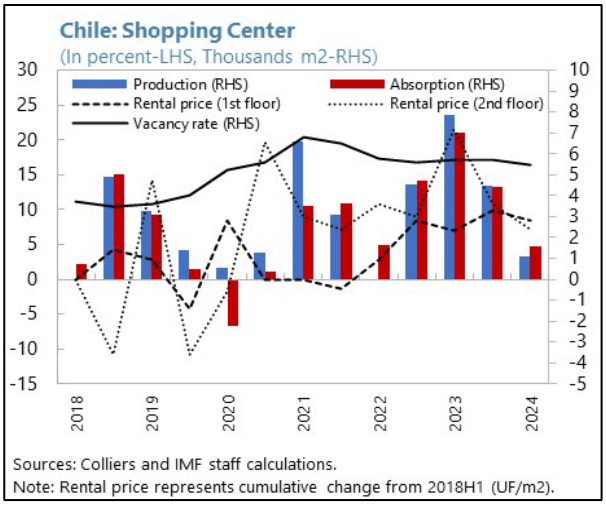
10. Since the pandemic, offices have faced a lack of demand; however, there are recent indications of a gradual recovery. According to the indicators in the BCCh's FSRs, vacancy rates have stayed mostly elevated in offices and shopping centers since the pandemic, while the rate has recently declined in warehouses. A closer examination of each sector, based on data provided by the private sector, indicates that in the office sector, rental prices appear to be rebounding, despite both demand (absorption) and supply (production) being low.[12] In the shopping center segment, although the vacancy rate moderately increased during the pandemic, probably due to lockdowns, the sector has exhibited some dynamism and the vacancy rate has recently been gradually decreasing. In the warehouse segment, the vacancy rate has risen from nearly zero, which reflected an increased demand for e-commerce activities, and lease prices have declined due to recent production outpacing absorption. In the hotel segment, the occupancy rate has been gradually recovering since the sharp decline during the pandemic, although this recovery is partly supported by a reduced number of rooms in operation. Looking ahead, real investment funds expect continued decline in office vacancy and continued increase in warehouse (industrial) vacancy.



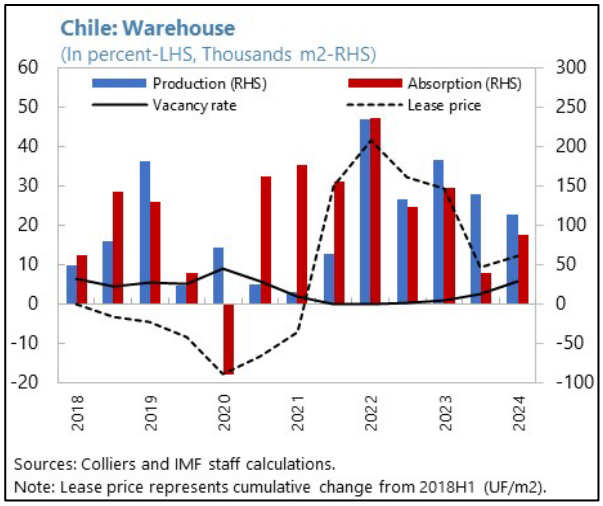




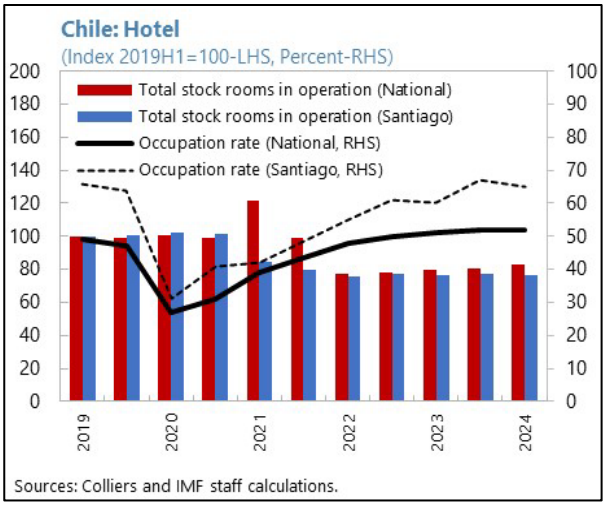
[12] The recovery in vacancy rates and rents are stronger in Class A offices, rented by large firms and government, than Class B offices, rented by SMEs. In terms of geographical heterogeneity, downtown Santiago area, the epicenter of the 2019 social unrest, has faced significantly elevated vacancy and reduced rents, as many large firms moved to other areas in Santiago.



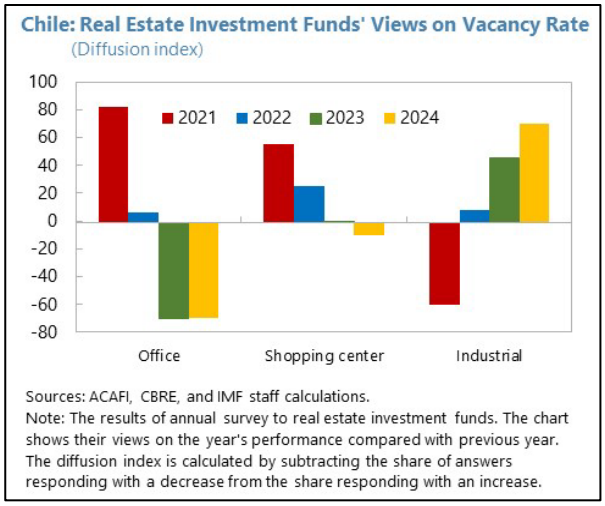
Sources: Colliers and IMF staff calculations.
Note: Rental price represents cumulative change from 2018H1 (UF/m2).



Sources: Colliers and IMF staff calculations.
Note: Lease price represents cumulative change from 2018H1 (UF/m2).



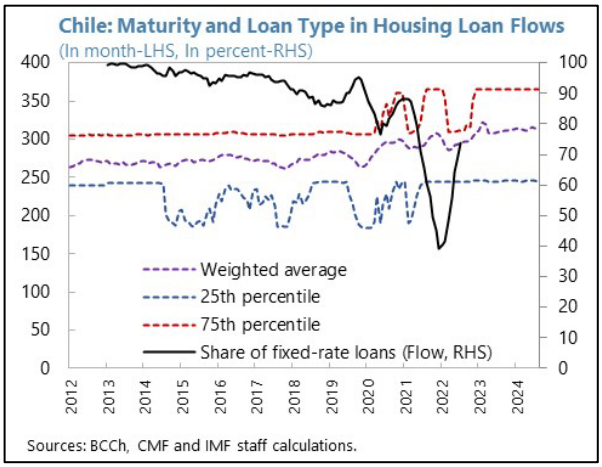
Sources: Colliers and IMF staff calculations.



Sources: ACAFI, CBRE, and IMF staff calculations.
Note: The results of annual survey to real estate investment funds. The chart shows their views on the year's performance compared with previous year. The diffusion index is calculated by subtracting the share of answers responding with a decrease from the share responding with an increase.

Housing Loans

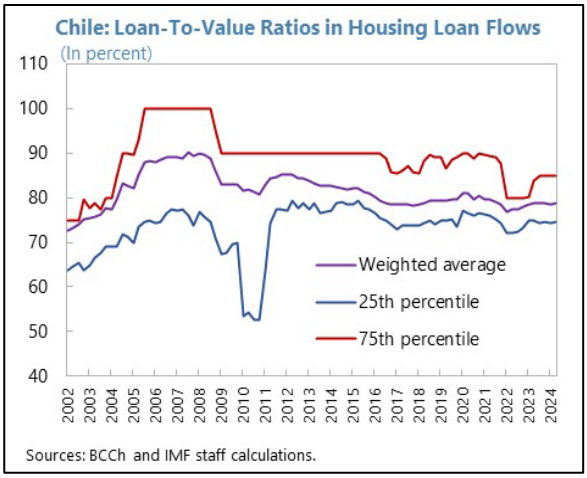
11. Most housing loans are fixed-rate (in real term), with maturity of 20 to 30 years and loan-to-value (LTV) ratios around 80 percent, primarily concentrated among high-income households.[13] During the low-rate environment of the pandemic, the share of mixed-rate loans—those with fixed rates for the first five years that then switch to variable rates—has increased, and as of 2023, about 10 percent of the mortgage debt stock is

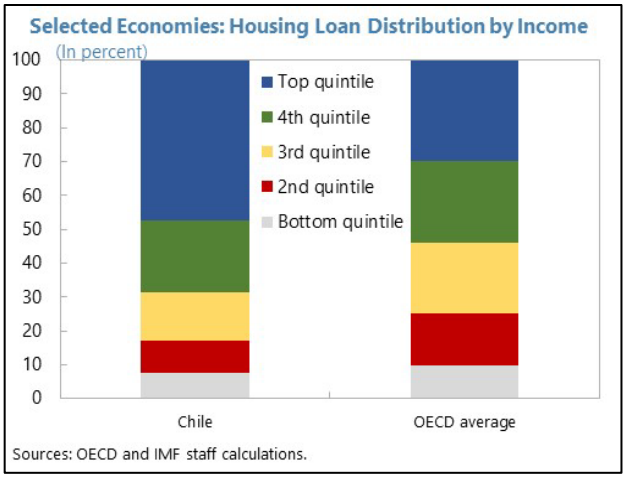


Sources: BCCh, CMF and IMF staff calculations.

[13] Mortgage loans operate under a full recourse system. This means that if a borrower defaults and the proceeds from the foreclosure sale fall short of covering the loan repayment, the creditor has the right to seek the remaining balance from the borrower's other assets, not just those tied to the mortgage. This framework discourages strategic defaults, and instances of default are largely linked to macroeconomic factors. Micco et al. (2012) provide an overview of Chilean mortgage markets, including the factors contributing to the resilience of mortgage borrowers.

indexed to mixed rates, predominantly among high-income households (see also Chapter V of the BCCh's 2023H1 FSR). As of 2023, variable-rate loans comprise only 3 percent of the total housing loan stock. Loan principal and interest payments are denominated in the UF, meaning they reflect real terms; thus, higher CPI inflation leads to increased repayments and interest rates for borrowers, whose incomes are not indexed to inflation. LTV ratios are concentrated around 80 percent, which is considered the threshold for non-high LTV according to a rule of thumb, and have remained stable.[14] Furthermore, the distribution of housing loans by income level shows that the share of high-income borrowers in Chile is significantly higher than the OECD average.



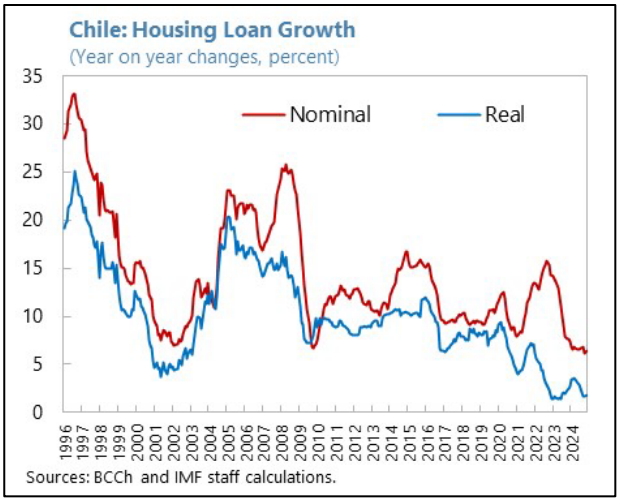


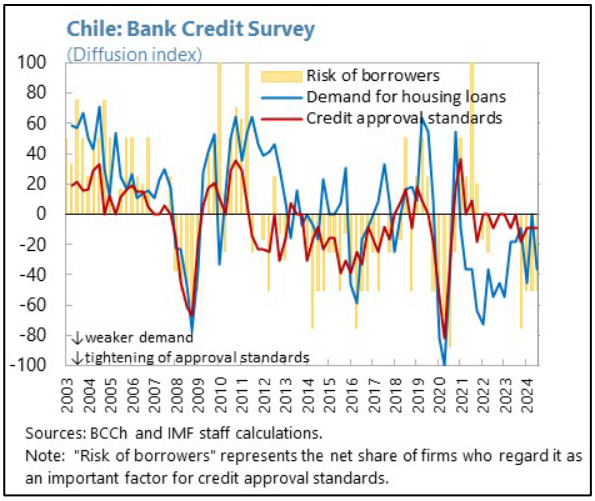
12. The housing loan growth is at a historical low amid elevated mortgage rates, which remain significantly higher than pre-pandemic levels. These rates are closely tied to long-term interest rates and have been relatively unaffected so far by recent cuts in monetary policy rates. Bank credit surveys suggest that weak demand, amid high borrowing costs, is the primary factor influencing the subdued credit growth.[15] Note that under the same level of mortgage rates, compared with 10 years ago, the financial burdens for borrowers are now significantly higher because of the higher house price levels (Chilean Banking Association <ABIF> 2024a).[16] According to the BCCh (2024), this weakness in demand could also be contributed by the recent decrease in or even the negative margin between rental yield and mortgage rates. At the same time, credit standards have tightened slightly, indicating a modest decline in borrower creditworthiness.

[14] Alegría et al. (2021) note that the tail of the distribution (90th percentile) was flexibly adjusted based on alerts from the authorities.

[15] The diffusion index (DI) for "credit approval standards" ("demand for housing loans") is calculated as the difference between the number of banks that responded indicating credit approval standards were less restrictive (credit applications became stronger) and the number of banks that responded indicating the standards were more restrictive (credit applications became weaker), expressed as a percentage of total responses. Hence, the decrease in the degree of negative values indicates that credit approval standards (demand for housing loans) are still tightened (became weaker).

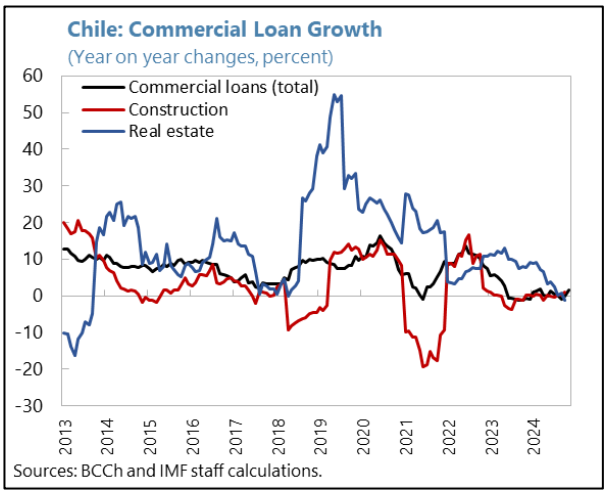
[16] According to estimates by the CChC, the financial burden and required household income for the same type of houses, assuming a 20 percent down payment, nearly doubled from October 2019 to June 2024.



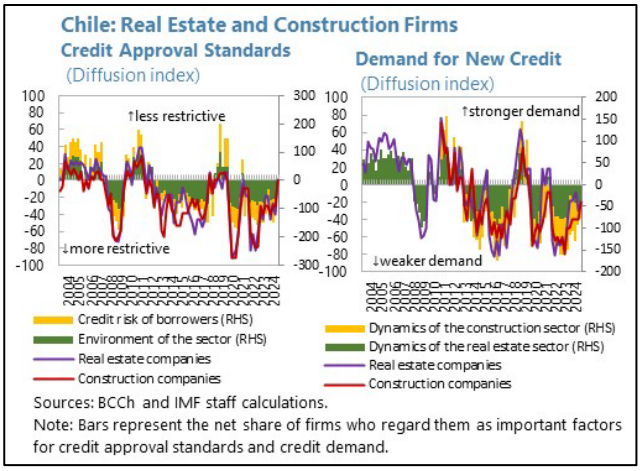


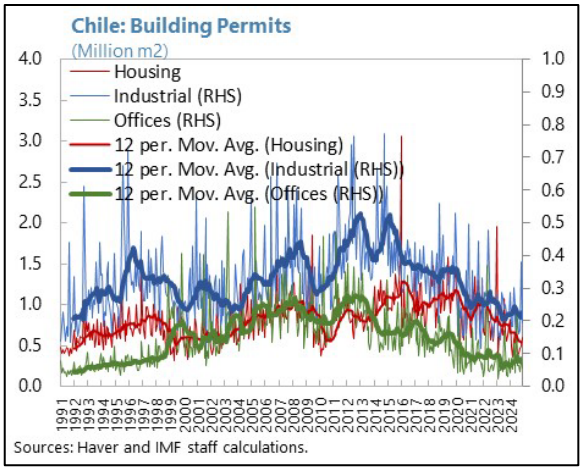
Commercial Loans to Construction and Real Estate Sector

13. The growth of credit to construction and real estate firms has stagnated amid tightened lending standards and weak sector dynamism. Since 2023, amid declining monetary policy rates, nominal credit growth to the construction sector has been nearly zero, while the real estate sector has experienced a gradual decline, reaching zero.[17] According to bank credit surveys, banks have tightened their credit approval standards due to the declining creditworthiness of these firms, and they report weak demand resulting from developments in the sector. This perspective on weak credit demand aligns with the real economy data, which show that building permits for residential, industrial, and office projects have all been on a downward trend.



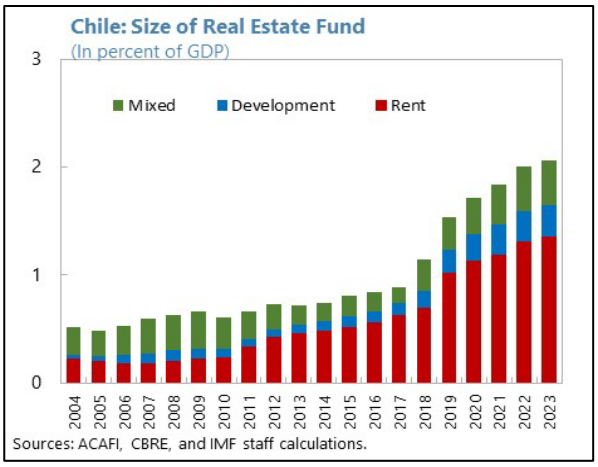
[17] Loans to construction firms tend to be shorter than those to real estate developers. Real estate developers typically use bank loans to finance the cost of building properties, while using their own funds to invest in land.

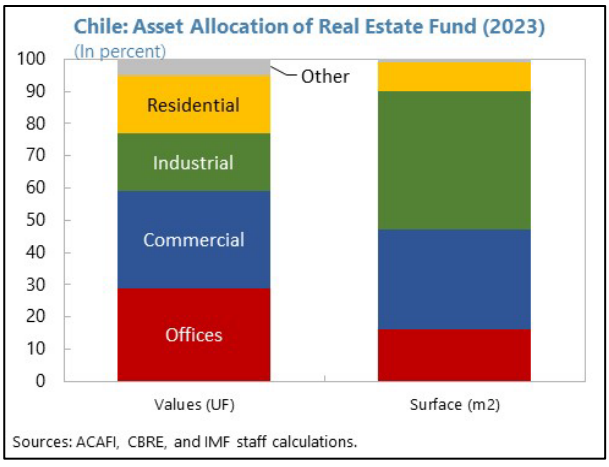




Real Estate Investment Fund

14. The size of the real estate investment fund sector remains limited, although it has trended upward.[18] These funds invest in office, commercial, industrial, and residential properties, resulting in diversified exposures across segments at the aggregate level. However, at the individual fund level, they tend to focus their investments more heavily on specific sectors (see also CBRE and ACAFI, 2024). As of the end of 2023, investments by funds in the commercial real estate sector accounted for 11 percent of total monitored office properties and 25 percent of industrial properties, based on surface area data from CBRE, while they are becoming more exposed to infrastructures such as data centers. Some real estate investment funds appear to be experiencing financial stress due to valuation losses, while the relatively small size of the sector indicates that these losses are unlikely to pose a systemic risk.[19]



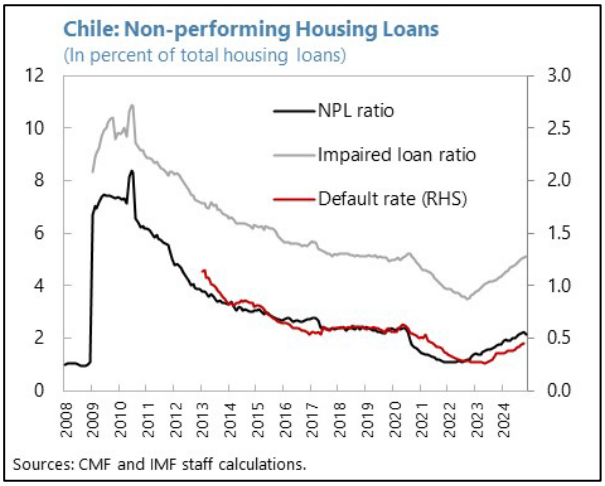


[18] A real estate investment trust (REIT) does not exist in Chile. Also, foreign investor participation in Chilean real estate investment fund is nearly zero, according to the Chilean Association of Investment Fund Administrators (ACAFI).

[19] Further mitigating factors are a limited number of closed-ended real estate investment funds whose initial terms are scheduled to expire during 2024 and 2025, as prescribed in the prospectus, and the internal regulations of each fund providing the managers with time to liquidate assets to avoid losses.

C. Credit Risk

15. Mortgage borrowers overall appear resilient, but vulnerabilities arise from the high leverage of some borrowers which need to be carefully monitored. The indebtedness of mortgage borrowers does not seem to have worsened, as at the aggregate level, household-debt-to GDP and mortgage debt-to-GDP ratios have stabilized since the pandemic. Additionally, at micro-level, household leverage and financial burdens appear to be improving.[20] However, borrower leverage is quite heterogeneous, with some individuals exhibiting high levels of debt,[21] and it is reported that, during 2012-13, a significant portion (about 16 percent on average) of mortgage loans was coupled with unsecured consumer loans to finance down payments, although this fraction decreased from 21 percent to 14 percent over the sample period.[22] This suggests that as many borrowers are significantly leveraged, the risk of rapidly increasing interest payments on consumer loans (used to finance down payments) in a high-interest-rate environment could lead to greater financial strain, particularly in the early years of the loans. Although the size of vulnerable borrowers may not pose a systemic risk, it is essential to monitor this situation. Furthermore, from the perspective of banks' credit risk assessments, the enactment of the Law to establish a consolidated debt registry in July 2024 is expected to help banks' risk management practices (Box II.2 in the BCCh's 2018H2 FSR and Box V.2 in the BCCh's 2021H1 FSR).



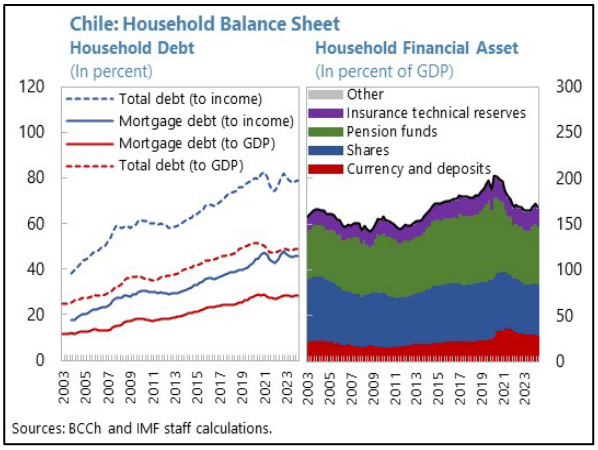
16. Non-performing loan (NPL) ratios in housing loans have moderately rebounded, likely as part of the normalization process. Following a decline after the GFC, NPL ratios further decreased during the pandemic, due to increased household liquidity from pension fund

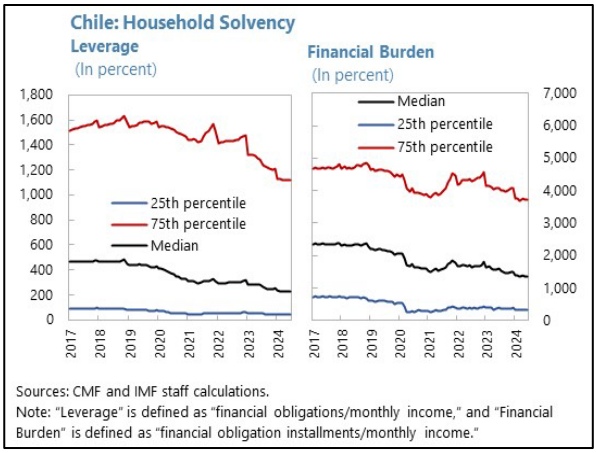
[20] The analysis in the BCCh's 2024H2 FSR, based on households' microdata, indicates that the bank debt-to-income (leverage) and financial burden ratios for the median household in each income group (based on nominal income in Chilean peso terms) are now comparable to pre-pandemic levels, showing no improvements, contrary to what is depicted in this chart. This suggests that the increase in nominal income, rather than a decrease in the nominal amount of debt and repayments relative to the same level of nominal income, is more likely to have contributed to the improvements shown in the chart.

[21] According to the BCCh's 2018H2 FSR, at the end of the first half of 2018, nearly 30 percent of bank mortgage debt was held by borrowers with two or more mortgages. Most of these borrowers have their real estate assets located in the same region, indicating that these properties are likely not second homes for personal use but rather investment properties intended for rental purposes.

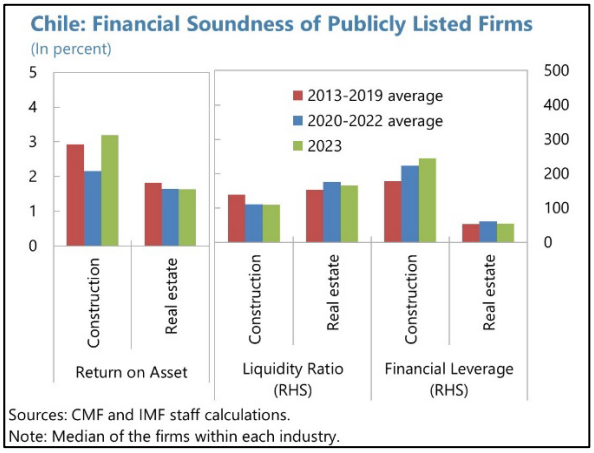
[22] Oda and Sepulveda (2014), using data from 2012-13, examined the unsecured loans granted to mortgage borrowers shortly before or after their mortgage approval. They found that approximately 16 percent of granted mortgages were paired with an unsecured loan. The amount of unsecured loans accounted for about 10 percent of the total mortgage loans, and the average monthly payment for these unsecured loans was around 80 percent of the mortgage payments, largely due to higher interest rates and a shorter average term to maturity of about five years. According to private banks, this type of financing behaviors seems to have basically disappeared at present.

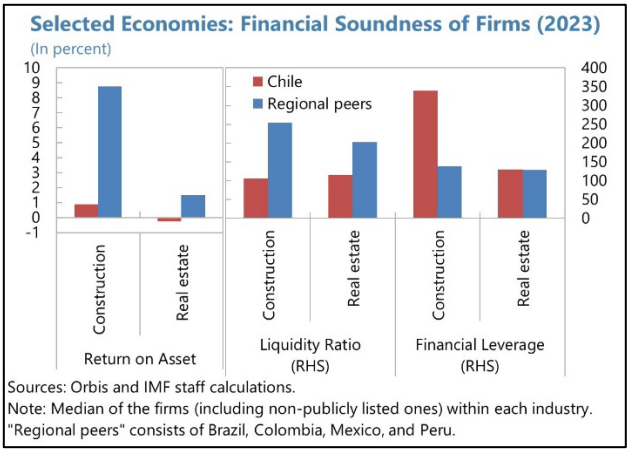
withdrawals. Since 2022, these ratios have risen again and approach pre-pandemic levels, likely reflecting the ongoing normalization of household liquidity.





17. The creditworthiness of construction and real estate firms appears to be gradually deteriorating. Since the pandemic, the liquidity ratios and financial leverage of publicly listed construction firms appear to have worsened, while those of publicly listed real estate firms have remained relatively stable. A comparison in 2023 between publicly listed (large) firms and all firms indicates that smaller firms tend to face more challenging business conditions, characterized by lower profitability and liquidity ratios.[23] Compared to regional peers, both construction and real estate firms appear more vulnerable, showing lower profitability, lower liquidity ratios, and higher leverage. These observations seem consistent with the developments in construction activity and business conditions of the construction firms.[24] Moreover, to alleviate liquidity pressures, some real estate developers seem to be starting to rent out properties (inventories) until they find buyers.

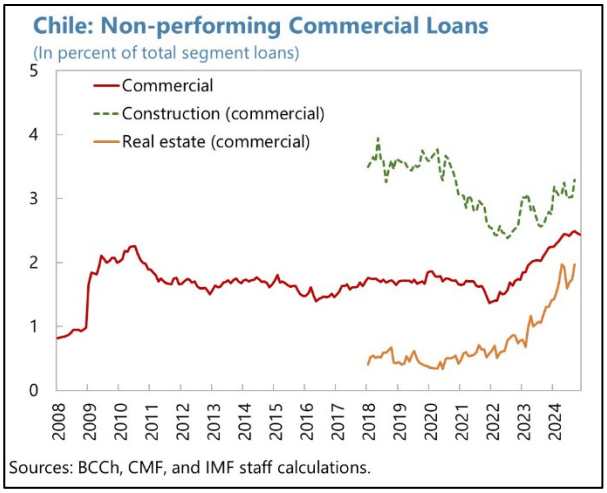




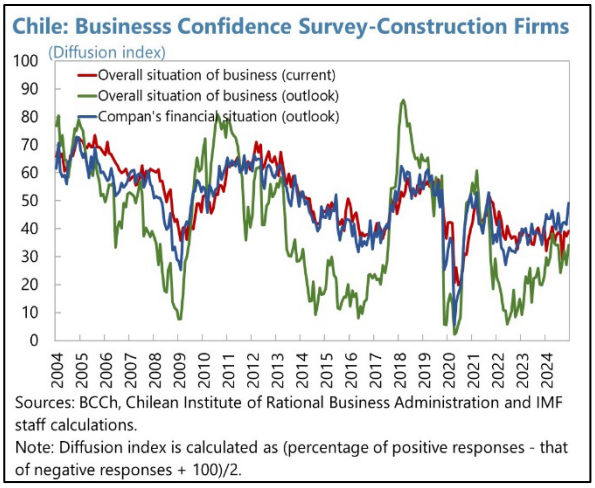
[23] Large construction firms operate globally or in regional peers (mainly Peru), diversifying their business portfolios, according to their financial statements.

[24] According to the CChC, the real construction investment dropped by -1.0 percent in 2023, driven by private housing construction (-2.5 percent). Financial conditions and debt levels of construction companies have weakened since the pandemic due to quarantines, rising material and financing costs, temporary labor shortages, and longer construction times.

18. Non-performing loan ratios in the construction and real estate sectors have recently been rising.[25] This trend is consistent with the deterioration of creditworthiness in these sectors. In the construction sector, however, according to the business confidence survey for construction firms, their negative outlook on business and financial conditions has recently shown a modest rebound, approaching neutral levels. This might be because many projects have recently been completed, alleviating liquidity pressures for construction firms, while increasing liquidity stresses for real estate developers.[26] It is also possible that it partly reflects the easing of access to loans due to FOGAES program, introduced by the government in April 2023 and running until December 2024, which provides partial guarantees for loans to construction firms (see also ABIF, 2024b).

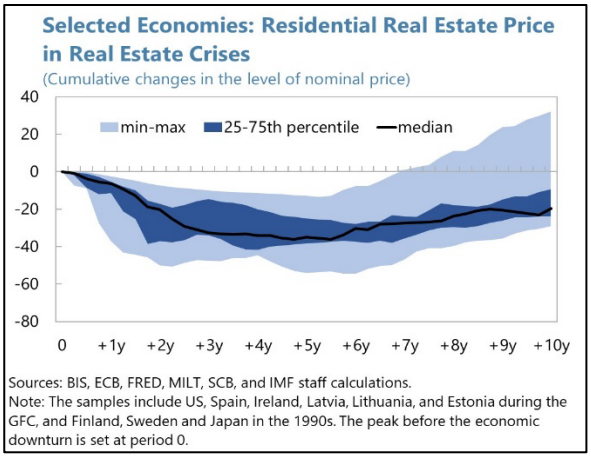


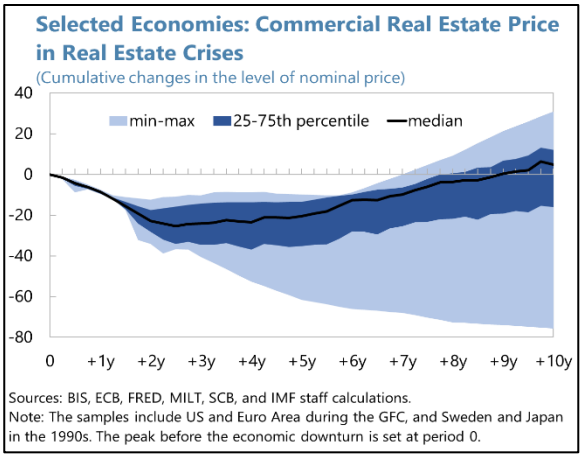
19. Changes in the values of real estate properties can potentially lead to credit costs through the decline in collateral values. Not only are housing loans primarily backed by these properties, real estate assets are often used also as collateral for commercial loans, particularly for SMEs. Given that past real estate crises in other countries have resulted in significant and prolonged declines in both residential and commercial property prices—for the median country it took a decade or more for residential/commercial prices to return to pre-crises levels, the risk of deterioration in Loss Given Defaults due to falling collateral values is important.



[25] The recent increase in NPL ratios in commercial loans is concentrated among SMEs that received government guarantees during the pandemic. FOGAPE-COVID and FOGAPE-Reactive, introduced in April 2020 and January 2021, respectively, provided guarantees to SMEs for working capital loans (the BCCh's 2024H2 FSR).

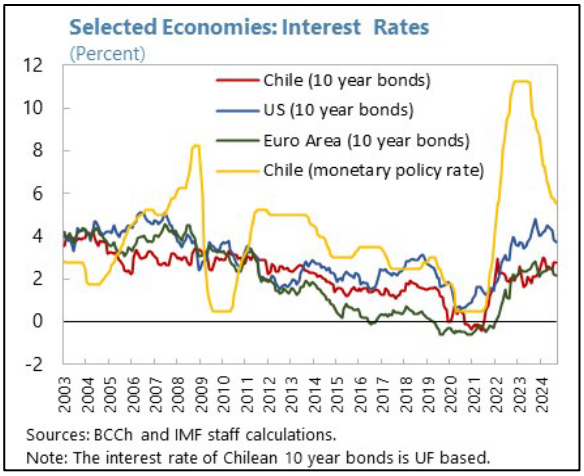
[26] According to Aninat et al. (2024), the default rate of construction firms significantly rose through 2022-23 (from 4 to 9 percent), before starting to level off in 2024 to 8 percent. In contrast, the default rate of real estate developers has been consistently increasing, reaching at 5 percent, above the pre-pandemic range (1-2 percent).

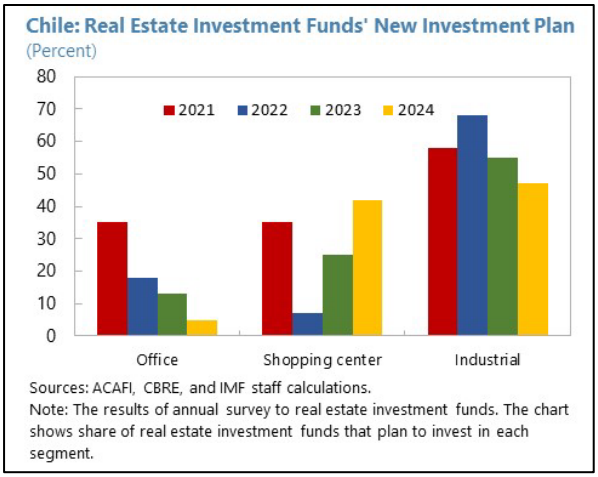




Risk Scenarios

20. Persistently high long-term interest rates and stagnation in the office sector could exacerbate challenges in the residential and commercial real estate markets, with potential spillover effects on construction and real estate firms.[27] Historically, monetary policy rate cuts have not always resulted in declines in long-term interest rates, especially when global interest rates remain high, which is currently the case. Should long-term interest rates remain elevated for a prolonged time, this could further weaken the creditworthiness of borrowers in the construction and real estate sectors and delay the recovery of construction activity. Also, if the weak demand for offices implies structural shifts, as surveys of real estate investment fund suggest a lack of investment, this could have lasting negative impacts on life insurers' investment portfolios. To prepare for these risk scenarios, it is essential to closely monitor the adequacy of NPL provision and collateral coverages for real estate-related loans and the concentration of life insurers' portfolios in underperforming segments, such as offices.





[27] The spillovers of external stress via foreign investors appear contained. Although foreign investors in Chile have the same property rights as local citizens and face very few restrictions on property purchases, their participation in the Chilean real estate market remains low, according to authorities and the private sector, while statistics on foreign investment participation are not available.

D. Preparedness of Financial Sector

21. NPL provision coverage for housing loans and commercial loans is around pre-pandemic levels at the aggregate level, and the banks loans are conservatively collateralized. For housing loans, banks accumulated additional provisions during the pandemic when NPL ratios were low, and the current levels of these provisions are now similar to pre-pandemic levels. This suggests that NPL ratios are so far aligning with banks' expectations. At the bank level, those with lower provision coverage in the pre-pandemic period have since improved their levels. A mitigating factor for mortgage loans is their concentration in domestic systemically important banks (D-SIBs), which account for 94 percent, which is higher than their share in commercial and consumer loans at 85 percent and 83 percent, respectively. NPL provision coverage for commercial loans shows a similar pattern to that of housing loans. However, a closer examination reveals that NPL provision coverage for real estate firms has recently declined at a faster rate than for total commercial loans, while coverage for construction firms appears to have increased. In this regard, according to the authorities, these loans are conservatively collateralized,[28] and banks have recently accumulated more collaterals rather than further provisions.

22. Banks' capital ratios and capital buffers (capital ratios minus capital requirements) have increased since the pandemic, indicating stronger resilience. At the aggregate level, the banking sector's capital adequacy ratios have risen significantly, largely due to the steady implementation of Basel III capital requirements. Simultaneously, capital buffers have also increased, reaching approximately 5-6 percent. Banks with lower capital buffers are primarily D-SIBs, partly due to higher capital requirements. Given that declines in capital ratios during GFC-type scenarios (in the US, Europe, and Japan) range from 2-5 percent, which is close to the decline in capital ratio in the BCCh's stress test, this 5-6 percent buffer can be considered adequate.[29] Moreover, the BCCh's exercise (Box II.1 in the 2024H2 FSR), on the resilience of banks against an abrupt drop in real estate prices (the market value of collateral) suggests that even a substantial decline in the real estate prices would not significantly harm the solvency of the banks, thanks to conservative collateral valuations under the regulations, where the values assigned reflect the appraisal at the time the loan was granted and do not include the increase in housing prices over the last decade.[30]

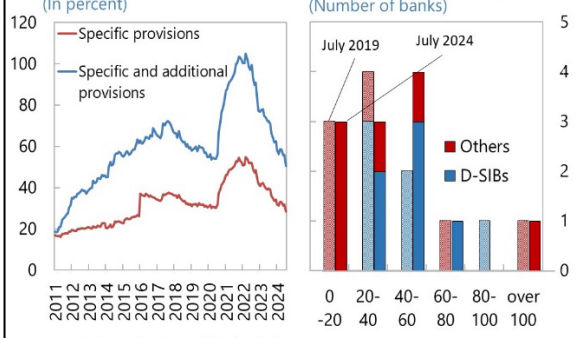
[28] About 90 percent of commercial loan exposures related to real estate is covered by the real estate collaterals, which is significantly higher than the coverage for other sectors (40 percent) (Box II.1, the BCCh's 2024H2 FSR). Regarding mortgages, the vast majority have LTV ratios of less than 80 percent. Additionally, the collateral valuations conducted by banks are conservative, in line with CMF regulations, as they are based on values at the time of granting the loan and do not reflect the increase in house prices over the past decade.

[29] Although the definitions of CET1 ratios and Chilean capital adequacy ratios differ, the changes in these ratios should be comparable to some extent, as both are primarily influenced by profits and losses. In fact, in the top-down bank stress tests in the BCCh's 2024H2 FSR, the declines in capital adequacy ratios and CET1 ratios are similar.

[30] The exercise indicates that a 20 percent drop in house prices would increase provision requirements by 0.33 percent of banks' risk-weighted assets (i.e., a decline in capital ratios by 0.33 percent). In the case of a 30 percent decrease in the market collateral values for commercial loans to real estate and construction sectors, provision requirements would increase by 0.26 percent of the risk weighted assets.

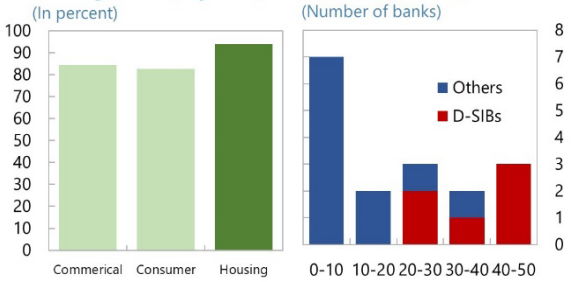
Figure 1. Preparedness of Banking Sector

Chile: NPL Provision Coverage of Housing Loans



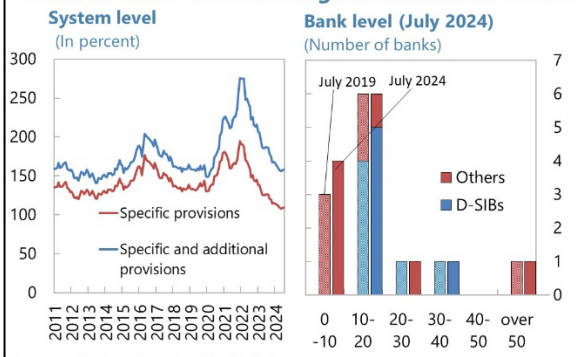
Sources: CMF, and IMF staff calculations.
Note: X-axis in the right chart represents provision coverage (percent).

Chile: Market of Housing Loans



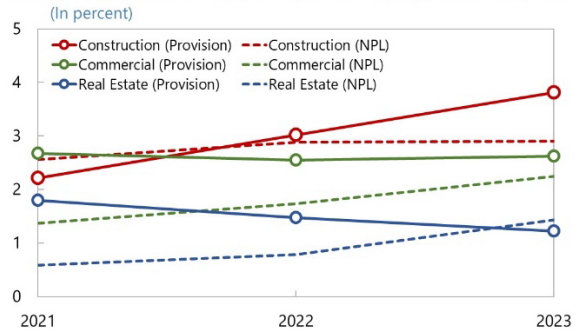
Sources: CMF, and IMF staff calculations.
Note: X-axis in the right panel represents the share of mortgage loans in total loans for individual banks (percent).

Chile: NPL Provision Coverage of Commercial Loans



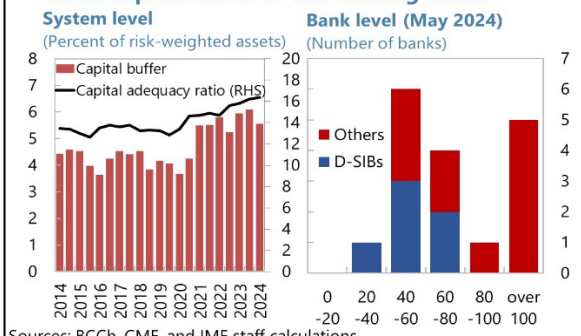
Sources: CMF, and IMF staff calculations.
Note: X-axis in the right chart represents provision coverage (percent).

Chile: Provision for Real Estate and Construction Firms



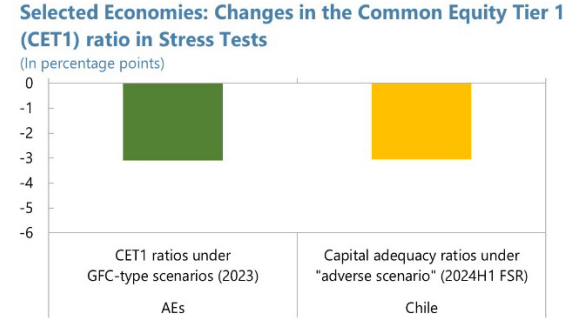
Sources: Banks' disclosures, and IMF staff calculations.
Note: "Provision" represents the weighted average of the provision ratio of D-SIBs and "NPL" indicates the non-performing loans ratio of the financial system.

Chile: Capital Buffer of the Banking Sector



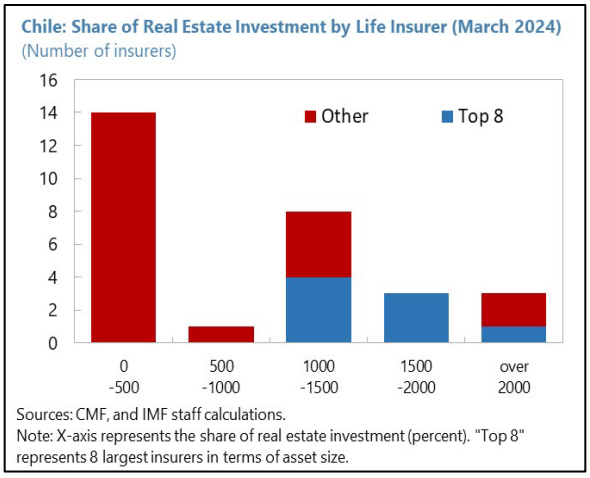
Sources: BCCh, CMF, and IMF staff calculations.
Note: X-axis in the right chart represents the capital buffer (percent of risk-weighted assets). The regulatory requirements on individual banks follow data from the CMF's database on banks' balance sheets.

Selected Economies: Changes in the Common Equity Tier 1 (CET1) ratio in Stress Tests

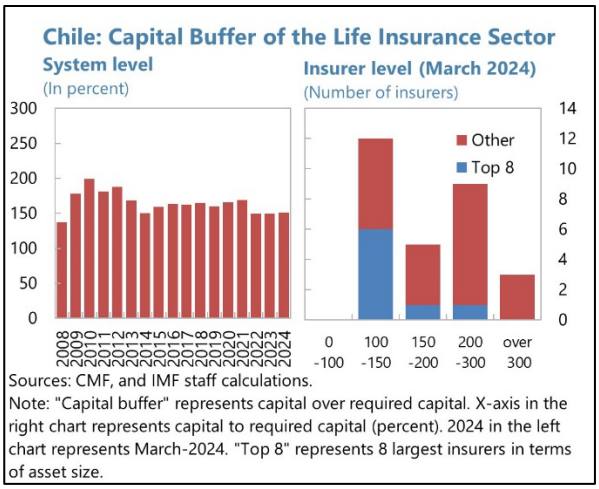


Sources: BCCh, BOE, BOJ, CMF, EBA, FRB, and IMF staff calculations.
Note: Stress tests in "AEs" consist of aggregate results in stress tests by the BOE (2022/23), the BOJ (2023 October FSR), the EBA (2023) and the FRB (2023 DFAST), where the bar and whisker, respectively, represent median and min-max. "GFC" represents the global financial crisis.

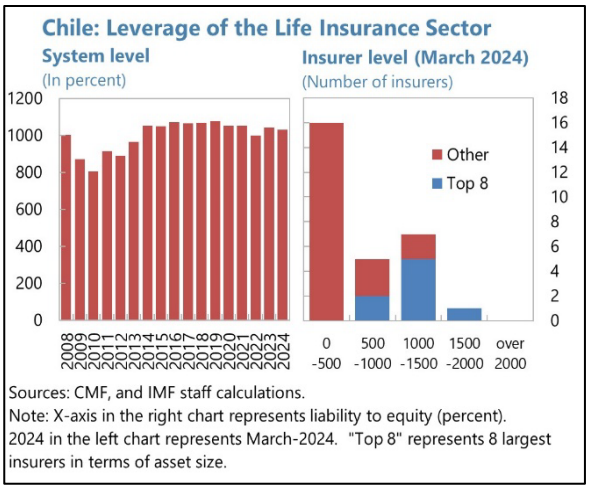
23. Capital buffers and leverage among life insurers have remained stable, while real estate investments are concentrated among major insurers. Exposures to real estate investment vary significantly across life insurers, with most of those having high exposures are among the top eight insurers by asset size. This concentration could be seen as a mitigating factor, as large insurers typically benefit from diversification in their portfolios. However, it also suggests that their exposures to the real estate sector could pose systemic risk implications for financial stability. At the aggregate level, life insurers' capital buffers have been stable, comfortably above regulatory requirements, and financial leverage has also remained stable at the level below regulatory maximum of 20. However, the top eight insurers tend to have lower capital buffers and higher leverage.



Sources: CMF, and IMF staff calculations.
Note: X-axis represents the share of real estate investment (percent). "Top 8" represents 8 largest insurers in terms of asset size.



Sources: CMF, and IMF staff calculations.
Note: "Capital buffer" represents capital over required capital. X-axis in the right chart represents capital to required capital (percent). 2024 in the left chart represents March-2024. "Top 8" represents 8 largest insurers in terms of asset size.



Sources: CMF, and IMF staff calculations.
Note: X-axis in the right chart represents liability to equity (percent). 2024 in the left chart represents March-2024. "Top 8" represents 8 largest insurers in terms of asset size.

24. Life insurers appear to be resilient to stress from the real estate sector. In terms of market risks from real estate investment, the book values of the investment are significantly lower than current market values, due to regulatory valuation method, where the values assigned reflect the appraisal at the time the investment was made. The CMF's stress testing exercise assuming a drop in real estate prices between 25 and 30 percent in the past did not raise significant concerns (IMF 2014) and more recent stress text exercise in December 2022, assuming the similar magnitude of stress confirmed that life insurers could withstand against shocks from real estate. Therefore, life insurers appear to be resilient against shocks on the real estate sector. Nonetheless, given the higher exposures, lower capital buffers, and higher leverage of the top insurers, close monitoring of the investment portfolios of major insurers and their impact on financial soundness is warranted.

E. Regulatory and Monitoring Framework

25. Regulations governing banks concerning real estate-related loans are comprehensive, and the CMF regularly conducts supervisory stress testing exercises. They primarily focus on capital requirements and loan loss provisions, with an implicit loan-to-value (LTV) limit in place, while the guidelines of the stress test require banks to incorporate real estate-related risk factors. Basel III regulations for risk-weighted assets have already been implemented, ensuring that credit risk associated with real estate related loan exposures is appropriately accounted for, in line with international standards, while estimates of PDs depend on banks' models and judgments.[31] With respect to loan loss provisions, Chilean provisioning structure is a forward-looking system set by domestic GAAP (see Raddatz, 2015). Therefore, a close examination of banks' estimates for the parameters related to credit risk-weighted assets and provisions is warranted. Currently, most loans are non-endorsable mortgages,[32] which are not subject to restrictions based on LTV or debt-to-income (DTI) ratios. Nonetheless, as mentioned earlier, LTV ratios are typically concentrated around 80 percent due to a regulatory change introduced by the SBIF (now CMF) in January 2016, which linked mortgage loan loss provisions to LTV ratios. This change significantly increased provisions for loans with an LTV exceeding 80 percent, thereby establishing 80 percent as an implicit LTV limit. [33] Compared to other countries, this implicit LTV ratio appears to be comparable. Additionally, the CMF develops a stress scenario for the ICAAP (Internal Capital Adequacy Assessment Process), which includes adjustment to house pries (40 percent decline in the latest stress test), and to assess the impact of this scenario, the CMF uses both bottom-up stress tests and its own top-down models. Within the bottom-up stress tests, Chilean banks are required to examine the impact of real estate sector developments on collateral values (see the guideline published in 2024).

Chile: Mortgage Loan Regulation

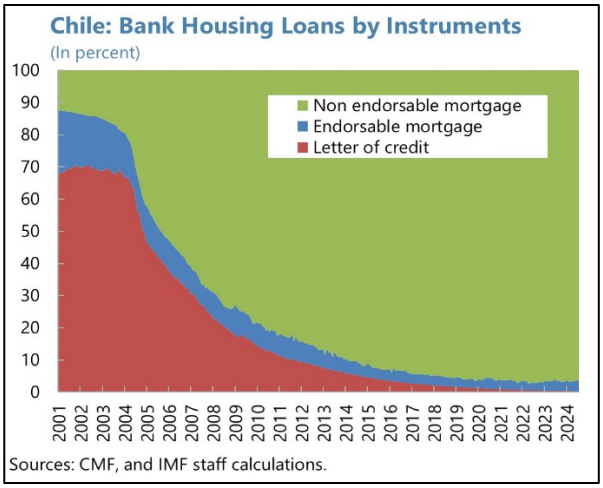
	LTV	DTI	Term to maturity
Letter of Credit	<75 percent	<25 percent	>1 year
Endorsable	<80 percent	-	1-30 year
Non-endorsable	-	-	-

Sources: CMF and Oda and Sepulveda (2014).
Note: LTV=Loan-to-value ratio and DTI=Debt-to-income ratio. "Letter of Credit" is a security issued by the lending bank, and once issued, the letter of credit is traded in a secondary market, while the originator bank retains the credit risk. "Endorsable" loans are financed entirely with the lending bank's resources, but can be transferred to another bank, while the originator retains all responsibility on debt services and other loan management activities. "Non-endorsable" loans are fully financed by the bank's resources, but cannot be transferred to another bank.

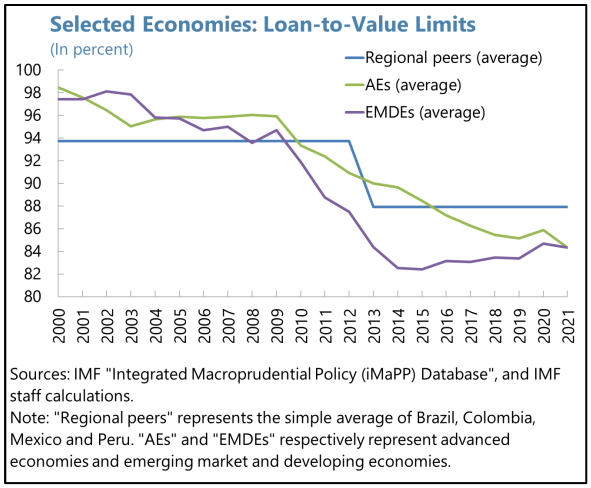
[31] The calculation of credit risk-weighted assets for business loans follows the simplified standard method outlined in Basel III. For housing loans, the risk weight generally increases with both the LTV ratio and the number of mortgages a borrower holds, while the risk weight for certain loans adheres to the Basel III standard model. For more details, see Aguilera et al. (2020) and Arata and Venegas (2024).

[32] Over the past two decades, the share of non-endorsable mortgages in housing loans has rapidly increased (until the 1990s, see). The BCCh's 2008H2 FSR (Box V.1) summarizes mortgage market regulations.

[33] According to Calani and Pailacar (2022), the LTV ratio decreased 9.8 percent for the median debtor, due to the regulatory change, while loan loss provisions (relative to mortgage loans) rose from 0.7 to 0.9 percent from 2014-16.



Sources: CMF, and IMF staff calculations.



Sources: IMF "Integrated Macroprudential Policy (iMaPP) Database", and IMF staff calculations.
Note: "Regional peers" represents the simple average of Brazil, Colombia, Mexico and Peru. "AEs" and "EMDEs" respectively represent advanced economies and emerging market and developing economies.

26. Chilean life insurers' real estate investments are constrained by specific investment limits and the CMF conducts supervisory stress testing exercises. Specifically, exposure limits for domestic real estate properties for Chilean life insurers are set at 25 percent of technical provisions and regulatory (risk) capital. Within this limit, investments in domestic residential real estate and non-residential real estate are, respectively, capped at 5 percent of technical provisions and regulatory capital, with a property valuation required at the time of acquisition. The investment in foreign real estate is limited to 3 percent. Moreover, exposure limits for mortgage loans are set at 30 percent of technical provisions and regulatory capital (OECD 2015). The CMF regularly examines the resilience of the real estate sector by conducting stress testing exercises. The recent exercise (December 2022) covered stress credit risk scenarios for mortgage loans, including a drop in collateral values, and a market risk stress scenario for real estate investment and leasing exposures (stressing real estate prices in accordance with standard global magnitudes). Moreover, methodological documents on risk-based capital suggest that insurers should establish a capital requirement for market risk related to real estate investments, which corresponds to the market values of the real estate multiplied by a factor of 20 percent (also used by CMF when requesting bottom-up stress tests from life insurers). More recently, in July 2024, the CMF published a regulation enforcing reporting requirements for investments made by insurance companies, including those related to real estate, which will allow the authorities for a deeper monitoring of life insurers' exposures and risks.

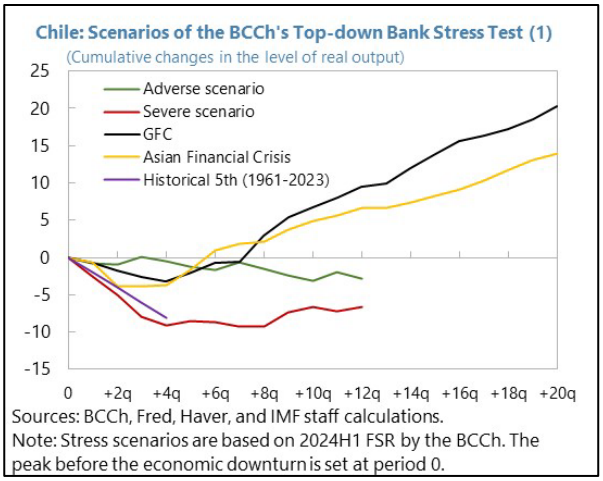
Chile: Investment Limit on Life Insurers

Instrument	Limits
Domestic real estate (Total)	25 percent of RT+PR
Residential real estate	5 percent of RT+PR
Commerical real estate (Subject to lease agreement)	5 percent of RT+PR
Foreign real estate (Total)	3 percent of RT+PR

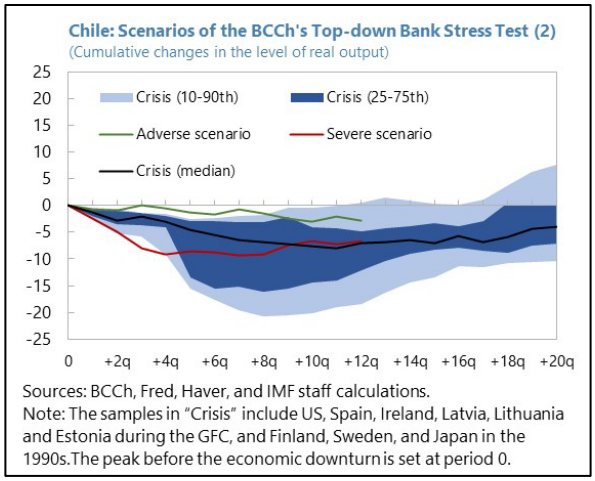
Sources: CMF
Note: "RT" and "PR", respectively, mean technical reserves and risk (regulatory) equity. There are also joint invest limits.

27. Regarding the BCCh's regular top-down bank stress tests, the model could be expanded to tail risks related to real estate crises and address relevant data gaps. The top-down bank stress tests (e.g., Alfaro and Sagner 2011 and Martínez, Cifuentes, and Becerra 2017) do

not specifically target real estate crises.[34] However, the magnitude of stress in the "severe scenario" is adequate for assessing banks' resilience in such situations as it is comparable to past real estate crises in other countries and the GFC-type stress scenarios in major advanced economies. The BCCh also has tools to separately assess the impact of the real estate crises on relevant sectors, such as top-down stress test models for firms. In particular, the default probability of real estate developers and construction debt is shocked at the firm level—specifically, with increases in long-term interest rates, drops in economic activity, and an increase in inflation (Córdova et al. 2021). The results are presented in the BCCh's FSRs under the term "debt at risk." However, in the top-down bank stress tests, scenarios for commercial real estate prices—often considered in advanced economies—appear to be excluded, likely due to data gaps in (aggregate) commercial real estate price indices.[35] In this regard, while banks' exposures to commercial real estate sector is so far limited, addressing the data gap in the indices is crucial. In the top-down bank stress test model, real estate-related risk factors are also not utilized to estimate credit costs for commercial loans,[36] and the channel in which the values of collateral affect LGDs does not seem to be implemented in the model.[37] To fully assess the propagation of the real estate crisis through the financial system and the macroeconomy, it is useful to incorporate these channels into the top-down bank stress test model.



Sources: BCCh, Fred, Haver, and IMF staff calculations.
Note: Stress scenarios are based on 2024H1 FSR by the BCCh. The peak before the economic downturn is set at period 0.



Sources: BCCh, Fred, Haver, and IMF staff calculations.
Note: The samples in "Crisis" include US, Spain, Ireland, Latvia, Lithuania and Estonia during the GFC, and Finland, Sweden, and Japan in the 1990s.The peak before the economic downturn is set at period 0.

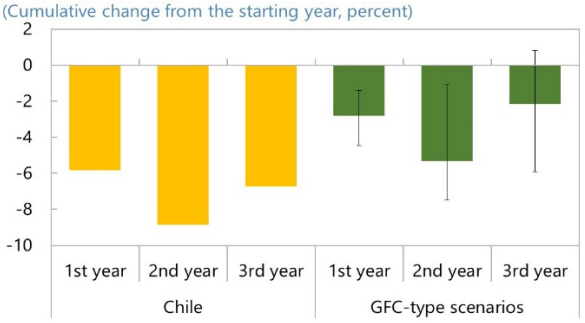
[34] In general, the advantage of top-down bank stress test models, compared with bottom-up stress test models, is that they enable authorities to evaluate private banks' risks from the same perspective and conduct timely examinations.

[35] House prices are endogenously determined based on macroeconomic developments in stress scenarios, with cumulative declines of about 20 percent.

[36] The top-down bank stress test models in major advanced economies consider the real estate prices as risk factors for non-housing loans (Correia, Seay, and Vojtech 2022 and DFAST 2024 Supervisory Stress Test Methodology).

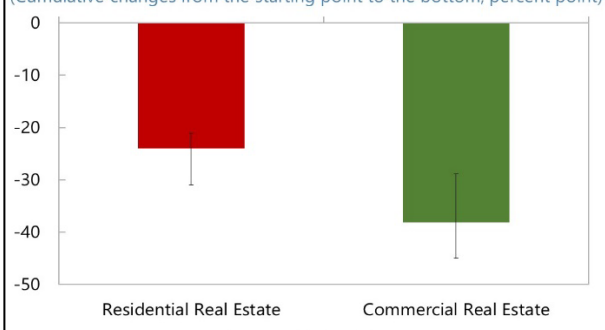
[37] The current module for loss from housing loans appears to incorporate residential real estate prices as a determinant of credit loss. However, it aims to capture the impact on PDs, while the effects on LGDs are not explicitly considered, making it difficult to disentangle the transmission channels. Top-down bank stress test models in advanced economies often more broadly link LGDs with real estate or land prices (see DFAST 2024 Supervisory Stress Test Methodology for the U.S., Budnik et al. 2023 for Euro Area and Abe et al. 2023 for Japan).

Selected Economies: Real Output Scenarios in the GFC-Type Scenarios
(Cumulative change from the starting year, percent)



Sources: BCCh, BOE, BOJ, EBA, FRB, and IMF staff calculations.
Note: Scenarios in the stress tests by the BCCh (2024H1 FSR) and GFC-type scenarios by the BOE (2022/23), the BOJ (October 2023 FSR), the EBA (2023) and the FRB (2023 DFAST), where the bar and whisker, respectively, represent median and min-max.

Selected Economies: Real Estate Price Scenarios in the GFC-Type Scenarios
(Cumulative changes from the starting point to the bottom, percent point)



Sources: BOE, EBA, FRB, and IMF staff calculations.
Note: Scenarios in the stress tests by the BOE (2022/23), the EBA (2023) and the FRB (2023 DFAST), where the bar and whisker, respectively, represent median and min-max.

F. Overall Risk Assessment and Policy Recommendations

28. As a baseline, the current adjustment in the real estate sector is expected to have only a limited impact on the financial sector. Analysis based on an estimated DSGE model indicates that the recent adjustment in the residential real estate sector is primarily a result of past shocks on mortgage rates, suggesting that the sector will modestly recover as the loosening of the global financial conditions and the past cuts to monetary policy rates gradually propagate to long-term interest rates. In the commercial real estate sector, offices have recently begun to show initial signs of recovery. While several mitigating factors contribute to the resilience of borrowers, pockets of vulnerability—particularly among highly leveraged mortgage borrowers—should be closely monitored, and the establishment of a consolidated debtor registry should proceed smoothly.

29. Risk scenarios include persistently high long-term interest rates and structural stagnation in the office segment. Elevated long-term interest rates could further weaken the creditworthiness of borrowers in the construction and real estate sectors, and lead to losses for banks. Additionally, weak demand in the office markets may imply structural shifts, which could negatively impact life insurers' investment portfolios. However, according to the stress tests and exercises conducted by the BCCh, the current capital buffers of banks and their collaterals for loans appear sufficient to absorb stresses from these risk scenarios, including tail risks associated with a real estate crisis. Furthermore, since real estate investments are primarily concentrated among major life insurers, their diversified portfolio should provide some resilience to such stresses. The supervisor's bottom-up stress testing frameworks for banks and life insurers appear to adequately incorporate real estate-related factors.

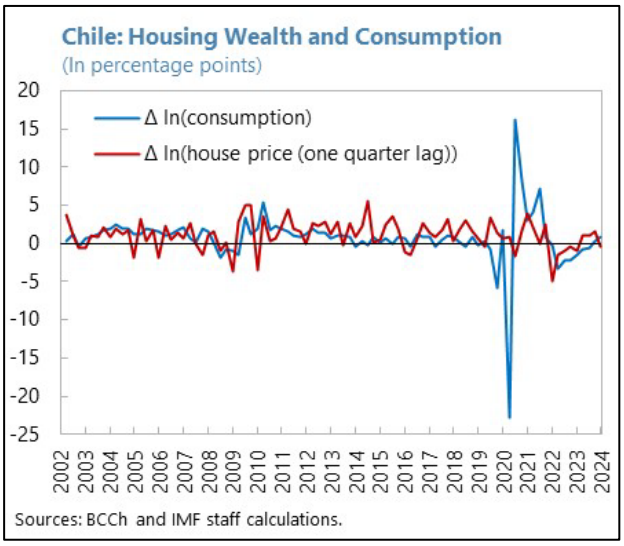
30. The authorities should prepare for the risks associated with a prolonged adjustment in the sector, as well as the tail risk of a significant downturn. To address these risk scenarios, it is essential to closely monitor the adequacy of NPL provision coverage and collaterals, specifically for loans to construction and real estate firms. Moreover, examining life insurers' portfolio concentration in weak segments, such as offices, is warranted. To prepare for a potential tail risk of a

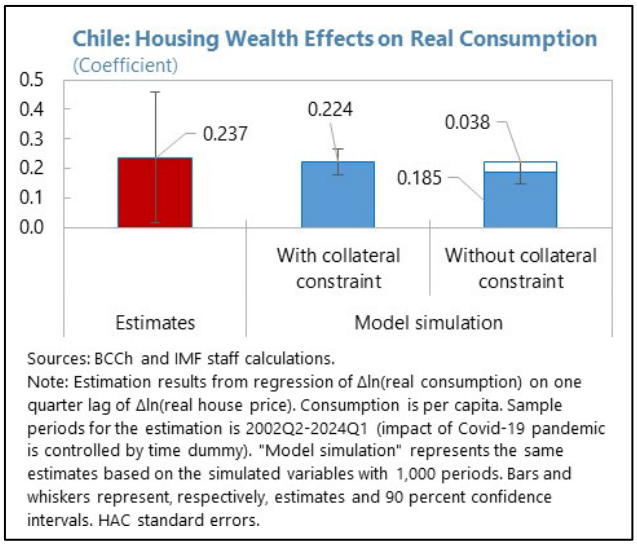
real estate crisis, directly evaluating banks' resilience to significant stress from a pronounced downturn in the real estate sector is crucial. While the "severe scenario" in the BCCh's top-down bank stress test appears comparable to past real estate crises in other countries and the BCCh has tools to separately assess the impact of real estate crises on relevant sectors, the top-down bank stress test does not fully model the specific risk factors associated with the real estate sector. Specifically, incorporating real estate sector variables as risk factors for commercial loans, modelling the impact of collateral value fluctuations on credit costs, and addressing data gaps in the commercial real estate price indices will help the authorities to assess the propagation of the real estate crises for the financial sector and the macroeconomy.

Annex I. Housing Wealth Effects in Chile

1. Housing wealth effects via collateral valuation are analyzed using an estimated model with Chilean data. We conduct counterfactual simulations using the estimated DSGE model (Iacoviello and Neri 2010; for an overview of the model and parameterization, see Annex Box). In this model, fluctuations in housing prices affect consumption, and these effects are reinforced by the degree of financial friction, as measured by the share of credit-constrained agents and the loan-to-value ratio. To measure the spillovers, we regress percentage changes (log differences) in aggregate consumption on lagged percentage changes in real house prices, including a constant term.[1] This equation can be interpreted as a reduced-form approach to capturing the direct and indirect effects that fluctuations in housing wealth have on aggregate consumption, although both variables are endogenous in the model.

2. Simulation results suggest the existence of a non-negligible direct collateral effect in Chile. In the simulated output of the model, regressing consumption growth on lagged growth in housing wealth yields a coefficient of 0.224 for changes in housing wealth, which falls within the 90 percent confidence interval of the estimate from the analogous regression on actual data.[2] This positive value captures, both in the model and in the data, the influence of common macroeconomic factors as well as the direct effect of changes in housing wealth on consumption through the collateral channel. However, comparing this estimate with that from the model without collateral effects allows us to disentangle the collateral effects. In fact, the regression based on the output from the model without collateral effects provides a coefficient of 0.185 for changes in





[1] This lag is included to mitigate the endogeneity problem. The estimate of the collateral effect is robust if lagged changes in consumption are controlled.

[2] This estimate does not represent the marginal propensity to consume in response to an increase in housing wealth.

housing wealth, which is smaller than the case where collateral effects are included. This difference of 0.038 implies the existence of non-negligible collateral effects in housing wealth effects.[3]

Box 1. Overview of the DSGE Model and Parameterization

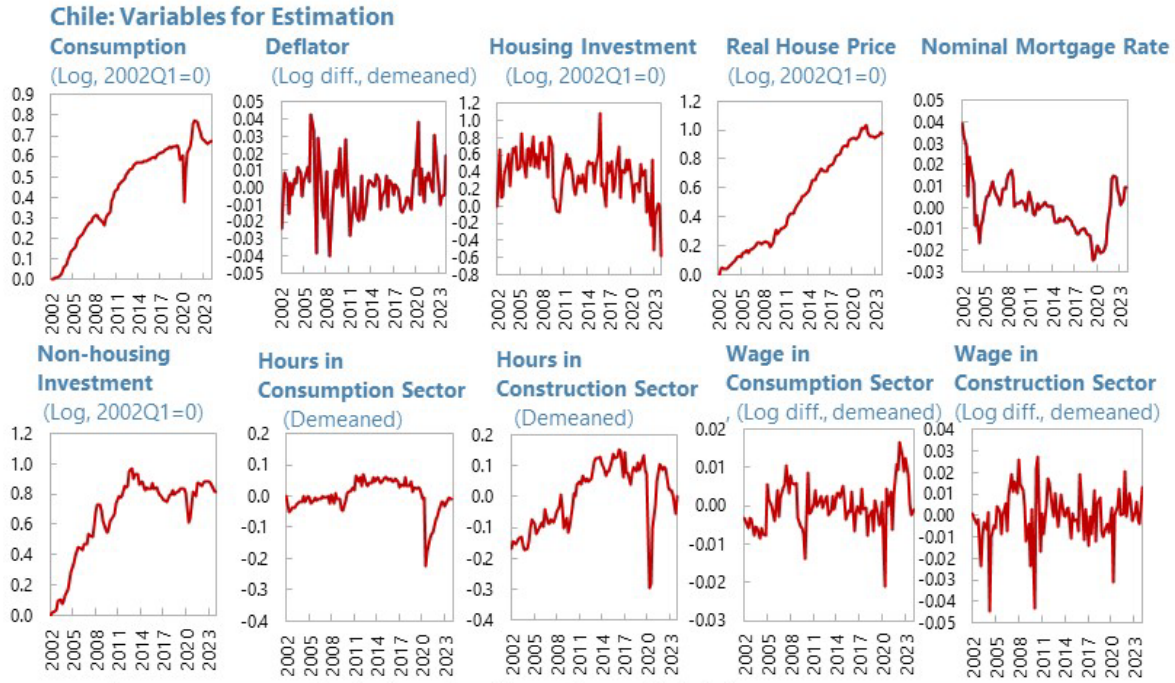
The DSGE model with a housing sector (Iacoviello and Neri 2010) includes four essential elements to align the model with the data. Specifically, (i) a multi-sector structure (housing and non-housing goods); (ii) financing frictions within the household sector; (iii) nominal rigidities; and (iv) a comprehensive set of shocks, including housing preference shocks. Elements (i) and (ii) are crucial for considering the role of the housing sector in the model, while (iii) and (iv) are incorporated to capture the various views on the sources and propagation mechanisms of business cycles, as described in canonical dynamic equilibrium models used in monetary policy analysis (e.g., Christiano, Eichenbaum, and Evans 2005 and Smets and Wouters 2007). Since this study uses this model to analyze the extent to which the cyclical fluctuations of the housing sector align with interest rates (mortgage rates), these elements are important.

The housing sector in the model has two main features. On the supply side, it exhibits sectoral heterogeneity: the non-housing sector produces consumption and business investment using capital and labor, while the housing sector produces new homes with capital, labor, and land. On the demand side, it incorporates a collateral channel: both housing and consumption contribute to households' utility,[1] and housing can serve as collateral for loans. Because housing and consumption goods are produced using different technologies, the model generates endogenous dynamics in both residential versus business investment and housing prices. Fluctuations in house prices simultaneously affect households' borrowing capacity and the relative profitability of producing new homes, creating feedback effects that influence the spending behaviors of both households and firms.

The model is estimated using Chilean data from the 2000s, following the calibration and estimation strategy of Iacoviello and Neri (2010). In terms of the calibrated parameters that have counterparts in the literature on Chilean macroeconomic models (Martínez et al. 2020 and Calani et al. 2022), discount factor in the original paper (0.9925) is within the range in the literature (0.9829-0.9997). In terms of capital share, because the range in the literature is 0.33-0.34, it is set as 0.33. Given the implicit LTV limits discussed in the main text, the key parameter—the LTV ratio for impatient households—is set at 0.8.[2] All other parameters are calibrated following the original paper. The estimated parameters, including shock structures, are derived using a standard Bayesian approach (the Metropolis algorithm) with Chilean macroeconomic data from 2002Q1 to 2024Q1 (for details of estimation strategy, see web Appendix C of Iacoviello and Neri, 2010). Specifically, ten observable variables are used for estimation: consumption, the deflator, housing investment, real house prices, the interest rate (nominal mortgage rate), non-housing investment, hours worked in the consumption and construction sectors, and nominal wages in both sectors.[3] Then, the means of posterior distribution are used as parameters. The key estimated parameter, the share of labor income accruing to credit-constrained agents, is estimated to be about 30 percent.[4]

[3] In Chile, home equity loans, which are often cited as a source of collateral in housing wealth effects, are not prevalent. However, due to the full recourse system for housing loans, stagnation in house prices could financially strain mortgage borrowers and spill over into consumption. Note also that the model implicitly assumes full accessibility to mortgage loans and thus cannot directly capture the low affordability of mortgage loans.

Box 1. Overview of the DSGE Model and Parameterization (concluded)



Sources: BCCh, CEIC, Haver, INE, National Institute of Statistics, and IMF staff calculations.
Note: Consumption and investment are divided by population and log-transformed. Consumption, investment, and house prices are normalized to zero in 2022Q1. Inflation, nominal interest rate, hours (log-transformed), and wage inflation are demeaned.

1/ The model has shocks on this housing preference. The shocks may either represent genuine shifts in households' tastes for housing or serve as a catchall for unmodeled disturbances that can affect housing demand. The shocks could also be caused by an increase in net immigration to Chile.

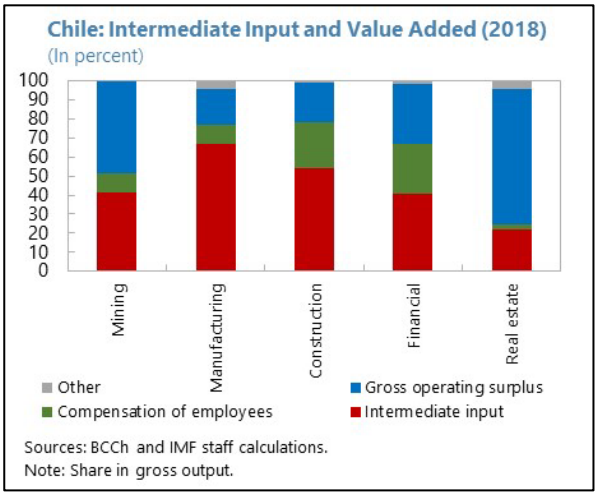
2/ The impact of the past shocks on mortgage rates on the cyclical fluctuations of the housing sector is broadly robust to higher values of LTV limits (0.8-0.9). For U.S., Iacoviello and Neri (2010) set it as 0.85.

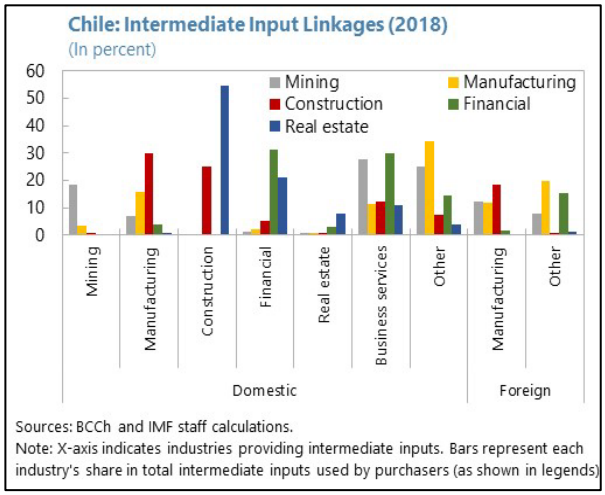
3/ For data transformation, see Iacoviello and Neri (2010). The consumption sector is represented by all sectors excluding construction. Due to data limitations, housing investment is proxied by building permits for total new housing, while non-housing investment is proxied by gross fixed capital formation. For calculating hours, average hours worked are the same for both the consumption and construction sectors (i.e., the indicator for all sectors is applied), whereas employment data are specific to each industry.

4/ A possible interpretation of this high share is that it reflects that mortgage borrowers are concentrated in high-income households, which have a larger impact on consumption. This estimate is broadly robust even when the consumption series excludes the impact from a consumption boom due to pension fund withdrawals.

Annex II. Input-Output Linkages and Inter-Sectoral Spillovers

1. The Chilean construction and real estate sector have different input-output linkages. The Input-Output table indicates that the labor share (compensation of employees) in the construction sector is higher than in other industries, whereas the labor share in the real estate sector is low. Instead, the real estate sector has a high gross operating surplus. According to the structure of intermediate inputs across these sectors, the domestic and foreign manufacturing sectors supply the domestic construction sector, and the domestic financial sector, along with the construction sector, provides inputs to the domestic real estate sector. Additionally, the business services sector supplies various inputs to both the construction and real estate sectors.

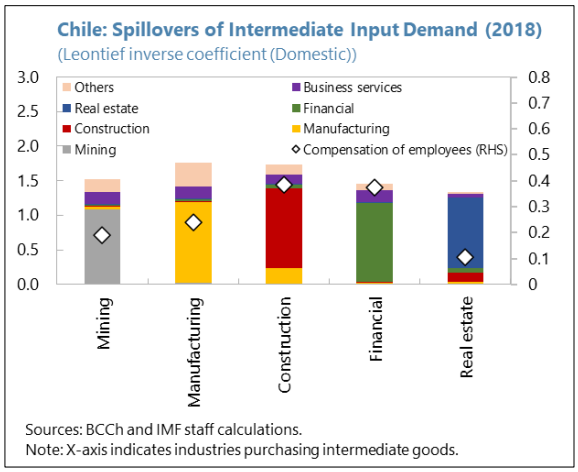


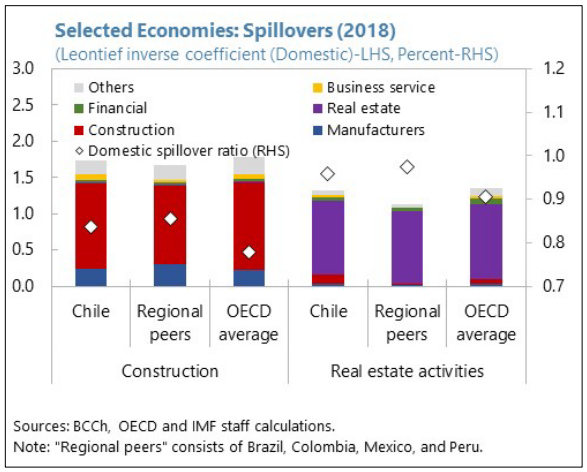


2. While the construction sector has large spillover effects on intermediate input demands and employee compensation, such effects are limited for the real estate sector. [1] On the one hand, spillover effects based on the Leontief Inverse matrix indicate that a one-unit increase in production in the construction sector mainly increases production in the manufacturing and business services sectors. The spillover to domestic manufacturers is moderately smaller than that of regional peers but comparable to the OECD average. On the other hand, a one-unit increase in production in the real estate sector mainly raises production in the construction sector, which is

[1] The (non-competitive import type) Leontief Inverse matrix $(I - A^d)^{-1} = I + A^d + A^{d\,2} + \cdots$ shows how output in each domestic sector rises in response to a unit increase in final demand, where I is the identity matrix and A^d is the input-coefficient matrix for domestic suppliers from the input-output table. The input-coefficient matrix A^d is derived by normalizing the input-output matrix, dividing it by the vector of total output, which represents the economic structure of the system. Therefore, spillover effects to intermediate domestic goods demand from a unit increase in intermediate domestic goods demand from an increase in final demand for specific domestic industry is calculated as $(I - A^d)^{-1}$ where I and $A^d + A^{d\,2} + \cdots$, respectively, represent the direct demand for the industry and indirect demands via supply chain (spillover effects). Spillover effects on compensation of employees are calculated by multiplying the spillovers to each domestic industry's gross output by its labor share, and thus the effects increase as the share of spillovers to industries with higher labor shares increases, assuming a fixed amount of spillovers to total gross output. Domestic spillover ratio is calculated as the ratio of the spillovers to gross output of domestic suppliers to those of total suppliers (including foreign suppliers). The spillovers to gross output of total suppliers are calculated based on another type of the Leontief Inverse matrix $(I - A)^{-1}$ where A represents the input-coefficient matrix covering both domestic and imported intermediate goods.

larger than that of regional and OECD peers. In terms of domestic spillover ratios in Chile, they are similar to those of regional peers but higher than those of OECD peers.





References

Abe, Nobuhiro, Kyosuke Chikamatsu, Kenji Kanai, Yusuke Kawasumi, Ko Munakata, Koki Nakayama, Tatsushi Okuda, and Yutaro Takano, 2023. "The Financial Macro-econometric Model (FMM, 2022 Version)," Bank of Japan Research Papers 23-03-30, Bank of Japan.

Aguilera, Gabriela, Claudia Alarcón, Diego Beas, Gabriela Covarrubias, Jaime Forteza, Alfredo Pistelli, Carlos Pulgar, Nancy Silva, and Alvaro Yáñez. 2020, "Basel III Implementation in Chile: Closing Evaluation," CMF Normative Study Series, December 2020.

Aladangady, Aditya, 2017. "Housing Wealth and Consumption: Evidence from Geographically-Linked Microdata," American Economic Review, 107 (11), pp. 3415-3446.

Alegría, Andrés, Rodrigo Alfaro, and Felipe Córdova, 2021. "The Effect of Warnings Published in a Financial Stability Report on Loan-To-Value Ratios," Latin American Journal of Central Banking, Volume 2, Issue 4, 100041.

Alfaro, Rodrigo, and Andrés Sagner, 2011. "Stress Test for Banking Sector: A Technical Note." Working Paper N 610, Banco Central de Chile.

Aninat, Magdalena, Kevin Cowan, and Inti Riquelme, 2024 "Residential Real Estate Sector in Chile: Analysis of its Challenges and Proposals for its Reactivation (in Spanish)" UAI Business School, October 2024.

Arata, Carlos Pulgar, and Sebastián Ramírez Venegas, 2024. "Impacto de Basilea III en Créditos Hipotecarios para la Vivienda (in Spanish)," Working Paper No. 01/24.

Bernanke, Ben, Mark Gertler, and Simon Gilchrist, 1996. "The Financial Accelerator and the Flight to Quality," The Review of Economics and Statistics, vol. 78(1), pp. 1-15.

Bernanke, Ben, Mark Gertler, Simon Gilchrist, 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework," in: J. B. Taylor & M. Woodford (ed.), Handbook of Macroeconomics, edition 1, volume 1, chapter 21, pp. 1341-1393.

Budnik, Katarzyna, Johannes Groß, Gianluca Vagliano, Ivan Dimitrov, Max Lampe, Jiri Panos, Sofia Velasco, Louis Boucherie, Martina Jančoková, 2023. "BEAST: A Model for the Assessment of System-Wide Risks and Macroprudential Policies," Working Paper Series 2855, European Central Bank.

Calani, Mauricio, and Manuel Paillacar, 2022. "The Pass-Through of Loan-Loss-Provisioning on Mortgage Lending: Evidence from a Regulatory Change," Journal of Banking and Finance, vol. 135(C).

Calani, Mauricio, Benjamín García, Tomás Gómez, Mario González, Sebastián Guarda, and Manuel Paillacar, 2022. "A Macro Financial Model for the Chilean Economy," Working Papers Central Bank of Chile 953, Central Bank of Chile.

Campbell, John Y, Joao F. Cocco, 2007. "How Do House Prices Affect Consumption? Evidence from Micro Data," Journal of Monetary Economics, vol. 54(3), pp. 591-621, April.

CBRE and ACAFI, 2024. "Reporte Inmobiliario: Análisis de Fondos de Inversión y Mercado Comercial (in Spanish)"

Christensen, Ian, and Ali Dib, 2008. "The Financial Accelerator in an Estimated New Keynesian Model," Review of Economic Dynamics, vol. 11(1), pp. 155-178.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans, 2005 "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," Journal of Political Economy, 113, No. 1, pp. 1–45.

Córdova, Felipe, Alejandra Cruces, and Sergio Díaz, 2023. "Prices and Slack in the Rental Market: Analysis of Listings (in Spanish)," Working Papers No 988, Central Bank of Chile.

Córdova, Felipe, Claudia Toledo, and Francisco Vásquez, 2021. "Funding Needs of Chilean Firms and Stress Testing during the Covid-19 Pandemic," Central Bank of Chile.

Correia, Sergio, Matthew P. Seay, and Cindy M. Vojtech, 2022. "Updated Primer on the Forward-Looking Analysis of Risk Events (FLARE) Model: A Top-Down Stress Test Model," Finance and Economics Discussion Series 2022-009. Washington: Board of Governors of the Federal Reserve System

Guren, Adam M, Alisdair McKay, Emi Nakamura, and Jón Steinsson, 2021. "Housing Wealth Effects: The Long View," The Review of Economic Studies, Volume 88, Issue 2, March 2021, pp. 669–707.

Iacoviello, Matteo, and Stefano Neri, 2010. "Housing Market Spillovers: Evidence from an Estimated DSGE Model," American Economic Journal: Macroeconomics, 2 (2), pp. 125–164.

Idrovo-Aguirre, Byron J., Francisco J. Lozano, and Javier E. Contreras-Reyes, 2021. "Prosperity or Real Estate Bubble? Exuberance Probability Index of Real Housing Prices in Chile," IJFS, MDPI, vol. 9(3), pp. 1-24, September.

International Monetary Fund (IMF), Western Hemisphere Dept., 2014. "Chile's Insurance Sector," in Chile: Selected Issues Paper, Volume 2014: Issue 219.

International Monetary Fund (IMF), 2019. "Chapter 2: Downside Risks to House Prices," in April 2019 Global Financial Stability Report.

International Monetary Fund (IMF), 2021. "Chapter 3: Commercial Real Estate," in April 2021 Global Financial Stability Report.

Martínez, Juan Francisco, Udara Peiris, and Dimitrios Tsomocos, 2020. "Macroprudential Policy Analysis in an Estimated DSGE Model with a Heterogeneous Banking System: An Application to Chile," Latin American Journal of Central Banking, Volume 1, Issues 1–4, 100016.

Martínez, Juan-Francisco, Rodrigo Cifuentes, and Juan Sebastián Becerra, 2017. "Pruebas de Tensión Bancaria del Banco Central de Chile: Actualización (in Spanish)," Working Papers Central Bank of Chile 801, Central Bank of Chile.

Micco, Alejandro, Eric Parrado, Bernardita Piedrabuena, and Alessandro Rebucci, 2012. "Housing Finance in Chile: Instruments, Actors, and Policies," IDB Publications (Working Papers) 3965, Inter-American Development Bank.

Oda, Daniel, and Fernando Sepúlveda, 2014. "Uncovering Our Self-Imposed Limits: Changes in Loan-to-Value and The Mortgage Market," Working Papers Central Bank of Chile 737, Central Bank of Chile.

Organisation for Economic Co-operation and Development (OECD), 2015. "Regulation of insurance company and pension fund investment," OECD report to G20, 5 September 2015.

Pardo, Claudio Adrián, 2000. "Housing Finance in Chile: The Experience in Primary and Secondary Mortgage Financing," Inter-American Development Bank, Mar 2000.

Raddatz, Claudio, 2015. "Macroprudential Policies: A view from Chile," Next Steps in Macroprudential Policies conference Thursday, November 12, 2015, Columbia University.

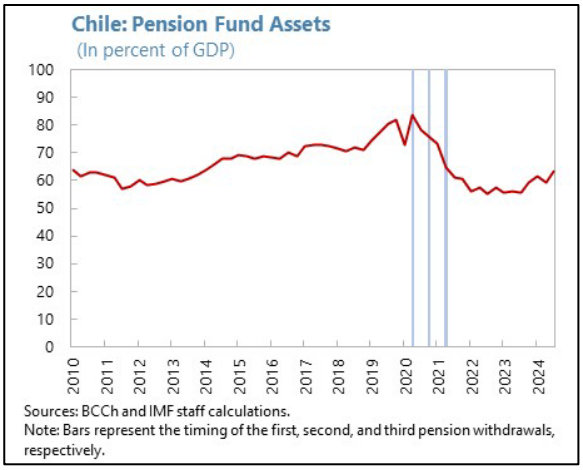
Smets, Frank, and Rafael Wouters, 2007. "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," American Economic Review, 97 (3), pp. 586–606.

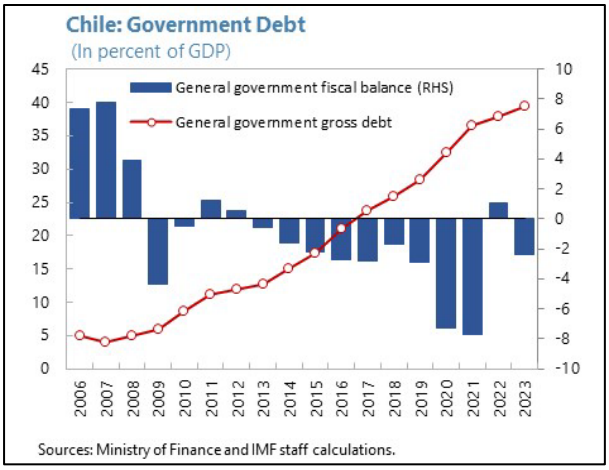
POST-PANDEMIC CHANGES TO CHILE'S FINANCIAL MARKETS[1]

Pension fund withdrawals, rising public debt, and the Banco Central de Chile's (BCCh) pandemic liquidity injections have reshaped Chile's financial landscape. In the context of the diminished demand for local bonds, large non-financial corporations and the government relied more on foreign investors. Overall, Chile's financial depth has diminished, and markets have become more volatile and sensitive to shocks. Restoring pension funds as well as continuing to strengthen market resilience and crisis response capabilities are essential for ensuring future financial stability.

A. Introduction

1. During the pandemic, the Chilean financial markets experienced several significant transformations. First, the size of pension funds significantly decreased, dropping from approximately 80 percent of GDP to less than 60 percent due to three rounds of pension fund withdrawals during the pandemic.[2] Second, the public debt-to-GDP ratio rose to about 40 percent of GDP. Third, the central bank injected substantial liquidity into the markets during the pandemic,[3] a measure that was unwound in April and July 2024.



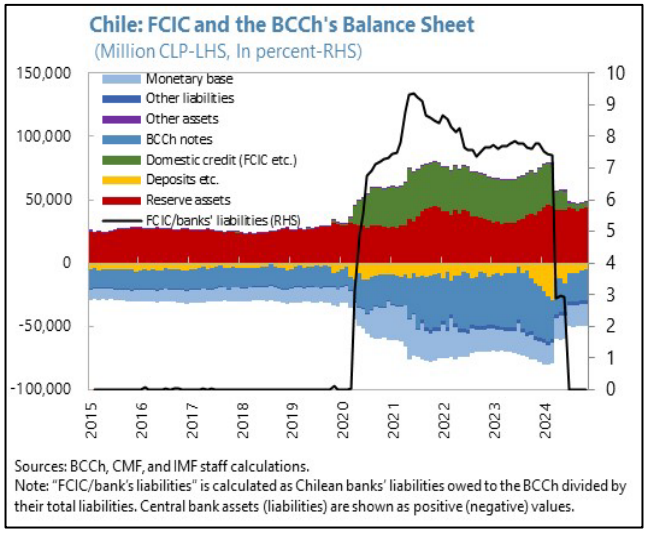


[1] Prepared by Tatsushi Okuda. The author would like to thank BCCh, CMF, and MoF staff for the helpful comments.

[2] The reduction of about 20 percent of GDP is comparable to pension contributions for about 9 years. For details on the pension fund withdrawals, see IMF (2021a) and IMF (2023). The Chilean financial market exhibited resilience to pandemic-related shocks, which occurred prior to the withdrawals, thanks to its high financial depth (see Chapter IV in the BCCh's 2020H2 FSR and IMF 2021b).

[3] In 2020-2021, the BCCh introduced three rounds of Facility of Credit Conditional on Lending Increase (FCIC), accepting commercial bank credits as collateral, which corresponded to about 8 percent of banks' total liabilities. Additionally, among other measures, to avoid disruptive impacts on asset prices from pension fund withdrawals, the BCCh implemented a cash purchase and forward sale program (CC-VP), temporary repo facilities for pension fund managers. For details of the BCCh's measures, see the BCCh's website for exceptional measures.

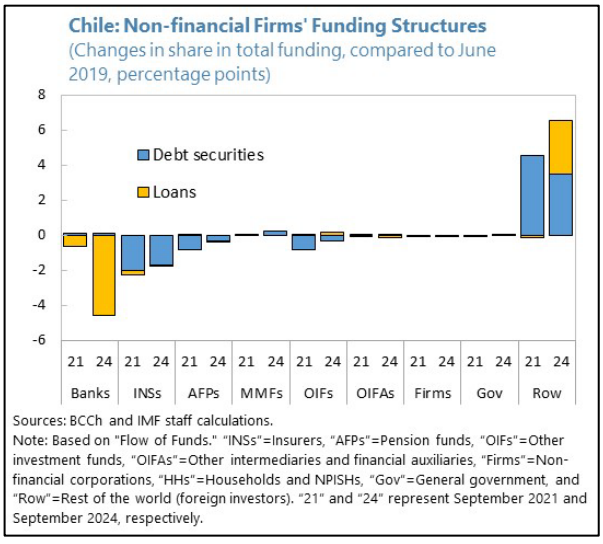
2. The diminished asset size of pension funds could significantly alter the landscape of the financial markets. The size of Chilean pension funds, relative to the size of the economy scale, is still larger than regional peers and comparable to OECD peers (Annex I). Chilean pension funds have played an important role in local financial markets as major long-term investors, holding significant shares in bond markets. This note analyses long-term implications of the pension fund withdrawals on financial markets, following earlier findings by the IMF (2023), which included a declined availability of long-term financing for the government and corporate sectors and a negative impact of pension fund withdrawals on local stock prices. Recent analysis by the BCCh showed that since end-2017, liquidity indicators in Latin America's fixed-income and equity markets have worsened, particularly in Chile, leading to a discussion on the effects of pension fund withdrawals (the BCCh's 2023H1 FSR).[4]



Sources: BCCh, CMF, and IMF staff calculations.
Note: "FCIC/bank's liabilities" is calculated as Chilean banks' liabilities owed to the BCCh divided by their total liabilities. Central bank assets (liabilities) are shown as positive (negative) values.

B. Changes in the Structure of Local Financial Markets

3. There was a shift toward foreign funding for non-financial corporates and the government. During the pandemic, non-financial firms relied more on foreign investors and less on banks, insurers, and pension funds for issuance of debt securities and funding via loans. Government debt holders have shifted from pension funds to banks and foreign investors during the pandemic, and this shift persisted until at least September 2024. This implies a dependence on foreign investors (on a stock basis) as well as a potential strengthening of the sovereign-bank nexus.[5]



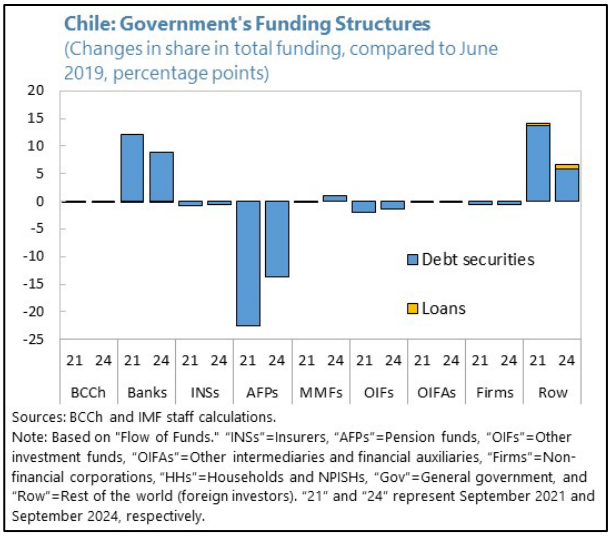
Sources: BCCh and IMF staff calculations.
Note: Based on "Flow of Funds." "INSs"=Insurers, "AFPs"=Pension funds, "OIFs"=Other investment funds, "OIFAs"=Other intermediaries and financial auxiliaries, "Firms"=Non-financial corporations, "HHs"=Households and NPISHs, "Gov"=General government, and "Row"=Rest of the world (foreign investors). "21" and "24" represent September 2021 and September 2024, respectively.

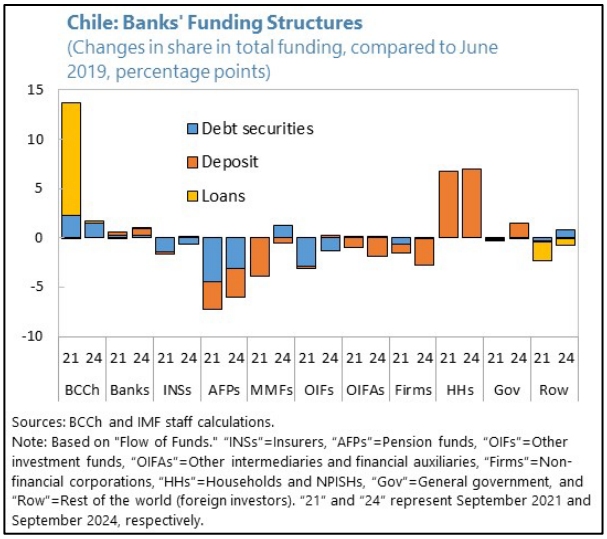
4. Banks have become more dependent on retail deposits and less on pension funds and money market fund deposits. Moreover, the share of bond funding for banks has

[4] See also Jara and Naudon (2024) on the implications of pension fund withdrawals for local financial markets.

[5] In this note, the term "sovereign-bank nexus" merely refers to the interconnectedness between banks and sovereigns, specifically banks' exposures to sovereign bonds, and does not include any assessments of the financial health of governments. The increase in banks' holdings of sovereign bonds is commonly observed in other emerging markets. For details, see IMF (2022).

decreased as the amount of bank bond funding has kept stable in the last couple of years, unable to increase in accordance with the increase in bank assets, primarily due to a reduction in the share of funding from pension funds.[6] Although loans from the BCCh increased during the pandemic, thanks to the FCIC, it have returned to pre-pandemic levels, as the FCIC was fully unwound in July 2024.[7]





An Increasing Reliance on Foreign Investors

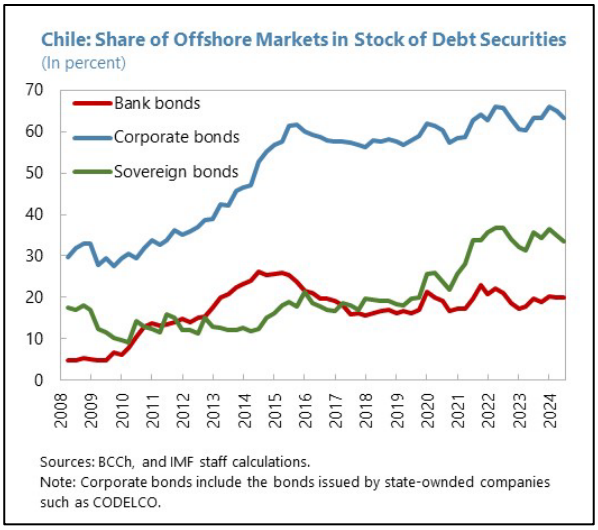
5. Issuance shifted to offshore markets, which increased exposures to external stress on a stock basis. This shift occurred, particularly for sovereign bonds and corporate bonds,[8] amid lower demand for local bonds, driven by pension fund withdrawals and a movement away from conservative funds (which mainly invest in local fixed-income assets) to other types of funds (see Annex 1). [9] However, in local markets, foreign investor participation has remained flat.

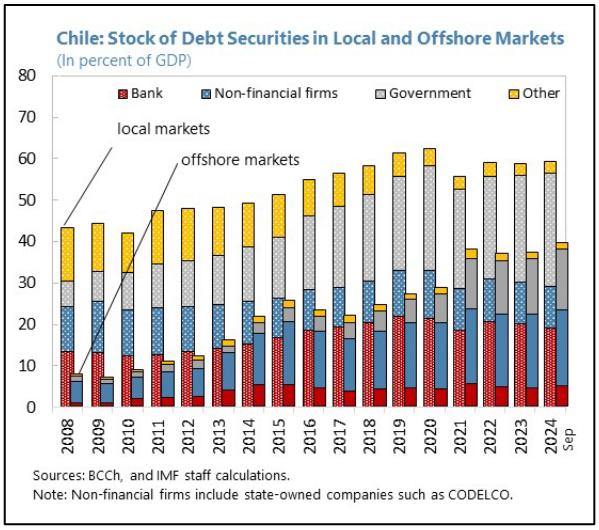
[6] A higher issuance of government debt in the local market (supply side factor) might have had an impact as well. The stagnation of the long-term credit demand (mortgages) also has reduced the necessity of bond funding for banks.

[7] Because of the accumulation of the liquid assets in advance, banks maintain their liquidity ratios (the Liquidity Coverage Ratios and the Net Stable Funding Ratios) above the regulatory minimums (the BCCh's 2024H2 FSR).

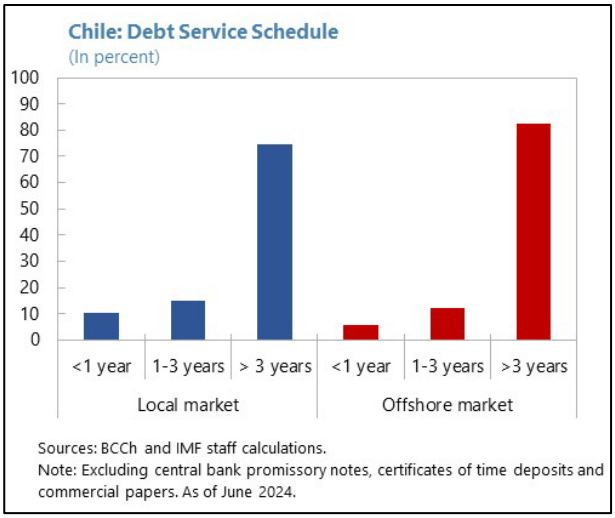
[8] This note refers to bonds issued by non-financial firms as "corporate bonds" and those issued by banks as "bank bonds."

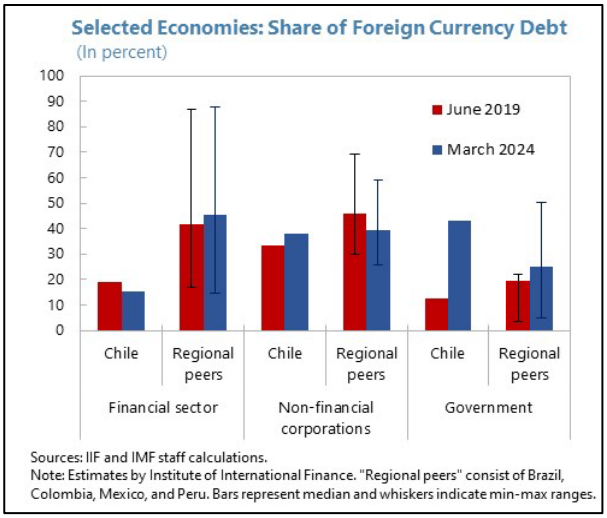
[9] The pre-pandemic rise appears to be in line with other emerging market economies given the lower cost of bond financing (Chang et al. 2017).





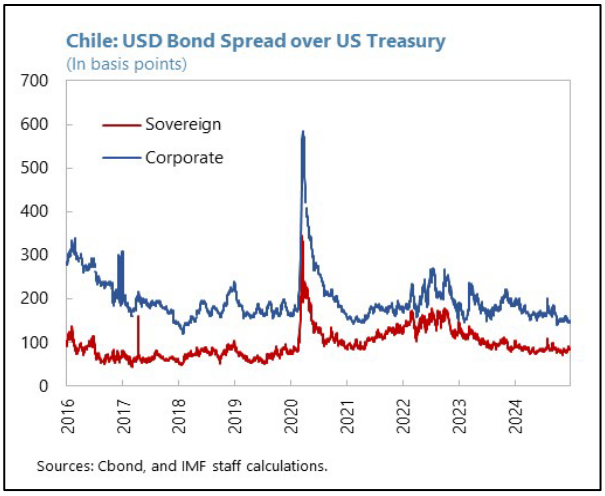
6. This shift does not pose an immediate risk. The overall redemption schedule of bonds issued in offshore markets appears to be diversified, similar to those issued in local markets. Financial and non-financial sectors have relatively low foreign-currency denominated debt, mainly issued by larger firms, which include state-owned firms and firms in mining and electricity, gas, and water sector. Dollar funding costs in US$-dominated bond markets were broadly stable, indicating that Chilean issuers have been viewed as sound. Similarly, dollar funding costs in local financial markets (onshore spreads) have been stable. Non-financial corporations' currency mismatch is generally limited, due to natural hedges from exporters and the use of derivatives,[10] and banks' currency mismatch is also restricted because of strict regulations on banks' foreign currency funding gaps (see the BCCh 2024H2 FSR).[11]





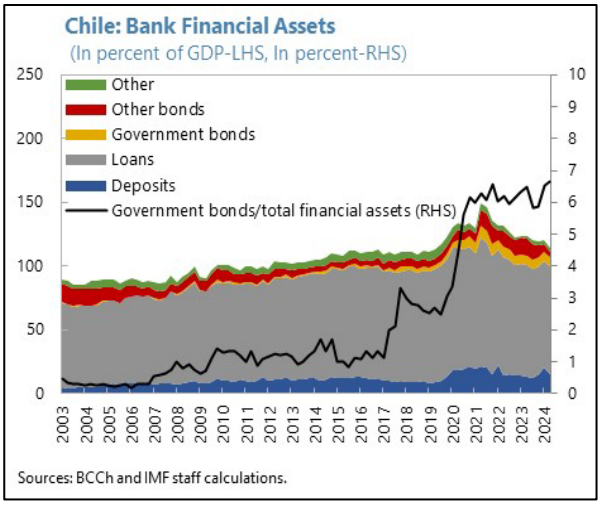
[10] Albagli et al. (2020) and Alfaro, Calani, and Varela (2021) highlight how Chilean firms have reduced foreign currency mismatch in their balance sheets.

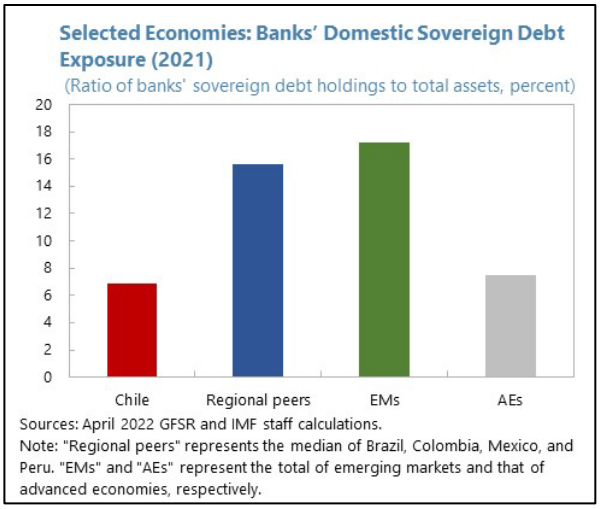
[11] For example, the total of all term mismatches for periods of up to 30 days cannot exceed the basic capital, taking into account only flows in foreign currency.



A Low but Rising Sovereign-Bank Nexus

7. The sovereign-bank nexus remains lower than regional peers but has increased since the pandemic. Since then, the share of government bonds in banks' total financial assets has doubled from about 3 to 6 percent, which now is similar to the median of advanced economies and significantly lower than that of regional peers and emerging markets. Banks' higher share of government security holdings may reflect two factors: fewer bankable credit activities and the implementation of liquidity requirements under Basel III regulations. For example, banks have been incentivized to hold sovereign bonds as high-quality liquid assets (HQLA) to bolster their Liquidity Coverage Ratios. The unwinding of the FCIC also temporarily motivated banks to increase their holdings of government bonds, as they were required to switch their collateral with the BCCh from illiquid assets (bank loans) to liquid assets (such as government bonds). This process was completed in July 2024.[12]

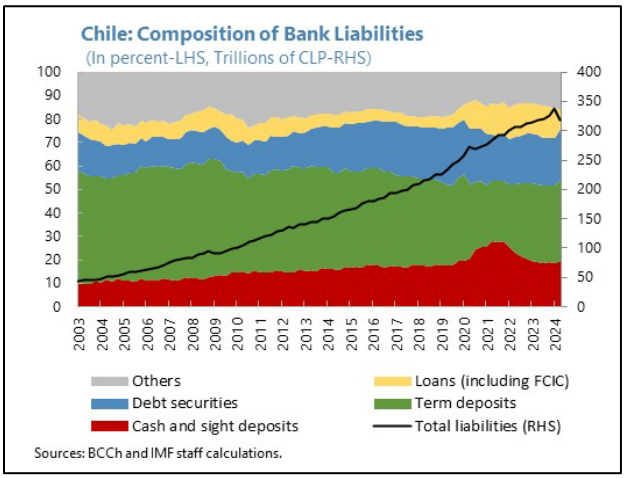


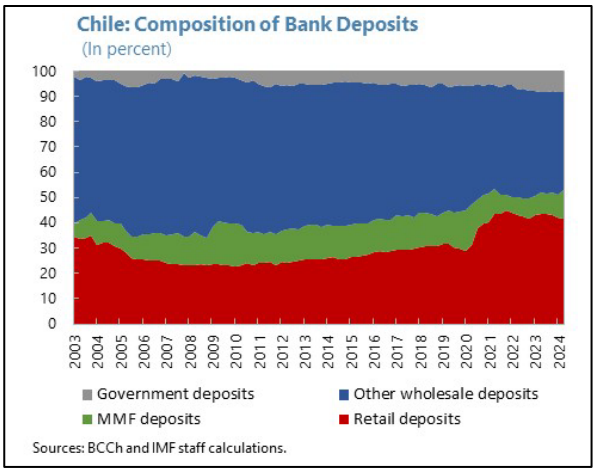


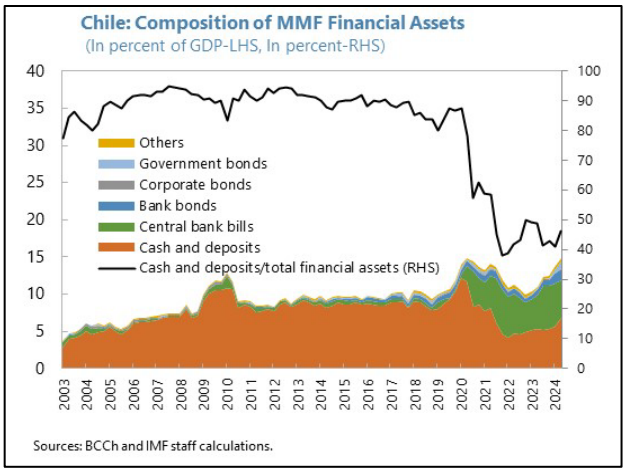
[12] In November 2022, the BCCh rolled out a collateral substitution program, which began in January 2023 and gradually standardized eligible collateral by replacing the collateral of the pledged credit portfolio with eligible financial instruments in the Central Securities Depository at a rate of 1/18 per month.

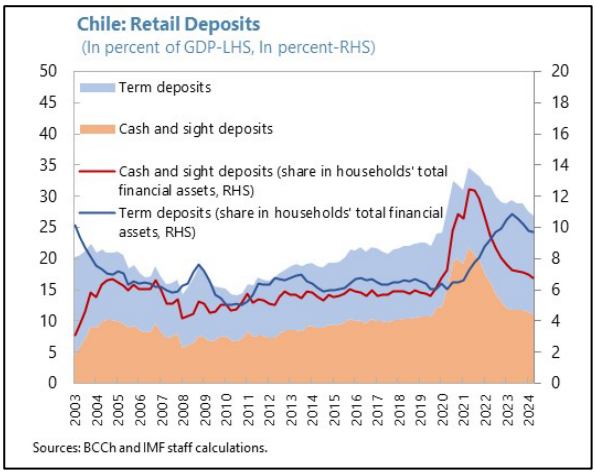
Banks' Narrowed Wholesale Funding

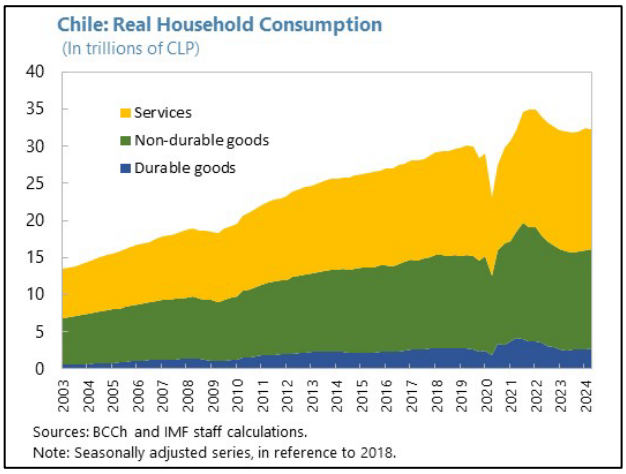
8. Banks' funding structures at instrument level has not significantly changed, while the sources of the deposits have shifted to retail deposits. The decrease in MMF (Money market fund) deposits had occurred as the depositors shifted their funds from bank deposits to central bank bills issued for the FCIC. Meanwhile, banks' funding structures are well-diversified and, at instrument level, have returned to a landscape similar to pre-pandemic levels, indicating that, for banks, this phenomenon is merely a shift of depositors from MMFs to households within a stable share of sight (short-term) deposits, and it has not affected their dependence on each funding instrument.[13]











[13] According to the BCCh's 2024H2 FSR, after the unwinding of the FCIC (as of September 2024), banks had shifted back to a funding structure similar to pre-pandemic one, with institutional investor funding recovering.

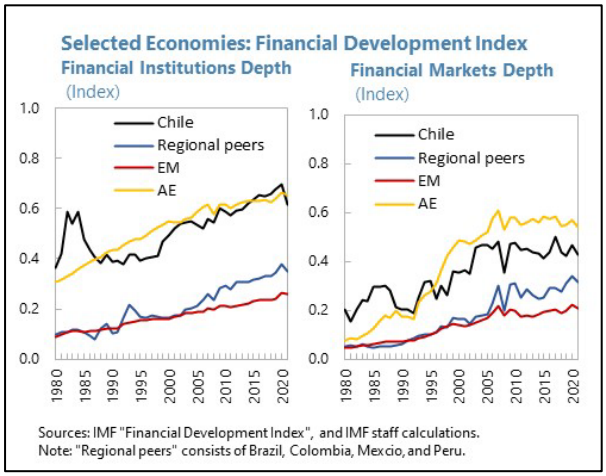
9. It is uncertain if the adjustment of retail deposit since the pension fund withdrawals is complete. While households' cash and sight deposits increased after the pension fund withdrawals (Madeira, 2022) they seem to have returned to pre-pandemic trends. The consumption boom and high-rate environments in 2022-2023 depleted much of the extra liquidity and shifted liquidity from sight to term deposits. Given that term deposits are still elevated, further adjustments of households' composition of their financial assets, might occur. It would likely depend on the interest rate development.

C. Financial Depth and Sensitivity of Financial Variables to Global Risk

Developments in the Financial Institutions and Markets Depth

10. The depth of financial institutions and markets in Chile was comparable to those in advanced economies pre-pandemic. The IMF's Financial Development Index[14] so far available until 2021, measures *financial institutions depth* in terms of (i) private sector credit to GDP, (ii) pension fund assets to GDP, (iii) mutual fund assets to GDP, and (iv) insurance premiums to GDP. It was comparable to the average of advanced economies, which is much higher than that of regional peers. Regarding *financial markets depth*, based on (i) stock market capitalization to GDP, (ii) stocks traded to GDP, (iii) international debt securities of governments to GDP, (iv) total debt securities of financial corporations to GDP, and (v) total debt securities of non-financial corporations to GDP, it was between the average levels of advanced economies and those of regional peers.

Indicators for Financial Institutions and Markets Depth
Financial Institutions Depth
Private sector credit to GDP
Pension fund assets to GDP
Mutual fund assets to GDP
Insurance premiums, life and non-life to GDP
Financial Markets Depth
Stock market capitalization to GDP
Stocks traded to GDP
International debt securities of government to GDP
Total debt securities of financial corporations to GDP
Total debt securities of nonfinancial corporations to GDP

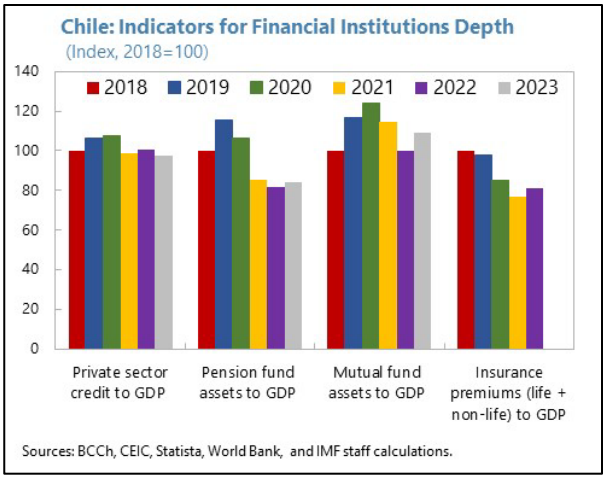


11. After the pension fund withdrawal, the depth of financial institutions declined in 2021, and the level has not recovered yet.[15] In 2021, *financial institutions depth* in Chile significantly declined. Based on the components of this indicator, it mainly reflected the decrease in pension

[14] For details on the methodology, see Svirydzenka (2016) and Sahay et al. (2015). A CMF report analyzes the trends and provides an international comparison of the depth of financial institutions and markets, using this index along with additional indicators, while not specifically focusing on the recent periods.

[15] Because the Financial Development Index does not publish the components of the financial institution depth and financial markets depth, the charts on the components of these depths are sourced from different database. The charts enable us to understand the factors behind the changes in depths and to infer the developments since 2022.

fund assets to GDP, which has not rebounded by 2023. Moreover, the other components of the financial institution depth have also declined and not fully recovered by 2023. Regarding *financial markets depth*, it declined similarly to trends observed in other countries in 2021. The components of this indicator indicate that this decline reflected modest decline in most indicators, while ratios of international debt securities of government to GDP having increased. As of 2023, these indicators have remained almost unchanged from 2021.



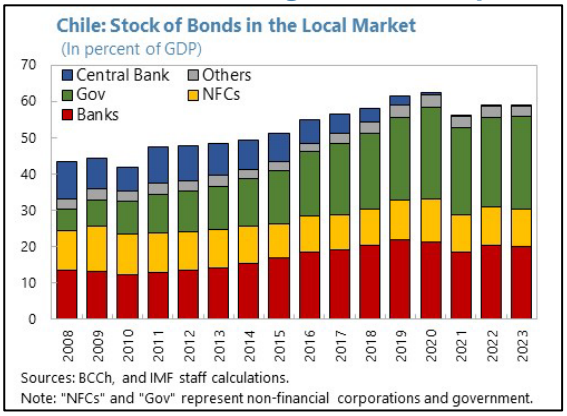
12. The developments in local financial markets since the pandemic suggest a shallower financial depth as well.[16] In the primary bond market, the stock of local bonds to GDP declined in 2021 and has since remained below pre-pandemic levels. Although the issuance of bank and corporate bonds appears to have returned to its pre-pandemic trend, driven by macro-financial conditions, no signs of pent-up issuance have been observed (see Box 1). Average maturity has moderately declined, and average interest rates have been increasing. In the secondary bond market, turnover has not yet returned to pre-pandemic levels, and corporate bond spreads remain higher than they were before the pandemic. The volatility (standard deviation) of corporate and bank bond spreads has stayed above the 2018 average, since 2019. This trend also somewhat holds for sovereign spreads. In the stock market, new issuance has stagnated, and market capitalization has declined.[17] This may have been partly due to the trend of stock market delisting (e.g., ownership takeovers) since the 2010s. Turnover, price-to-earnings (PER) ratios, and price-to-book (PBR) ratios are also lower than pre-pandemic levels. The deterioration of the market liquidity has been more significant for small cap firms.[18] While volatility in local equity markets has decreased from its peak during the pandemic, it is still higher than the 2018 average.

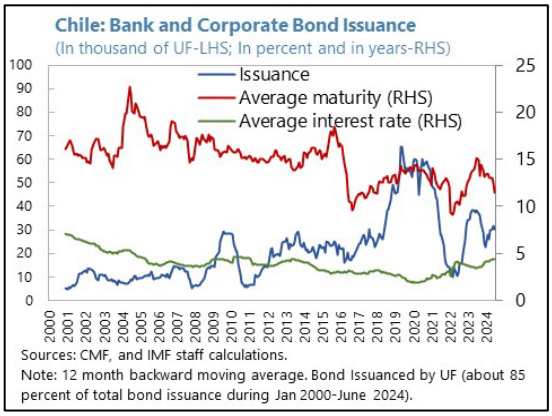
[16] The Chilean stock exchange plans to merge with the exchanges of Colombia and Peru. The goals are to attract global investors and increase market liquidity by incurring smaller fixed costs for accessing diversified portfolios through a unified trading platform with consistent rules and enabling USD transactions. This initiative aims to be more complete than Mercado Integrado Latinoamericano (MILA), which simply connected the trading platforms of Chile, Colombia, Mexico, and Peru without standardizing rules. The integration is planned to begin with equity markets and later extend to bond markets.

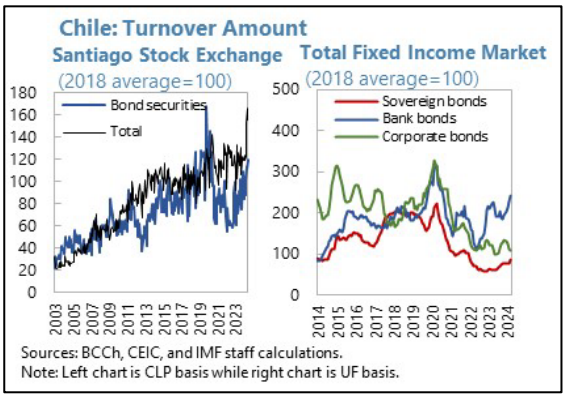
[17] This may have been partly due to the trend of stock market delisting (e.g., ownership takeovers) since the 2010s.

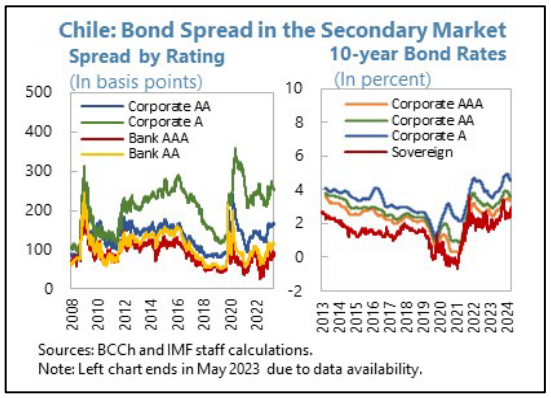
[18] The deterioration of the market liquidity has been more significant for small cap firms.

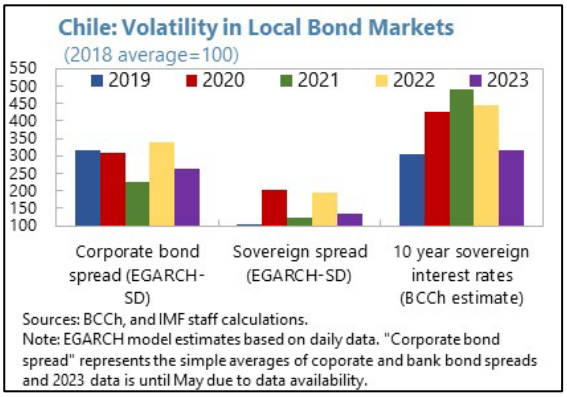
Figure 1. Developments in Local Financial Markets

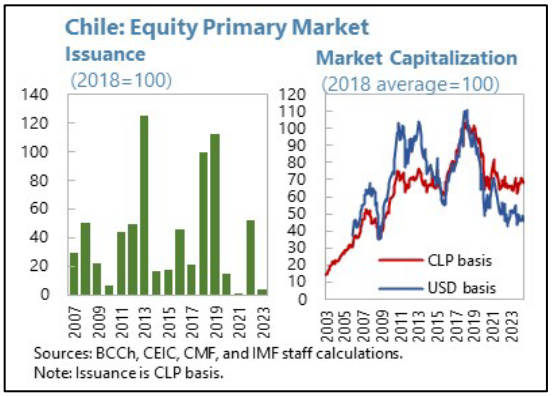


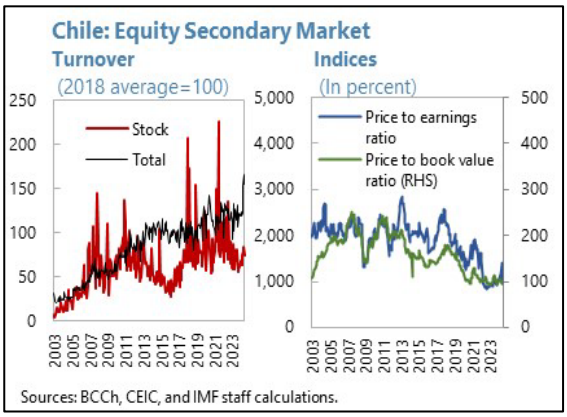


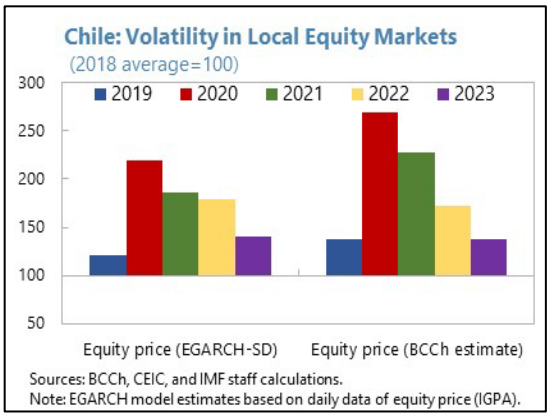




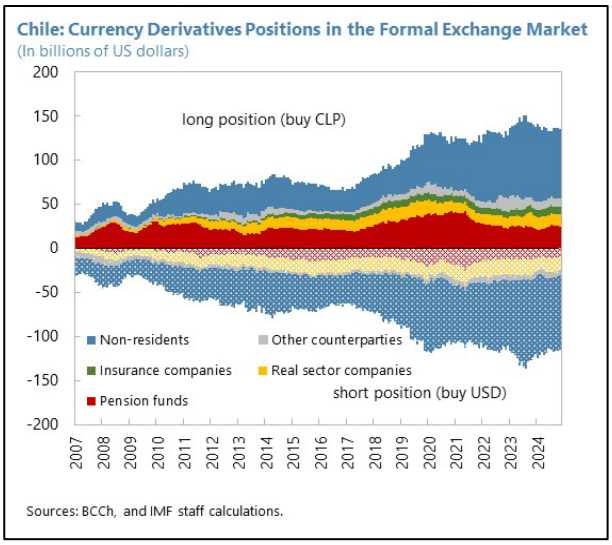


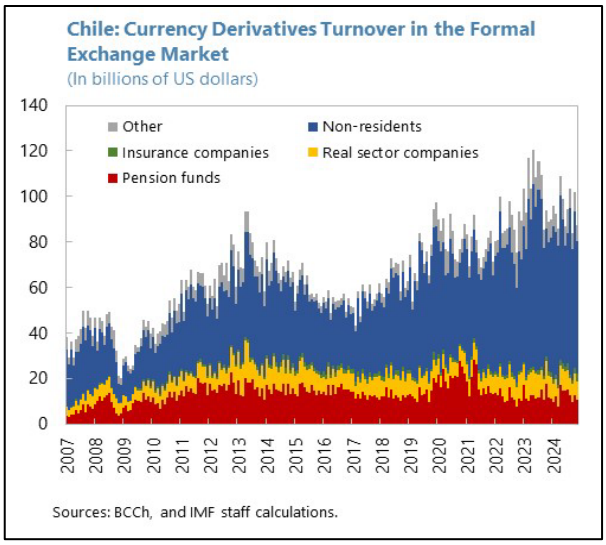


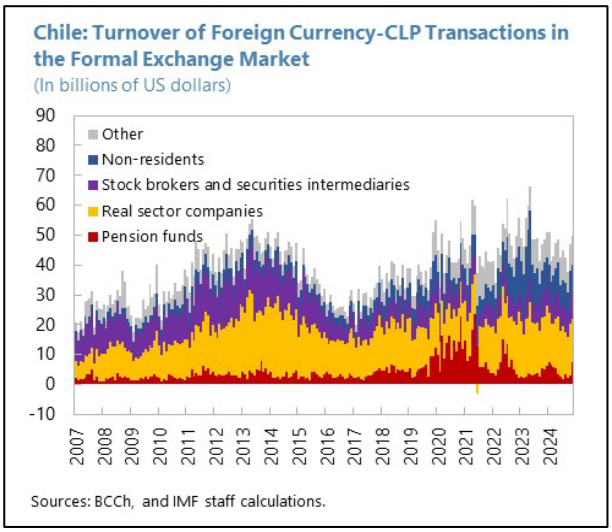




13. In the foreign exchange market, the presence of non-residents has increased amid a declining presence of pension funds. The presence of pension funds in both gross currency derivative positions and turnover has declined, while that of foreign investors has significantly increased in both spot and derivative markets. Meanwhile, the volatility of exchange rates still is elevated, compared with the 2018 average. In this regard, the performance of pension funds as a natural offset to non-resident capital outflows has weakened. Pension fund investment rules impose strict limits on foreign investment (and hedging rules for foreign exchange risk). Consequently, in response to exchange rate movements, pension funds must rebalance their portfolios. As a result, pension funds act as shock absorbers, with this function being proportional to the transaction volume required and ultimately the size of the pension fund assets (IMF 2023). Increased volatility may imply a weakening of this cushioning mechanism.[19]







[19] An article titled "The Exchange Rate and Foreign Investment Limits for Pension Funds" and Box II.2 in the BCCh's 2007H2 FSR examine the impact of the limits on pension fund investment on the FX market. Box IV.1 in the BCCh's 2008H1 FSR discusses Chilean pension funds' exchange rate risk hedging.

Sensitivity of Local Financial Variables to Global Risk

14. One can assess empirically the implications of shallower financial depth on the resilience of financial markets against external stress. In particular, the responses of local financial variables to an increase in global financial stress are estimated using daily local projection models. Specifically, the following time series model is estimated:

$$y_{t+h} - y_{t-1} = \alpha_{t+h} + \beta_{t+h}\, GFS_t + \gamma_{t+h} X_{t-1} + \varepsilon_{t+h} \quad for\ h = 0, \dots, 10$$

where $y_{t+h} - y_{t-1}$ represents the cumulative daily changes of each financial variable from t-1 to t+h. The model is estimated separately for sovereign bond spreads, corporate bond spreads, equity prices, exchange rates, onshore spreads, and the local stress index for sovereign bond and exchange rate markets. The latter is constructed by the BCCh based on volatility, spreads, liquidity indicators, and flows in the market (the BCCh's 2020H2 FSR). The variable y_t on day t is the level, except for equity prices (log-level). α_{t+h} indicates the constant, GFS_t represens the global financial stress index, developed by the Office of Financial Research (OFR) in the U.S., and X_{t-1} consists of a set of control variables, specifically, the one period lag of dependent variable ($y_{t-1} - y_{t-2}$) and the lag of the global financial stress index (GFS_{t-1}). By including these variables, the impact of the past local financial conditions and the influence of the past global financial stresses are controlled, making the estimate of β_{t+h} the estimated cumulative response of the dependent variable to a (historical) one standard deviation increase in global financial stress from t-1 to t, where the increase is comparable to the bottom-peak of the index during the Euro debt crisis.[20] The sample period covers daily data from January 2000 to July 2024, or the longest available period within that timeframe, and the models are estimated separately for the responses before September 2019 and after October 2019, i.e. the separation of the sample periods are based on the start of the 2019 social unrest. The reason for this separation is that the social unrest is considered the initial event that affected the financial markets [21], in a series of events such as the Covid-19 pandemic and pension fund withdrawals, i.e., the starting point of regime changes in the local financial markets. This also allows us to use a larger number of observations for estimation with smaller samples (during and post-pandemic periods). In this regard, Annex III examines the robustness of the results with respect to the separation of the samples. The standard errors are corrected for heteroskedasticity and autocorrelation (HAC estimators). Then, the charts present the estimated responses along with 90 percent confidence intervals for a one standard deviation increase in global financial stress.

[20] The bottom peaks during the subprime mortgage crisis, the global financial crisis (GFC), the Euro debt crisis, and the pandemic are about 3, 5, 1, and 3 standard deviations of the index (from January 2000 to July 2024), respectively. In interpreting this estimate, it encompasses not only the direct impact of global financial stress but also the effects of the endogenous responses of other local financial variables on the dependent variable.

[21] The social unrest is considered to have deteriorated market sentiment, serving as a wake-up call for traditional investors who were previously comfortable investing in the domestic market to reallocate their assets toward global markets.

15. Local financial variables appear to have become more sensitive to global financial stress.[22] Compared to (pre-social unrest and) pre-pandemic periods, the responses have tended to increase in sovereign bond spreads, corporate bond spreads, equity prices, and exchange rates. In particular, the differences in sovereign bond spreads and equity prices are statistically significant at the 10 percent level. Additionally, responses in exchange rates have also increased compared to pre-pandemic periods, while the results for onshore spreads are mixed. As a result, the local financial market stress index has also been more strongly heightened in response to a one standard deviation increase in the global financial stress index. These results are broadly robust to different separation periods, sample periods for the pre-pandemic periods, and the number of lags for control variables (Annex III).

16. The authorities are taking steps to restore financial market depth, strengthen crisis response capabilities, and enhance the resilience of the markets. The proposed pension fund reform includes an increase in the pension contribution rate, specifically from 10 to 16 percent, and the authorities have recently imposed limits on frequent transfers between different types of funds, to reduce the need to hold excessive precautionary liquidity.[23] Furthermore, the Fintech Law allows for providing new financial products such as Mini-bonds.[24] As part of a resilience approach, the Financial Market Resilience Law is being implemented. The Law aims to increase the depth of the interbank repo market by providing legal certainty to market participants involved in repo operations, with the BCCh currently preparing regulations (2024H2 FSR). It also enables the BCCh to provide liquidity to non-bank financial entities, including systemic credit unions and financial market infrastructures, and establishes a framework under which the BCCh may exceptionally offer repos to the non-banks in the event of systemic financial stress. Furthermore, it enhances the CMF's regulatory powers to impose liquidity buffer requirements on mutual funds and intends to facilitate internationalization of the Chilean peso by simplifying the procedure for obtaining a Tax Identification Number for CLP accounts held by non-residents. Additionally, the BCCh is implementing a self-securitization scheme to increase the supply of collateral instruments for financial transactions. And the primary market maker system for sovereign bonds, aimed at enhancing liquidity in secondary markets, is currently in the implementation phase. Moreover, the current implementation of the Basel III capital and liquidity requirements, including the counter-cyclical capital buffers for banks (currently 0.5 percent of risk-weighted assets, with plans to gradually increase to a 1 percent neutral level), aims at strengthening the resilience of the financial sector by building buffers against market stress.

[22] This result, highlighting the correlation between shallower market depth and higher sensitivity to external stress, is consistent with the findings in Box I.1 of the BCCh's 2024H2 FSR, which indicate that funding costs (10-year interest rates) tend to rise in response to increasing geopolitical risks in countries with shallower market depths.

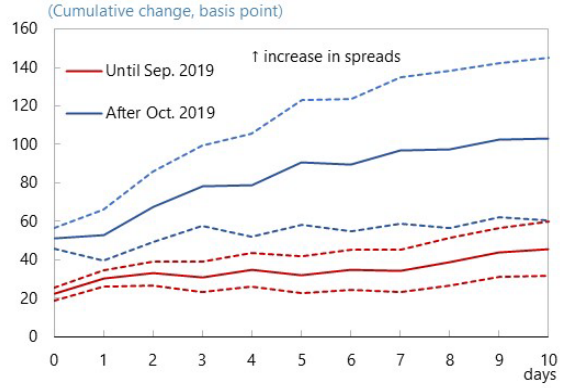
[23] Box V.1 in the BCCh's 2020H1 FSR highlights the risks associated with the impact of financial advisory services on significant pension fund movements and the increased preference of pension funds for liquid assets as a precautionary measure.

[24] Mini-bonds are unsecured bonds sold by companies to individuals or institutions, referred to as "mini" due to their smaller issue size compared to the minimum required for bonds in institutional capital markets.

Figure 2. Responses of Local Financial Variables to Global Financial Stress

Chile: Responses of Sovereign Bond Spread to Global Financial Stress Index

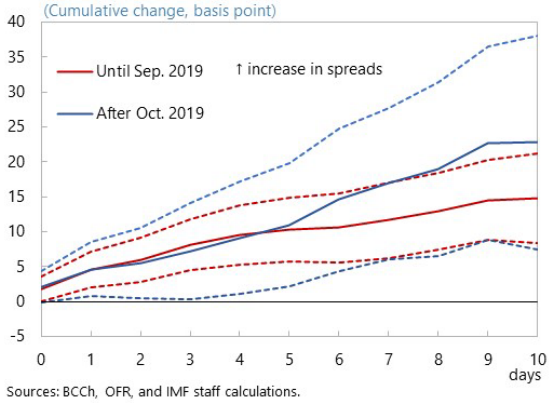
(Cumulative change, basis point)



Sources: BCCh, JP Morgan, OFR, and IMF staff calculations.
Note: The bold and dotted lines represent estimates and 10-90 percentiles, respectively, with standard errors based on HAC estimators. "Sovereign bond spread" refers to EMBI. The sample periods are January 2000 to July 2024.

Chile: Responses of Corporate Bond Spread to Global Financial Stress Index

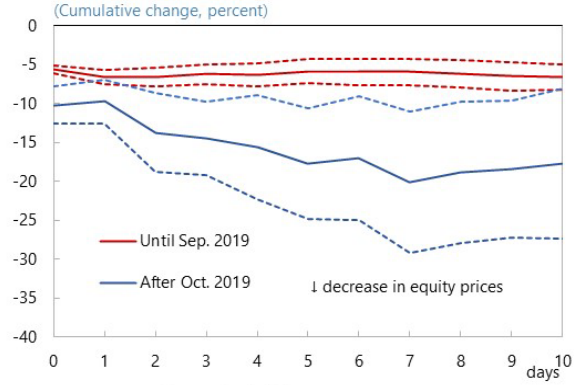
(Cumulative change, basis point)



Sources: BCCh, OFR, and IMF staff calculations.
Note: The bold and dotted lines represent estimates and 10-90 percentiles, respectively, with standard errors based on HAC estimators. The sample periods are January 2008 to May 2023 due to data limitations. "Corporate bond spread" is the simple average of AA and A bank and corporate bond spreads.

Chile: Responses of Equity Price to Global Financial Stress Index

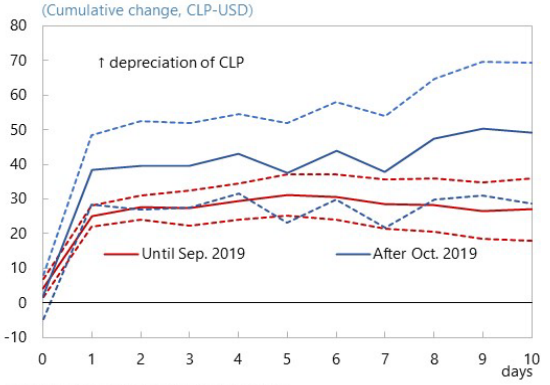
(Cumulative change, percent)



Sources: CEIC, OFR, and IMF staff calculations.
Note: The bold and dotted lines represent estimates and 10-90 percentiles, respectively, with standard errors based on HAC estimators. The sample periods are January 2000 to July 2024. "Equity price" represents the IGPA general index.

Chile: Responses of Exchange Rate to Global Financial Stress Index

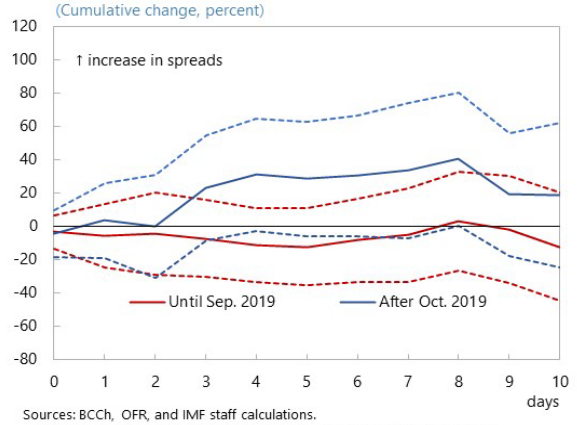
(Cumulative change, CLP-USD)



Sources: BCCh, OFR, and IMF staff calculations.
Note: The bold and dotted lines represent estimates and 10-90 percentiles, respectively, with standard errors based on HAC estimators. The sample periods are January 2000 to July 2024.

Chile: Responses of On Shore Spread to Global Financial Stress Index

(Cumulative change, percent)

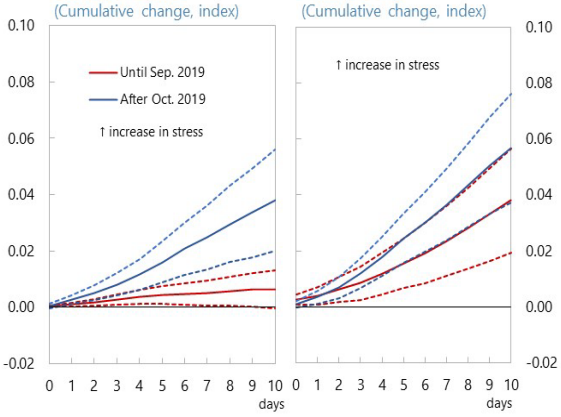


Sources: BCCh, OFR, and IMF staff calculations.
Note: The bold and dotted lines represent estimates and 10-90 percentiles, respectively, with standard errors based on HAC estimators. The sample periods are January 2000 to July 2024.

Chile: Responses of Local Stress Index to Global Financial Stress Index

Sovereign Bonds (Cumulative change, index)

Exchange Rate (Cumulative change, index)



Sources: BCCh, OFR, and IMF staff calculations.
Note: The bold and dotted lines represent estimates and 10-90 percentiles, respectively, with standard errors based on HAC estimators. The sample periods are January 2000 to July 2024.

Box 1. Sign-Restriction VAR Analysis on Bond Issuance

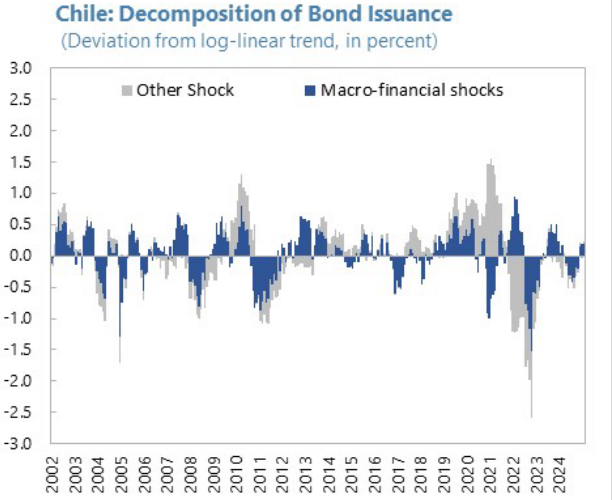
The factors influencing developments in bond issuance in the primary market can be disentangled in an empirical exercise. A historical decomposition of bond issuance using a Bayesian Vector Autoregression (VAR) model is conducted, with an identification strategy based on sign restrictions. Specifically, the deviation from the log-linear trend of the 12-month moving averages of the monthly total issuance of corporate and bank bonds in the Chilean capital market (percent) is analyzed.[1] The model includes three additional variables: GDP growth (year-on-year changes in IMACEC, percent), CPI inflation (year-on-year changes, percent), and the monetary policy rate (percent)[2], with four lags. Three types of shocks are identified: (i) a demand shock that positively affects GDP, inflation, the policy rate, and bond issuance; (ii) a supply shock that positively affects GDP and bond issuance but negatively affects inflation; and (iii) a monetary policy (MP) shock that negatively affects GDP, inflation, and bond issuance while positively affecting policy rates. It is assumed that GDP and bond issuance react with the same sign, as an increase in investment (GDP) leads to a greater supply of bonds. The remaining shocks capture a variety of factors, including the impact of diminished pension fund assets for both decreased demands and higher funding costs for issuers. The sample for estimation runs from January 2001 to June 2024.

Sign Restrictions for the Baysian VAR model

	GDP	Inflation	Policy Rate	Bond Issuance
Demand shock	+	+	+	+
Supply shock	+	-	?	+
MP shock	-	-	+	-
Other shocks	?	?	?	?

Note: "+" and "-" represent positve and negative responses, respectively. "?" indicate no restriction.

The estimation results suggest that pension fund withdrawals had a negative impact on bond issuance during the pandemic, with no sign of pent-up demand after that. "Macro-financial shocks" represents the net of the contributions of demand, supply, and monetary policy shocks. Although the macro-financial shocks in the bond issuance market explained most of the decline during the GFC, they could not account for the decrease in issuance after the pandemic. Since then, "other shock" has not contributed to bond issuance in either direction, which is consistent with the observation that pension fund assets relative to GDP have recovered only gradually, rather than strongly rebounding.



Sources: BCCh, and IMF staff calculations.
Note: Based on the estimated Bayesian VAR model with four period lags (sample periods Jan 2001- June 2024). Bond issuance in the UF.

1/ Given that issuances in Chilean pesos and US dollars are limited and quite volatile, this analysis focuses on debt denominated in UF, which accounts for approximately 85 percent of total issuance in the sample. The data is sourced from the CMF.

2/ While longer-term rates are more relevant to bond issuance, this analysis uses the monetary policy rate because identifying economic and monetary policy shocks based on sign restrictions is widely accepted in the macroeconomic literature, whereas identifying shocks to longer-term rates is more challenging. Note that when monetary policy rates are replaced with long-term (10-year) interest rates in UF terms, the estimation results for the contributions of the "macro-financial shocks" and "other shock" remain broadly unchanged.

D. Risk Assessment and Policy Recommendations

17. Pension fund withdrawals, higher public debt, and the BCCh's liquidity injections during the pandemic have reshaped the Chilean financial network. In the context of reduced demand for local bonds, large non-financial corporations and the government relied more on offshore markets and foreign investors for issuance during the pandemic. An increase in retail deposits from pension fund withdrawals and central bank liquidity narrowed banks' wholesale funding channels, such as MMF deposits and bank bonds. Additionally, banks' exposure to sovereign bonds has increased, but the sovereign-bank nexus remains lower than regional peers and part of the increase might be temporary as it was partly driven by the collateral switching for the FCIC unwinding process that ended in July 2024.

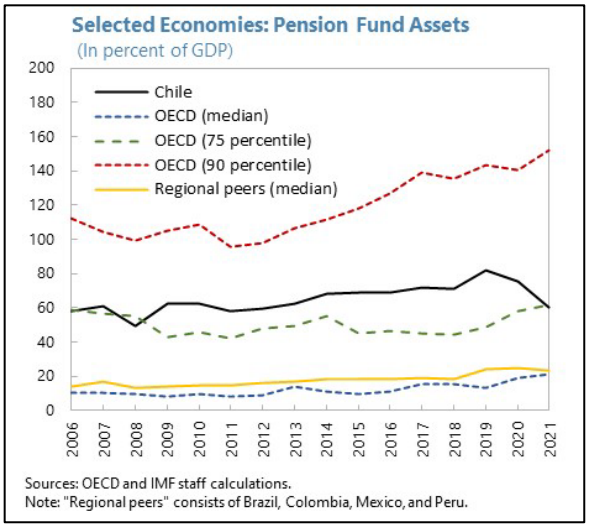
18. The dilution of local market depth following pension fund withdrawals has made the market more sensitive to external financial stress. Local financial variables are estimated to have become more responsive to global financial stress. The estimate is based on the entire period since late 2019 and does not account for variations in sensitivity over that time.

19. Restoring the size of pension funds and their ability to invest in relatively illiquid assets will help restore financial market depth and rebuild the resilience against external shocks. Further pension fund withdrawals should be avoided. The proposed increase in the pension contribution rate would help accelerate the rebuilding of market sizes. Moreover, recent regulatory changes imposing limits on frequent transfers between different fund types are a development that enhances pension funds' ability to invest in assets with lower liquidity.

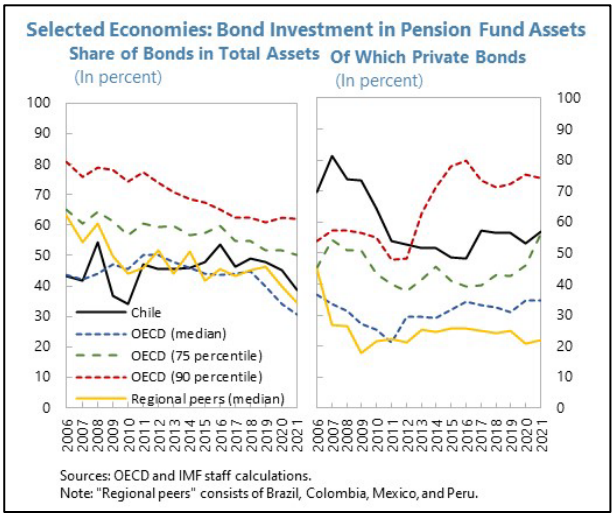
20. Given the heightened sensitivity, it is crucial to strengthen the market's resilience and the authorities' crisis response capabilities. It is particularly important to implement the Financial Market Resilience Law smoothly to develop the interbank repo market, enhance the BCCh's ability to respond to financial distress situations, and strengthen the mutual fund liquidity management framework. Facilitaing internationalization of Chilean peso through the implementation of the Law could also enhance the resilience by providing diverse counterparty options and deepening the Chilean peso's role in cross-border transactions to reduce dependence on foreign currency funding.

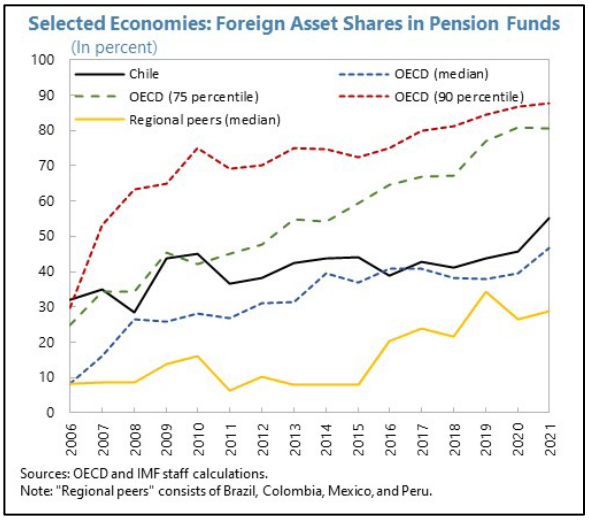
Annex I. Chilean Pension Funds

1. Chile has a large pension fund sector, although its size has recently declined. Until 2019, the ratio of pension fund assets to GDP was increasing, reaching around 80 percent, which is significantly higher than the median of regional and OECD peers (approximately 20 percent). However, following the pension fund withdrawals, this ratio has dropped to around 60 percent. While this level is still high, it is comparable to the 75th percentile of OECD peers.



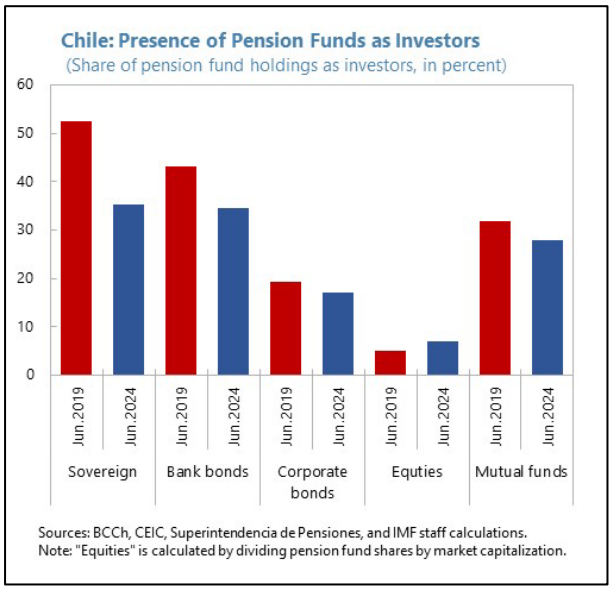
2. Chilean pension funds have primarily invested in private domestic bonds, although they have also been increasing their foreign investments.[1] The share of bonds in pension fund assets in Chile is similar to the regional and OECD medians, while the share of private bonds in total (public and private) bond investments has been higher than those medians. This indicates that Chilean pension funds have actively invested in private bonds compared to other countries. Meanwhile, the share of foreign assets in pension fund portfolios has steadily increased, in line with global trends. In terms of the level of this share, it is comparable to the median among OECD peers and significantly higher than that of regional peers.





[1] Since the creation of pension funds in 1981, investment rules have been progressively relaxed. Initially limited to fixed-income instruments, pension funds were later allowed to invest in equities, foreign assets, and other instruments including (domestic and foreign) alternative assets. Currently, Chilean pension funds can invest up to 80 percent abroad, with limits ranging from 5 to 80 percent depending on the fund profile. Pension funds were allowed to invest in alternative assets in 2016 and the investment limit have been increased (for detail, see Box IV.2 of the BCCh's 2024H1 FSR).

3. Chilean pension funds have a significant presence in various instruments within the local financial markets. These include sovereign bonds,[2] bank bonds, mutual funds, and corporate bonds, as pension funds favor long-term investments. They tend to buy-and-hold these securities. Before the pension fund withdrawals, pension funds held around half of the sovereign and bank bonds and about 20 percent of corporate bonds in the market. However, these shares declined following the withdrawals. Pension funds also have significant holdings in mutual fund investments, while their share in direct equity investments remains relatively limited.[3]



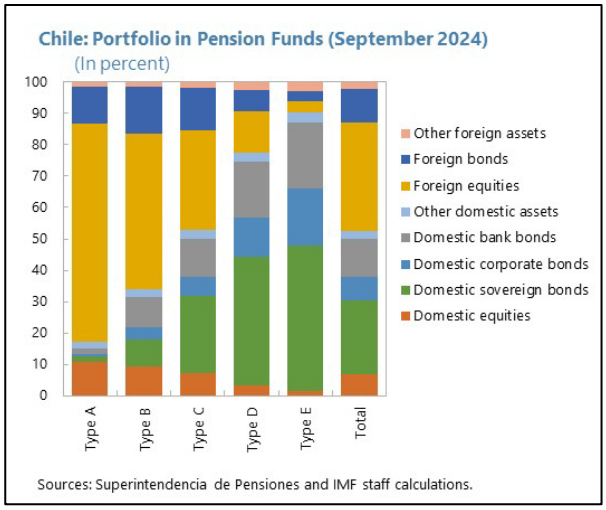
4. Chilean pension fund investors tend to shift investments across different fund types in response to macro-financial conditions, compelling pension funds to maintain adequate liquid assets to accommodate these shifts.[4] In Chile, the 2002 reform introduced five fund types (A–E) with varying exposure to variable-income assets. Specifically, type A funds primarily invest in foreign equities and are regarded as the riskiest, while type E funds mostly invest in domestic bonds and are considered the safest. A key feature of Chilean pension funds is their frequent shifts among these five types. For example, during financial distress events like the Global Financial Crisis and the pandemic, funds shifted from types A and B to types D and E, reflecting the risk aversion of pension holders. Conversely, in 2022, when bond investment performance was weak due to heightened interest rates, funds moved from types D and E to types A and B. These shifts, driven by a significant number of individual investors often guided by financial advisory firms,[5] have led pension funds to maintain ample liquidity, hampering their investment in illiquid assets. Recently, limits on these shifts have been introduced.

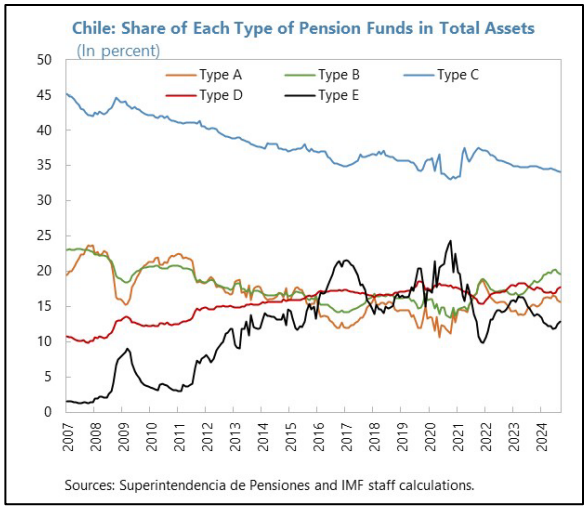
[2] Box II.1 in the BCCh's 2017H1 FSR explains the microstructure of sovereign bond market.

[3] Article in the BCCh's 2007H1 analyzes the impact of pension fund transactions on the local stock market.

[4] Box III.1 in the BCCh's 2009H2 FSR analyzes this issue and confirms that, during times of crisis, members' decisions to change funds do impact the pension funds' portfolio adjustments, while the overall portfolio adjustments continue to be determined by the decisions of the administrators.

[5] For details, see Da et al. (2016) and OECD (2020).





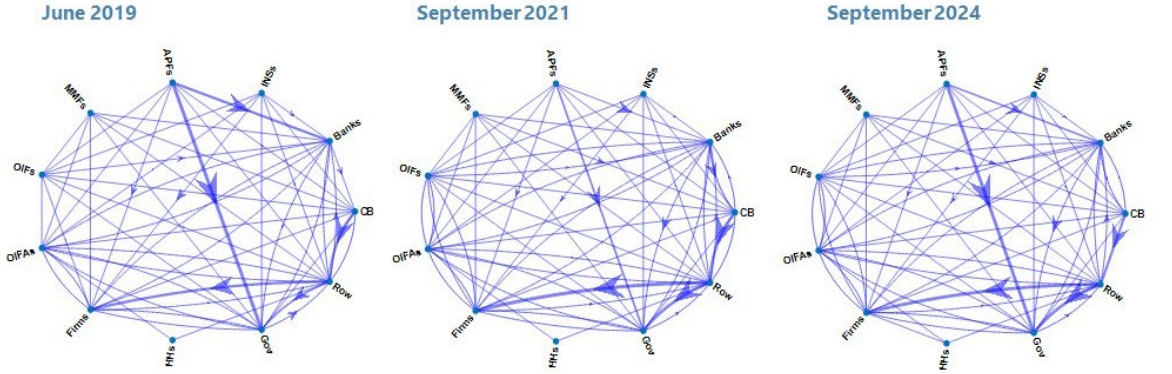
5. Pension funds' strategy to invest in longer duration has changed. After pension fund withdrawals, type E funds have lost prominence, while Chilean pension funds have recently actively used interest rate derivatives to increase in duration of their local fixed-income investments, amid smaller pension fund asset to GDP compared to the pre-pandemic. Specifically, pension funds hold long positions (receiving a fixed rate) in long-term interest rates and short positions in short-term interest rates (paying a variable rate).

Annex II. Network Analysis on Chilean Funding Structures

1. This Annex illustrates the changes in funding networks before, during, and after the pandemic, categorized by financial instrument.[1] The networks are depicted based on sector-level financial accounts, allowing for a better understanding of complex financial relationships across sectors. In terms of the chart structures, an arrow from A to B indicates that A provides liquidity to B. For debt securities and mutual funds, this means that A has purchased and holds B's debt securities or mutual fund shares. For deposits, A holds deposits with B, while in the case of loans, A has lent money to B. The thicker arrows represent stronger network links, specifically indicating the share of each network link in the total networks in terms of the monetary amount. While the observations align with Section B in the main text, the coverage of sectors is broader.

2. According to the network of debt securities, the main shifts relate to the role of pension fund and foreign investors. In particular, the liquidity provision from pension funds to the government, non-financial corporations, and banks has decreased, while liquidity provision from overseas to these sectors has increased. Moreover, the liquidity provision from other investment funds to banks and from insurers to non-financial firms has narrowed. During the pandemic, liquidity provision from the BCCh to banks increased via bank bonds purchase program (started in March 2020), and bank bonds reinvestment program (started in January 2021).[2]

Chile: Network of Debt Securities



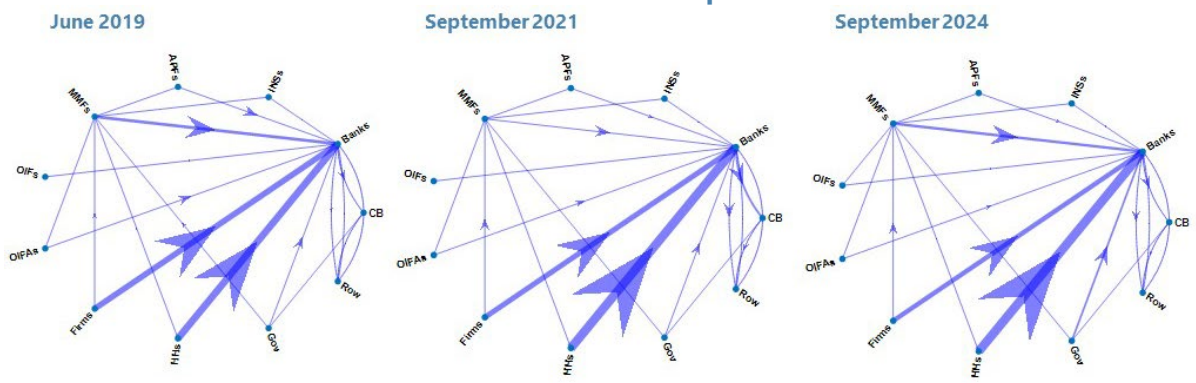
Sources: BCCh and IMF staff calculations.
Note: Based on "Flow of Funds." "INSs"=Insurers, "AFPs"=Pension funds, "OIFs"=Other investment funds, "OIFAs"=Other intermediaries and financial auxiliaries, "Firms"=Non-financial corporations, "HHs"=Households and NPISHs, "Gov"=General government, and "Row"=Rest of the world (foreign investors). Arrows indicate the direction from sources to recipients of funds. The thicker arrows represent stronger network links, specifically reflecting the share of each network link within total networks in terms of the monetary amount associated with debt securities.

3. The network of deposits indicates that households are now the primary providers of liquidity to banks. At the same time, money market funds and pension funds have become smaller liquidity providers. Additionally, while banks' deposits in the BCCh increased during the pandemic, probably mirroring the liquidity provision from the central bank such as FCIC and bank bonds

[1] Box IV.1 in the BCCh's 2021H1 FSR analyzes the interconnectedness between banks and NBFIs.

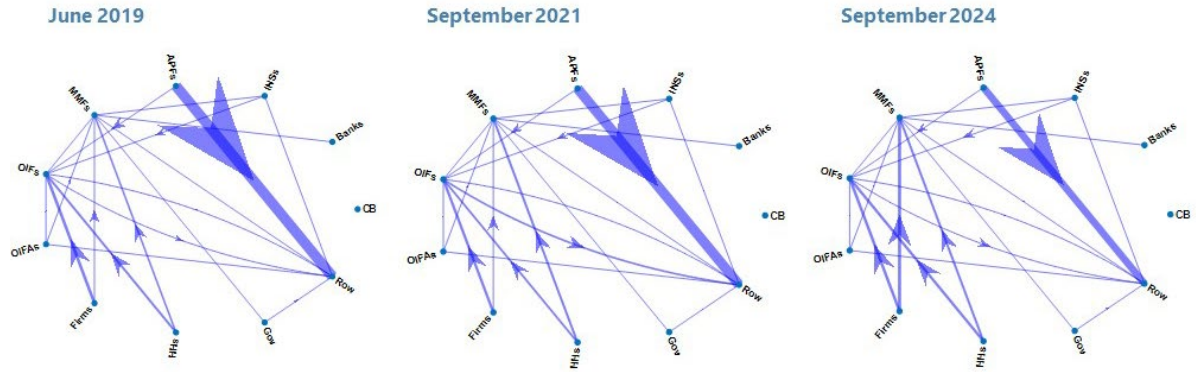
[2] For details, see exceptional measures.

purchase program, they have now decreased as part of the FCIC was unwound in April and July 2024.[3] Meanwhile, deposits from the government to banks have gradually increased since the pandemic.



Sources: BCCh and IMF staff calculations.
Note: Based on "Flow of Funds." "INSs"=Insurers, "AFPs"=Pension funds, "OIFs"=Other investment funds, "OIFAs"=Other intermediaries and financial auxiliaries, "Firms"=Non-financial corporations, "HHs"=Households and NPISHs, "Gov"=General government, and "Row"=Rest of the world (foreign investors). Arrows indicate the direction from sources to recipients of funds. The thicker arrows represent stronger network links, specifically reflecting the share of each network link within total networks in terms of the monetary amount associated with deposits.

4. The network of mutual fund investments reveals that the presence of pension funds in overseas markets has decreased, while liquidity provision from households and firms to mutual funds (MMFs and other mutual funds) has increased. Additionally, liquidity provision from other mutual funds to overseas markets has moderately increased.

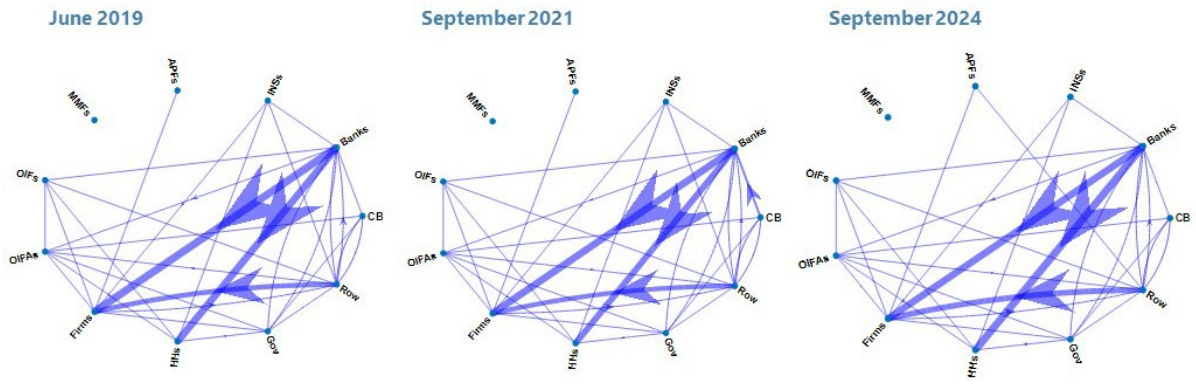


Sources: BCCh and IMF staff calculations.
Note: Based on "Flow of Funds." "INSs"=Insurers, "AFPs"=Pension funds, "OIFs"=Other investment funds, "OIFAs"=Other intermediaries and financial auxiliaries, "Firms"=Non-financial corporations, "HHs"=Households and NPISHs, "Gov"=General government, and "Row"=Rest of the world (foreign investors). Arrows indicate the direction from sources to recipients of funds. The thicker arrows represent stronger network links, specifically reflecting the share of each network link within total networks in terms of the monetary amount associated with mutual funds including MMFs.

[3] While the amount of central bank deposits from banks declined since 2021, it increased in the fourth quarter of 2023 and the first quarter of 2024, likely reflecting the banks' purchase of the liquidity deposits issued by the BCCh to facilitate repayment (announced in September 2023).

5. Finally, the network of loans indicates an increasing provision of liquidity from overseas to non-financial firms.[4] The loans from the BCCh to banks increased during the FCIC period but returned to pre-pandemic levels following the unwinding in April and July 2024.

Chile: Network of Loans



Sources: BCCh and IMF staff calculations.
Note: Based on "Flow of Funds." "INSs"=Insurers, "AFPs"=Pension funds, "OIFs"=Other investment funds, "OIFAs"=Other intermediaries and financial auxiliaries, "Firms"=Non-financial corporations, "HHs"=Households and NPISHs, "Gov"=General government, and "Row"=Rest of the world (foreign investors). Arrows indicate the direction from sources to recipients of funds. The thicker arrows represent stronger network links, specifically reflecting the share of each network link within total networks in terms of the monetary amount associated with loans.

[4] According to BIS locational banking statistics, loans from the United States, Spain, and Hong Kong SAR have increased from Q2 2019 to Q2 2024.

Annex III. Robustness of the Analysis on Sensitivity of Local Financial Variables to Global Risk

1. This Annex examines the robustness of the local projection analysis regarding the sensitivity of local financial variables to global financial stress in the main text. Specifically, this Annex explores the robustness from three perspectives. First, the separation period between pre-pandemic and during-and-post-pandemic periods. Although the results in the main text separate samples at the end of September 2019, to ensure a larger number of observations for estimation in the during-and-post-pandemic periods, other separation points are considered. Second, the estimation period for the pre-pandemic period. The analysis in the main text uses all available samples to ensure a sufficient number of observations, which might cause the estimation results to heavily depend on sensitivity from a long time ago (e.g., 15 years ago), such as sensitivity to the GFC. Therefore, this Annex estimates the sensitivity by focusing on more recent periods. Finally, the adequacy of control variables will be examined.

2. The results are broadly robust to different separation periods, sample periods for the pre-pandemic periods, and the number of lags for control variables. Specifically, results of the robustness checks are as follows.

- ***Separation of sample periods.*** If we separate the samples at the end of January, i.e., exactly before and after the pandemic, the results remain almost unchanged from those in the main text. Even if the samples are separated at the end of May 2020 (the first round of pension fund withdrawals), the results remain broadly robust, especially regarding exchange rates and equity prices, while the difference between the pre-pandemic and the during-and-post-pandemic periods become less striking for sovereign and corporate bond spreads. Note that, because the sample periods for the during-and-post-pandemic periods are only about four years long for corporate bonds and five years long for other variables, shifting the separation period to the end of May 2020 reduces the sample size by approximately 25 percent for corporate bonds and 20 percent for the other variables, respectively.

- ***Sample periods for pre-pandemic periods.*** If the sample period for the pre-pandemic period starts from 2014, the estimation results remain broadly unchanged or even become sharper. Specifically, the response of corporate bond spreads becomes significantly less sensitive in the pre-pandemic period, leading to a sizable difference in sensitivity between the pre-pandemic and the during- and post-pandemic periods. Moreover, the response of exchange rates becomes less persistent in the pre-pandemic period, resulting in a wider difference in sensitivity five days after the stress date. Consistent with this, the difference in the local stress index for exchange rates also widens.

- ***Control variables.*** The estimation results remain quite robust even when the number of lagged control variables is extended from one period to multiple periods, i.e. ($y_{t-2} - y_{t-3}$, $y_{t-3} - y_{t-4}$,…, GFS_{t-2}, GFS_{t-3},…) are added to X_{t-1}.

References

Albagli, Elías, Mauricio Calani, Metodij Hadzi-Vaskov, Mario Marcel, Luca A Ricci, 2020. "Comfort in Floating: Taking Stock of Twenty Years of Freely-Floating Exchange Rate in Chile," IMF Working Papers 2020/100, International Monetary Fund.

Alfaro, Laura, Mauricio Calani, and Liliana Varela, 2021. "Granular Corporate Hedging Under Dominant Currency," NBER Working Papers 28910, National Bureau of Economic Research, Inc.

Chang, Roberto, Andrés Fernández, and Adam Gulan, 2017. "Bond finance, bank credit, and aggregate fluctuations in an open economy," Journal of Monetary Economics, vol. 85(C), pp. 90-109.

Da, Zhi, Borja Larrain, Clemens Sialm, and José Tessada, 2016. "Coordinated Noise Trading: Evidence from Pension Fund Reallocations," NBER Working Papers 22161, National Bureau of Economic Research, Inc.

International Monetary Fund (IMF), Western Hemisphere Dept., 2021a, "Chile's Pension System in the Aftermath of Covid-19: Impact and Reform Options," Chile: Selected Issues, Volume 2021, Issue 084, International Monetary Fund.

International Monetary Fund (IMF), Western Hemisphere Dept., 2021b, "Asset Prices and Capital Flows During the Covid-19 Pandemic," Chile: Selected Issues, Volume 2021, Issue 084, International Monetary Fund.

International Monetary Fund (IMF), 2022, "The Sovereign-Bank Nexus in Emerging Markets: A Risky Embrace," Global Financial Stability Report April 2024, Chapter 2.

International Monetary Fund (IMF), Western Hemisphere Dept., 2023, "Macroeconomic Implications of Pension Funds and Capital Markets," Chile: Selected Issues, IMF Country Report No. 23/37.

Jara, Alejandro, and Alberto Naudon, 2024. "The changing nature of the financial system: the Chilean experience," Note prepared to be presented at the BIS meeting of Deputy Governors on 18–19 March 2024.

Madeira, Carlos, 2022. "The impact of the Chilean pension withdrawals during the Covid pandemic on the future savings rate," Journal of International Money and Finance, Volume 126, 102650

Organisation for Economic Co-operation and Development (OECD), 2020. "Effects of fund switches for Chilean pension members and their macroeconomic/financial impact," Technical assistance for the Financial Stability Council of Chile Report prepared by Jessica Mosher and Pablo Antolin August 2020.

Sahay, Ratna, Martin Cihak, Papa M N'Diaye, Adolfo Barajas, Diana B Ayala Pena, Ran Bi, Yuan Gao, Annette J Kyobe, Lam Nguyen, Christian Saborowski, and Katsiaryna Sv, 2015. "Rethinking Financial Deepening: Stability and Growth in Emerging Markets," IMF Staff Discussion Notes 2015/008, International Monetary Fund.

Svirydzenka, Katsiaryna, 2016. "Introducing a New Broad-based Index of Financial Development," IMF Working Papers 2016/005, International Monetary Fund.