TECHNICAL ASSISTANCE REPORT

CHILE

Strengthening Systemic Liquidity Management

January 2025

Prepared By

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Authoring Department

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The analysis and policy considerations expressed in this publication are those of the IMF's Monetary and Capital Markets Department.

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Glossary

ASRF	Asymptotic Single Risk Factor
ATS	Automatic Trading System
BCCh	Banco Central de Chile
BTP	Nominal Treasury Bond
CCP	Central Counterparty
CC-VP	Bank Bond Buy-/Sellback Program
CD	Certificate of Deposit
CEF	Financial Stability Council
CLF	Chile Unidad de Fomento (Chilean Unit of Account)
CLP	Chilean Peso
CMF	Comisión para el Mercado Financiero (Financial Market Commission)
CMG	ELA Crisis Management Group
CPF	Chilean Peso Indexed to the UF
CPS	Chilean Peso at Nominal Value
CRD	Corporate Risk Division
CSD	Central Securities Depository (Deposito Central de Valores)
CVaR	Conditional Value-at-Risk
DMO	Debt Management Office
DvP	Delivery-versus-Payment
ELA	Emergency Liquidity Assistance
EMDE	Emerging Market and Developing Economy
EWG	ELA Working Group
FCIC	Financial Crisis Inquiry Commission
FLI	Intraday Permanent Liquidity Facility
FMD	Financial Markets Division
FMRA	Financial Markets Resilience Act
FoP	Free-of-Payment
FPD	Financial Policy Division
FPL	Overnight Liquidity Facility
FSAP	Financial Sector Assessment Program
FX	Foreign Exchange
GDP	Gross Domestic Product

GFC	Great Financial Crisis
GMRA	Global Master Repurchase Agreement
HQLA	High-Quality Liquid Asset
ICMA	International Capital Market Association
IMF	International Monetary Fund
IFRS	International Financial Reporting Standards
IRB	Internal Rating Based
IRR	Internal Rate of Return
LCL	Liquidity Credit Line Facility
LCR	Liquidity Coverage Ratio
MCM	Monetary and Capital Markets Department
MoF	Ministry of Finance
MoU	Memorandum of Understanding
MRA	Master Repurchase Agreement
NBFI	Non-bank Financial Institutions
NDF	Non-Deliverable Forwards
NFC	Nonfinancial Corporations
NSFR	Net Stable Funding Ratio
OTC	Over-the-Counter
PD	Probability of Default
PWRA	Purchase-with-Resale-Agreement
RFQ	Request-for-Quote
SII	The Tax Authority
SP	Superintendent of Pensions
TA	Technical Assistance
TIPS	Treasury Inflated-Protected Securities
TPM	Tasa de Politica Moneria (Monetary Policy Rate)
UF	Unidad de Fomento (Unit of Account)
USD	United States Dollar
VaR	Value-at-Risk

Preface

At the request of the Central Bank of Chile (BCCh), a Monetary and Capital Markets (MCM) Department mission visited Santiago from May 23–June 4, 2024, to assist the authorities in improving their systemic liquidity management covering four areas: collateral policy, emergency liquidity assistance, systemwide measures to support market functioning and repo market development.

The mission met with BCCh officials including Governor Rosanna Costa; Vice Governor Stephany Griffith-Jones; Board members Claudio Soto, Luis Felipe Céspedes, and Alberto Naudon; General Manager Luis Oscar Herrera; the Heads of the Financial Policy, Financial Markets, and Corporate Risk Divisions—Rosario Celedón, Ricardo Consiglio, Diego Ballivian, respectively—and General Counsel Juan Pablo Araya; staff from the Ministry of Finance (MoF) and the Financial Markets Commission (CMF) and the Superintendent of Pensions (SP); and from the private sector, commercial banks, mutual funds, pension funds, and financial market infrastructure providers. The mission wishes to thank all BCCh staff for their cooperation, productive discussions, and their warm hospitality. In particular, it thanks Gabriel Aparici and Carlos Fernandez for the excellent arrangements that greatly facilitated the mission's work.

Executive Summary

The Chilean financial sector is large (290 percent of gross domestic product (GDP)), diversified, and sophisticated. Nonbank bank financial institutions (NBFIs) account for almost half of the sector, with pension funds dominating. The banking sector is concentrated, with six banks accounting for 87 percent of bank assets (May 2024). Financial markets are well developed, with a free-floating exchange rate with no restrictions. The unique feature is the predominance of inflation-indexed products, issued by both the government and the private sector. Consequently, there are active markets in inflation derivatives such as short-term inflation forwards and medium-term inflation swaps.

Although the responses to recent crises were effective, there are gaps in the BCCh's ability to deal with idiosyncratic liquidity stress, and one important market segment is undeveloped—the domestic repo market. Following a Monetary and Capital Markets (MCM) Department technical assistance (TA) mission in 2018, the Financial Markets Resilience Act 2023 (FMRA) was passed, expanding the BCCh's ability to respond to liquidity stress on two fronts. First, it allowed for broader eligibility for emergency liquidity assistance (ELA) by including central counterparties (CCPs) and credit unions that meet banklike regulations. Second, it allowed for providing support systemwide or to sectors that are facing specific liquidity pressures (e.g., the pension sector). The International Monetary Fund (IMF)'s Financial Sector Assessment Program (FSAP) in 2021 highlighted that the authorities were not well prepared to provide ELA and the absence of an active repo market undermined financial resilience. Consequently, this TA mission aimed to address four areas: (i) the BCCh's collateral framework; (ii) the ELA framework (iii) systemwide support measures; and (iv) repo market development.

The BCCh should introduce a collateral framework to facilitate its lending operations while mitigating financial risks. A coherent collateral framework has three components: (i) eligibility criteria; (ii) valuation procedures; and (iii) risk mitigation measures. While the emphasis is on an overall framework, there is a need to distinguish between collateral that is eligible for monetary policy operations and that is eligible for ELA and systemwide support measures, the latter of which will be lower quality.

Eligibility should be determined by scanning bank balance sheets for available collateral, setting a priority order and then assessing the collateral against potential liquidity needs. The ordering should consider several aspects, including credit, liquidity, legal, and correlation risks. Once all collateral types are ranked, the BCCh should demarcate eligibility for monetary policy operations from those eligible for ELA (or potentially systemwide operations). This requires assessment of the potential lending needs in normal times—that being the steady state BCCh balance sheet after the maturity of crisis programs. Based on the mission's ranking, it is recommended that banks' bonds and certificates of deposit (CDs) be removed from collateral eligible for monetary policy operations because of the high correlation risk.

Approaches to valuation and risk mitigation need to be modified. The BCCh should develop market-based valuations algorithms for marketable securities and theoretical valuations where there are no observable prices. Methodologies for illiquid and nonmarketable assets also need to be developed. Risk mitigation measures need to be refined with haircuts aiming for risk equivalence across all collateral, calibrated to contain liquidity, market, credit, and other risks to within the BCCh's specified 95 percent tolerance level. Haircuts can be complemented with concentration limits and provisions for overcollateralization to further contain risks where necessary.

An ELA framework has four components: (i) a *Legal Foundation* that supports discretionary lending; (ii) *Internal Procedures* that details the conditions and policy parameters under which ELA is provided, and the allocation of BCCh divisional responsibilities; (iii) *Formalized Arrangements* between the BCCh,

CMF, and Ministry of Finance (MoF) covering each party's responsibilities; and (iv) *Transparency and Communication* measures to help condition market behavior and for ex-post central bank accountability.

The BCCh should establish an internal ELA Working Group (EWG) to operationalize the framework. A wide range of input is needed for ELA preparedness and decision making. The EWG's task is to ensure that the BCCh is well prepared to deal with requests quickly and efficiently. The EWG should assign divisional responsibilities and oversee the preparation of detailed procedures, including standardization of a request letter, an ELA master agreement, and funding templates. Further, it should take the lead on establishing ELA policy parameters, including duration, the interest rate, and potential conditionality.

The BCCh, CMF, and MoF should establish a Crisis Management Group (CMG) to ensure clarity about respective roles. The BCCh has the ultimate decision on whether to grant ELA—they have a mandate for financial stability, and it is their resources and reputation that are most at risk. The CMF, as supervisor and regulator, is also key because they must make a quick determination on whether an applicant is solvent and viable. The MoF should also be involved because there may also be circumstances where systemic risks are elevated with high uncertainty regarding solvency or collateral values, which could justify the BCCh receiving a government indemnity. The BCCh should take the lead in the CMG to develop a Memorandum of Understanding (MoU) that details the members' respective roles and responsibilities.

The BCCh acted decisively and successfully on a range of measures to address disruptions to the functioning of core markets during the social unrest and COVID-19 pandemic of 2019–20. It intervened in the spot foreign exchange (FX) and forwards markets to dampen volatility and alleviate strains in USD funding markets. In securities markets, the BCCh intervened directly, buying bank bonds and BCCh bonds. To deal with the redemption pressures in the pension sector, it undertook bank bond buy-/sellbacks. Measures taken in money markets included a 30-day funding repo program, an unsecured credit line limited to the amount of a bank's reserve requirement, and an expansion of collateral eligibility.

The BCCh and other recent central bank experiences provide lessons for the design of future systemwide market support programs. The key is to first diagnose the problem, which could be predominantly a funding liquidity or market liquidity problem, while recognizing the interaction between the two. Then a program should be designed and targeted to address the identified problem, guided by some principles, including that: (i) intervention triggers should be discretionary and guided by market functioning indicators; (ii) pricing should be set to encourage take-up at the onset while facilitating exit; (iii) temporary or self-liquidating operations are preferred over outright transactions to limit BCCh risks and facilitate exit; and (iv) transparency arrangements should support the program's effectiveness while ensuring central bank accountability.

Despite an otherwise diversified financial sector, the domestic repo market is underdeveloped, which calls for a clear strategy with assigned leadership. The fundamental drivers of an active repo market are missing in that the secondary market in fixed-income securities is shallow—there is no requirement for dealers to fund inventory or to cover short positions—and significant excess liquidity undermines the need for liquidity distribution through secured transactions (i.e., repo) in normal times. Efforts underway to deepen secondary markets will ultimately support repo activity, as will the reduction in excess liquidity as crisis-era programs roll off. There are several issues identified that potentially constrain repo activity, including legal, regulatory, taxation, accounting, and infrastructure. These cut across several government agencies as well as the private sector. A comprehensive medium-term market development strategy is needed to ensure all issues are identified and addressed. Coordination is therefore vital, as is leadership. With both monetary policy and financial stability objectives, the BCCh is best placed to lead these efforts.

Recommendations

Table 1. Key Recommendations

Recommendations	Authority	Timeframe[1/]
Collateral Policy		
Establish a methodology for determining collateral preference.	BCCh	Short-term
Demarcate monetary operations' eligible collateral consistent with an operational framework and transparency requirements.	BCCh	Short-term
Develop and operationalize valuation methodologies for each eligible collateral.	BCCh	Medium-term
Monitor potential arbitrage and mispricing between nominal and inflation-indexed securities.	BCCh	Medium-term
Adopt haircuts' calibration models that allow for achieving the risk equivalence principles.	BCCh	Medium-term
Emergency Liquidity Assistance		
Establish an ELA Working Group to allocate divisional responsibilities, establish detailed procedures, and define parameters to ensure operational preparedness.	BCCh	Short-term
Prepare a standard request letter for institutions requesting ELA.	BCCh	Medium-term
Prepare an ELA master agreement covering all elements of the lending arrangement (including conditionality).	BCCh	Medium-term
Prepare funding plan templates.	BCCh	Medium-term
Establish a Crisis Management Group (BCCh, CMF, MoF) to define interagency responsibilities, including the assessment of solvency and viability, the conditions for government indemnities, and protocols for information sharing. A MoU should be developed to cover these issues.	BCCh/ CMF/MoF	Medium-term
Prepare an ELA regulation to communicate publicly the major elements of the ELA framework.	BCCh	Short-term
Systemwide Measures		
Market support programs should be priced in a way that incentivizes take-up at launch and facilitates exit while safeguarding the BCCh's balance sheet.	BCCh	Medium-term
The BCCh should minimize the risks to its balance sheet and facilitate exit by prioritizing buy-/sellback transactions over outright asset purchases.	BCCh	Medium-term
The BCCh should consider publishing more granular data about the assets acquired in market support programs.	BCCh	Medium-term

Recommendations	Authority	Timeframe[1/]
The BCCh could consider ex-ante, disclosing its FX intervention objectives more clearly, and ex-post, disclosing its evaluation of how effectively those objectives were met.	BCCh	Medium-term
Repo Market Development		
Ensure policies promote an active domestic market in fixed-income securities.	BCCh/ CMF/MoF	Long-term
Continue to drain excessive liquidity through the roll off the crisis era.	BCCh	Medium-term
Remove interbank (secured and unsecured) transactions from the reservable base, for the purposes of the reserve requirement.	BCCh	Short-term
Publish the implementing regulation for the FMRA related to close-out netting.	BCCh	Short-term
Ensure that the stay of enforcement under the resilience and recovery regime is limited (preferably not longer than two days).	BCCh	Short-term
Publish a standard master repurchase agreement based on the GMRA.	BCCh	Medium-term
Ensure that the capital relief for collateralization is attributable to dealers.	BCCh/ CMF	Medium-term
Assess all barriers for NBFI participation in the repo market and remove them where there is no justification for such barriers (i.e., with pension funds).	BCCh	Medium-term
Clarify the application of regulatory capital rules to repo.	CMF	Short-term
Confirm that short-selling is neither prohibited nor discouraged.	BCCh/ CMF	Short-term
Clarify taxation across the life cycle of a repo, ensuring that the focus is on economic substance and not the legal form.	BCCh/SII	Medium-term
Develop and disseminate comprehensive local guidance on accounting for repo, including the reuse of collateral.	BCCh/CMF	Medium-term
Facilitate the introduction of electronic messaging systems to support the OTC market with automatic confirmation, reporting, and links to settlement.	BCCh/ CMF/MoF	Medium-term
Identify a “champion” (e.g., a senior official in the BCCh) to develop and drive strategy for the repo market covering all aspects.	BCCh	Short-term
Develop comprehensive regulatory reporting of activity in the unsecured and secured money markets (starting with high-level and low frequency).	BCCh/ CMF	Medium-term
Encourage the formation of a repo market association to act as a point of contact for the authorities, a contact for market participants to exchange experience, and a body to compile a guide to best practices.	BCCh/ CMF	Short-term

[1/] Near term: < 12 months; medium term: 12 to 24 months; long term: >24 months.

Introduction

1. **The Chilean economy is on track for a firm recovery, as imbalances created during the pandemic have been largely resolved.** Over the medium term, real GDP is forecast to grow to about its potential of 2.25–2.5 percent. Inflation has fallen from a peak of 12.8 percent (December 2023) to 3.4 percent (May 2024), but convergence to the BCCh's three-percent target is set to slow. The current account deficit (nine percent of GDP in 2022) narrowed substantially in line with the swift rebalancing of the economy and the recent copper price rally. Fiscal policy aims to reach its deficit target of 1.9 percent of GDP in 2024.

2. **The Financial Stability Council (CEF) is the coordinating body of the authorities responsible for financial stability and is chaired by the Ministry of Finance (MoF).** Other members are the Pension Superintendency (SP) and the Financial Market Commission (CMF)—which is the primary financial supervisor and regulator covering banks, large credit unions, insurance, and securities markets. The BCCh is a permanent invitee and advisor to the CEF. The BCCh's financial stability mandate is focused on normal functioning of internal and external payments, with the BCCh the provider of emergency liquidity. The CEF's high-quality semi-annual financial stability report facilitates the identification and containment of financial risks in Chile.[1]

3. **The BCCh's ability to respond to liquidity stress was expanded after a MCM technical assistance (TA) mission in 2018.[2]** The mission assessed nonbank financial institutions' (NBFIs) (market infrastructures, nonbank deposit takers, pension funds, and others) access to the BCCh's accounts and facilities and eligibility for ELA. The mission's recommendations were incorporated in the Financial Markets Resilience Act 2023 (FMRA), with ELA eligibility expanded to include CCPs and credit unions that meet banklike regulation. The FMRA also permits the BCCh to provide liquidity through repo transactions to financial sectors (e.g., the pension sector) that are facing stress, even though individual entities within the sector are not eligible for ELA.

4. **The 2021 Financial Sector Assessment Program (FSAP) pinpointed three areas where efforts were needed to better manage BCCh's risks and improve financial market resilience.[3]** First, the BCCh's collateral framework needs to be upgraded to better manage the risks of its lending operations. Second, operational gaps in providing ELA should be addressed with internal procedures developed, and a regulation is needed to publicly communicate key elements of the ELA framework. Finally, the lack of an active repo market (i.e., secured lending segment) could amplify financial shocks, undermining the financial system's resilience. Therefore, a dedicated development strategy is needed for this market segment.

5. **This report provides an assessment and recommendations on four interrelated areas, which combined have a material bearing on the efficiency and resilience of the Chilean financial sector.** They are collateral policy, emergency lending assistance, systemwide market support programs, and the development of the repo market. First, the financial landscape is described, as the context matters for all these issues, particularly in Chile, with its large NBFI sector and the prevalence of inflation-linked products.

[1] Cheng Hoon, et al. 2017. "Financial Stability Reports in Latin America and the Caribbean." IMF WP/17/73. International Monetary Fund, Washington, DC.

[2] https://www.imf.org/en/Publications/CR/Issues/2020/05/13/Chile-Technical-Assistance-Report-Central-Bank-Services-to-Non-bank-Financial-Institutions-49411.

[3] https://www.imf.org/en/Publications/CR/Issues/2022/09/09/Chile-Financial-Sector-Assessment-Program-Technical-Note-on-Systemic-Liquidity-523255.

I. Financial Market Landscape

6. **The BCCh moved to inflation targeting with a flexible exchange rate in 1999, with the last substantial capital controls being removed in 2001.** The operational framework is well specified, with the BCCh closely aligning the uncollateralized overnight interbank rate (IRR) with the announced stance as communicated with the monetary policy rate (MPR). It uses several conventional instruments to manage monetary conditions, including standings facilities (set at 25 basis points on either side of the MPR), reserve requirements, open market operations, and outright purchases and sales of securities.

7. **The BCCh balance sheet more than doubled in size as crisis measures were implemented but is now shrinking quickly (Figure 1).** Prior to 2020, assets were almost exclusively foreign assets, but the response to the two crises necessitated a substantial increase in domestic assets to address market dysfunction (see Section IV). The balance sheet increased from approximately 16 percent of GDP pre-crisis to its peak of 34 percent in 2021. With market functioning long restored, crisis-era programs are rolling off, and this should bring the balance sheet back to around 20 percent of GDP by end-2024.

8. **The financial sector is large (290 percent of GDP) and diversified (Figure 1).** The banking sector, which makes up 41 percent of the financial sector is, however, heavily concentrated, with six banks accounting for 87 percent of banking assets. The NBFI segment (48 percent of the financial sector) is dominated by pension funds with assets equivalent to about 60 percent of GDP (down from over 80 percent before the three extraordinary withdrawals in 2020–21). The pension sector is concentrated, with the largest fund accounting for around 30 percent of the sector. Other financial institutions (including mutual funds as well as other financial auxiliaries) and insurance companies are also prominent, with about 20 percent and eight percent of financial sector assets, respectively.

9. **The Chilean FX market is liquid and efficient, with well-developed hedging markets.** The interbank spot market is operated as a continuous electronic over-the-counter (OTC) market by the Bolsa de Comercio de Santiago, based on market-making agreements that include 21 banks licensed by the CMF. As a legacy of past exchange controls, non-deliverable forwards (NDFs) are still the dominant derivative instrument used for hedging CLP risks both in Chile and abroad. Domestic NBFIs maintain long USD exposure on their balance sheets, while nonfinancial corporates (NFCs) take the opposite position. Both hedge with NDFs. Nonresidents are the most active in NDFs and use them extensively as a spot proxy to take speculative positions.

10. **The prominence of inflation-linked products is unique to the Chilean financial markets.** Over 75 percent of outstanding debt is inflation linked (including over half of government debt and most bank and corporate debt). Inflation-linked instruments are priced in a special unit of account (the CLF), which is linked to the nominal CLP by an inflation multiplier (the UF). The principal issuers are the central government (in both nominal and inflation-linked structures) and banks and corporates (largely in inflation-linked bonds). The share of nominal government bonds (BTPs) increased after 2015 and caught up with the share of inflation-linked government bonds (BTFs) in 2020. However, the government bond segment is modest in international terms, equivalent to about 26 percent of GDP in March 2024 (13.5 percent in nominal and 12.2 percent in inflation-linked, compared with 35 percent in Mexico and 68 percent in Brazil (2022)). The prevalence of inflation-linked assets and liabilities, and even in term deposits, has spawned a market in inflation derivatives, such as short-term inflation forwards and medium-term inflation swaps (see Box 1 for details on pricing indexed products).

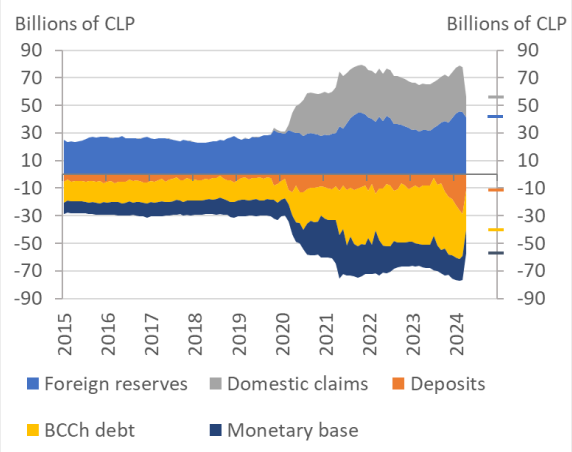
11. **Pension funds are the principal investor in all types of debt, holding almost half of all debt and about half of government debt.** The more conservative pension funds have larger allocations in government debt and smaller allocations in equity. The largest allocation across the pension sector is in equity, in particular, foreign equity. The pension funds reportedly use money market mutual funds and short-term bonds for liquidity management. Banks, insurance companies, mutual funds, and offshore investors hold fairly similar shares of bank and corporate bonds. However, banks limit themselves to nominal corporate debt. Insurance companies are second only to pension funds as investors in corporate debt but are entirely invested in inflation-linked corporate debt. Money market funds have invested mainly in central bank bills over the past five years. Fixed-income fund portfolios have become concentrated in bank and corporate inflation-linked bonds. Insurance companies focus on corporate and bank inflation-linked debt and real estate. They do not have large government bond allocations. Foreign investors prefer nominal government debt to inflation-linked and account for about 40 percent of nominal government debt holdings but mainly use derivatives to gain exposure to Chile.

12. **Secondary market trading in fixed-income securities is thin, as most investors buy and hold.** Turnover on the stock exchange in fixed-income securities is equivalent to about USD 150 billion per month and has fallen from its peak in 2018, not least in response to the three pension fund withdrawals in 2020-21. Government bond turnover has been particularly badly hit (falling from about 13 percent to under three percent). There is evidence of some relative value trading, to take advantage of pricing anomalies arising from imbalances in offshore supply and demand on inflation derivatives and spreads to cash bonds. Still, large anomalies (i.e., arbitrage opportunities) exist for reasons that are not clear given the overall openness and sophistication of the financial environment. Ten-year swap spreads against nominal government bonds reached almost 100 basis points in May 2024 (having jumped from -40 basis points in September 2022) and 70 basis points against 10-year inflation-linked government bonds (up from -30 in December 2022). Although sizeable, the corporate bond market is illiquid. There is no treasury bill market, and central bank bill issuance is currently limited to 14 days or less.

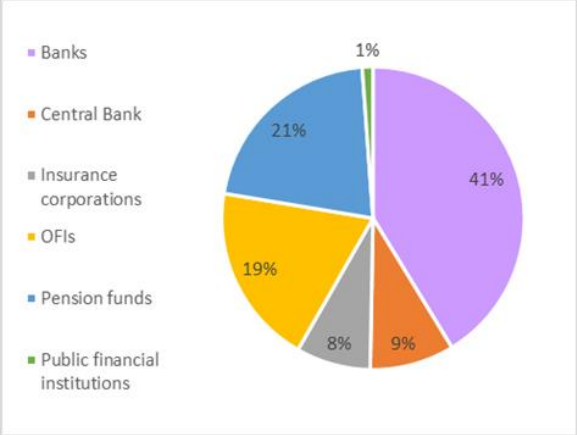
13. **The interbank money market is thin, equivalent to less than three percent of bank assets and under one percent of liabilities.** Interbank trading takes the unusual form of the issuance of CDs (42 percent, down from 59 percent in 2018), unsecured deposits (42 percent, up from 21 percent in 2018), and bank bonds (16 percent, down from 20 percent in 2018). Customer repo is much larger than interbank repo. Some banks are very active cross-border in US dollar repos against both peso and dollar sovereign securities, typically in large size. In contrast, the domestic repo market is small and is currently almost entirely bank-to-customer rather than interbank. At end-2022, the total repo market was equivalent to about four percent of GDP.

Figure 1. Financial Sector

BCCh Balance Sheet

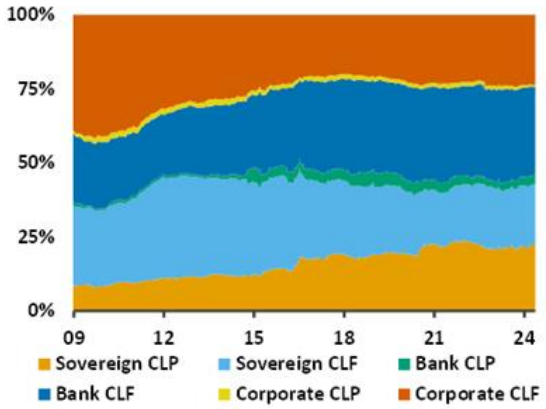


Financial Sector Shares



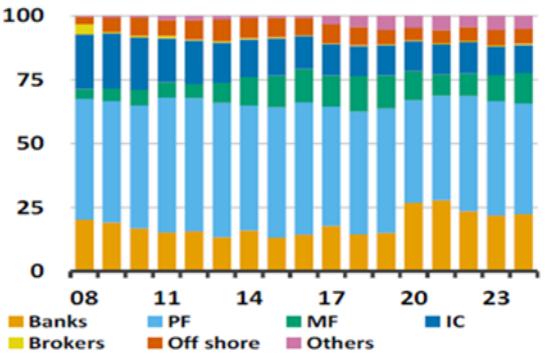
Fixed Income Outstanding Amounts

(percent of total)



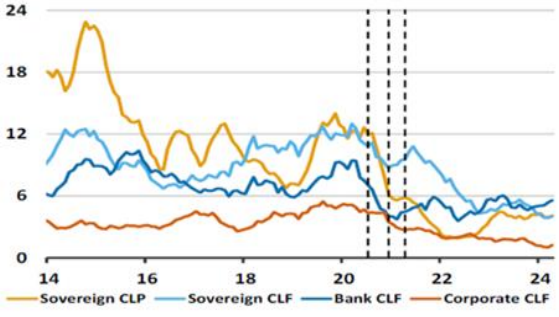
Bond Holdings

(percent of total)



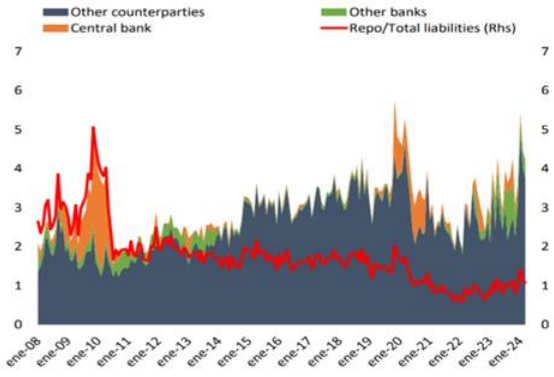
Fixed Income Turnover

(percent, six-month average)



Banks' Repo Activity

(Billions of pesos; Percentage)



Source: BCCh and IMF staff.

II. Collateral Framework

A. Current Situation

14. **The BCCh's collateral framework is largely based on program-specific requirements.** With excess liquidity, a stable banking system, and a functioning interbank market, there is little need for the BCCh to inject liquidity through its lending operations. Collateral eligibility has evolved largely in response to the Great Financial Crisis (GFC), the social disruptions of 2019, and the COVID-19 pandemic.

15. **The BCCh has three liquidity-providing operations (Table 2) with varying collateral eligibility:** (i) an intraday permanent liquidity facility (FLI); (ii) an overnight liquidity facility (FPL); and (iii) a Repo. Counterparties can mobilize collateral under Repo, Purchase-With-Resale-Agreement (PWRA) modality, or by pledge (Repo-Prenda), depending on the program. Repo, and FLI and FLP—both under Repo and pledge—are standard monetary policy operations and are restricted to banks. The Organic Law of the BCCh prohibits the acceptance of government securities in normal times under PWRA, but they can be accepted under pledge (see the row "BTP BTU" in Table 2).[4] In addition, the FCIC (funding-for-lending scheme) was a systemwide program implemented during the COVID-19 pandemic and expired in July 2024.

Table 2. BCCh Lending Operations and Collateral Eligibility

Instruments	FPL	FPL Prenda	Repo	Repo Prenda	FLI	FLI Prenda
PDBC	X	X	X	X	X	X
BCP BCU	X	X	X	X	X	X
BTP BTU		X		X		X
Bank Bond						
Mortgage	X	X	X	X	X	X
Corporate Bond						
Securitized Bond						
Mortgage Notes	X	X	X	X	X	X
Deposits						
Securities						
Commercial Credits						

Source: BCCh.

Eligibility

16. **There are eight classes of assets currently eligible for BCCh operations (Appendix I).** Prior to the GFC, three types of assets were eligible, namely the BCCh's securities, government securities (pledge only), and mortgage notes issued by banks. To alleviate stress during the GFC, eligibility was extended with three additional categories of bank assets: mortgages, CDs, and

[4] In August 2020, Chile's Congress approved a law to allow the central bank to buy government bonds in the secondary market in exceptional circumstances, when the preservation of the normal functioning of internal and external payments demands it. The decision has to be approved by four out of five of the central bank's directors, and the bonds would be resold by the bank in the open market under the terms and conditions decided by the Board. Primary market government bond purchases remain prohibited.

bank bonds. During the pandemic, eligibility was expanded further, with corporate bonds and credit claims acceptable under the FCIC program.

17. **The BCCh can accept a broader set of assets when providing ELA (Article 36) under its financial stability mandate.** There are no additional legal restrictions for ELA eligibility except the prohibition of the acquisition of government securities under PWRA, equities, and subordinated and convertible instruments issued by commercial banks. The BCCh has no established preference order. However, the BCCh can determine the order in consideration of the balance sheet of the applicant and the severity of the crisis.

18. **The law is prescriptive on eligible collateral for "special programs," that is, systemwide measures envisioned under Article 36 bis.** Counterparties of special programs are financial institutions, including pension funds and unemployment funds, supervised by the CMF and SP but not eligible for ELA. Collateral eligibility for such programs is restricted to fixed-income securities issued by commercial banks, excluding shares, convertible, and subordinated instruments.

Valuation

19. **The BCCh uses three valuation methods, applied as relevant to market conditions and the type of collateral.** For sufficiently liquid securities, the valuation is market-based using securities' prices sourced from both international and local trading platforms. Illiquid securities are valued using theoretical models, for which the BCCh engages an external entity to calibrate yield curves and to price inflation-indexed securities as well as other fixed-income securities. For nonmarketable collateral, such as credit claims (used in the FCIC program), the nominal value of the credit's outstanding amount is used.

Risk Mitigations Measures

20. **Haircuts on marketable securities are applied as a spread over their yield (Table 3).** They are calibrated using a conditional value-at-risk (C-VaR) model, with a risk tolerance set at 95 percent. The haircut calculation is performed daily and is based on the excess return distribution over the equivalent-maturity government security. The calibration is made at the issuer level, where the issuer's overall haircut is derived by averaging the standalone haircuts of its securities. Additionally, haircuts are adjusted to account for liquidity risk through an add-on, which is a function of the bid-ask spread and the overall turnover of the security. Haircuts are calibrated based on a time series for 10 days.

Table 3. BCCh Applicable Haircuts (basis points)

Haircuts	ACTUAL
Government Bonds	0
Bank Bonds	60
Term Deposits	50
Corporate Bonds	65
Commercial Papers	65
Credit Claims	1,000

Source: BCCh.

21. **For marketable securities, margins are applied to the loan amount and supplemented by margin calls.** Margins are calibrated using a C-VaR approach with a risk appetite of 95 percent for maturity buckets one, two, three, four, five, seven, and 10 years. A 10-day settlement period is

assumed, and margins are meant to protect the central bank from interest-rate variations of that period. For each maturity bucket, a C-VaR is thus calibrated on the yield differential $(y_t - y_{t-10\ days})$, where y_t is the security yield at day t.. The model used a five-year time series of daily yield differentials. As of the mission, the initial margin was 3.5 percent, implying that the value of the mobilized collateral should be higher than 1.035 times the loan amount. The margin call was 3.5 percent, that is, the counterparty might be required to increase the amount of the mobilized asset by 3.5 percent as needed.

22. **Applicable haircuts and margins schemes are meant to comply with a coverage percentage of 98 percent.** The coverage percentage aims at mitigating sovereign interest rate risk. It is calibrated on the five-year time series of the two-year yields of nominal government bonds.

23. **The BCCh developed a methodology to calibrate haircuts for nonmarketable collateral used in the FCIC program.** The model is meant to capture mainly the credit and duration risks for the counterparty's portfolio of credit claims. The credit risk component of the haircut is based on the expected losses estimated according to the CMF's standard methodologies. This expected loss is set at 1.75 percent, which is that of the lowest category of eligible loans.[5] The duration risk is computed by assuming an average monthly amortization rate of 8.5 percent. The resulting haircut for the collateral portfolio is rounded and thus set to 10 percent. Haircuts are reviewed monthly, as are the conducted stress scenarios in which the risk classification of a given credit claim is downgraded by three categories. The Corporate Risk Division and Division of Financial Market are notified if the test reveals that the applicable haircuts are too loose.

B. Establishing a Coherent Collateral Policy

Background

24. **Collateral policy should be part of a central bank's overall risk management framework.** In non-dollarized economies, central banks enjoy extensive capacity to issue local currency and regulate credit, making them uniquely positioned to address idiosyncratic or systemwide liquidity problems. That support can take several forms, including asset purchases, collateralized lending, and foreign exchange interventions. Central bank risk management frameworks should monitor and manage the risks inherent to these operations. For collateralized lending, the risk is the exposure to the asset that has been temporally acquired (either through a purchase or pledge) and is intended to be returned either to the counterparty at the end of the contract or, in the event of default, sold into the market.

25. **A coherent collateral framework has three main elements:** (i) eligibility criteria; (ii) valuation processes—market-based and theoretical; and (iii) risk mitigation measures, including haircuts and margining, concentration limits, and overcollateralization procedures. For each component, policy parameters should be determined to contain financial and operational risks within identified risk tolerances while minimizing price distortions across asset classes which could otherwise impact credit allocation. The framework should also, where possible, facilitate market development, for example, through standardized approaches.

26. **While the principles underpinning collateral frameworks are similar for monetary operations and ELA, there are some key differences (Table 4).** Monetary operations involve counterparts that are not under stress, and so generally, the risk of lending is lower.

[5] The CMF has 10 debtor categories: A1, …, A6, B1, …, B4. 1.75 percent corresponds to the expected losses of the category A4.

Consequently, eligible collateral is predefined, publicly communicated, and generally higher quality. The valuation methodologies and risk mitigation measures will also be public. In contrast, for ELA, the counterparty is under stress and will have used all its monetary operations-eligible collateral—meaning lower credit quality and less liquid collateral must be used. While transparency must be high in the case of monetary operations—because participants need certainty on the modalities of all monetary instruments—the same is not true for ELA, because some ambiguity may contain moral hazard.

Table 4. Monetary Policy versus ELA Operations

	Monetary Policy Operations	ELA
Objective	**Price stability**	**Financial stability**
Eligibility	**High-quality liquid assets**	**Broader collateral acceptance**
Collateral Preference	**None (asset selection by banks)**	**Defined by the central bank**
Rule versus Discretion	**Rules (might change in systemwide crisis)**	**Central bank discretion**
Valuation	**Disclosure of key methodological elements**	**Nondisclosure to the public**
Haircuts	**Public**	**Nonpublic**
Concentration Limits	**None (generally)**	**Applicable**

Source: IMF staff.

27. **Collateral eligible for systemwide support measures would need to be targeted to the identified problem.** For this reason, it may need to be broader than that for monetary operations but narrower than that of ELA. Collateral eligibility would likely be announced along with the other program modalities. Once those are announced, the central bank would commit to accepting the collateral under the predefined rules. Valuation would be at the central bank's discretion, as would the haircuts, margining, concentration limits, and overcollateralization provisions, all of which would need to be considered in the context of the severity of the stresses being faced.

Recommendations

Eligibility

28. **The prohibition of PWRA and Repo-Prenda limited effects on the BCCh's capacity to implement monetary policy.** Ideally, central banks could have both pledge and PWRA in their toolkit, which would provide more flexibility in changing market conditions. The main advantages of PWRA include the upfront legal transfer of the underlying asset, which minimizes the legal transfer risk in case of a counterparty default. That risk is rather subdued in Chile, as the country has a well-functioning central securities depository. PWRA operations also contribute to market liquidity, as the purchased assets can be reused in another PWRA contract. While this could be a concern given the lack of collateral in Chile's repo market (Section V), the BCCh could overcome the burden by issuing its own securities in reverse-repo operations as needed.

29. **The BCCh should establish a methodology for determining the preference order for each collateral.** It is assumed that any asset on a bank's balance sheet, unless explicitly prohibited by law, is a priori acceptable as collateral. The central bank controls financial risks by defining and

imposing a hierarchy of collateral acceptance (i.e., highest credit quality and most liquid first) and through the application of haircuts. An algorithm is provided (Appendix II) for the ordering of collateral based on several characteristics, including liquidity, legal certainty, valuation, volatility, total volume on issue, and distribution in the financial sector. This methodology is flexible and scalable across asset characteristics. The established preference order should be used to determine the eligibility scope for a diverse set of central bank liquidity providing operations including monetary policy, ELA, and systemwide measures.

30. **The BCCh should demarcate between collateral accepted in normal times (for monetary policy operations) and that accepted in a stress situation (i.e., ELA).** Based on the established order, the collateral for monetary policy operation is the most preferred, that is, it is lesser risk across the assessed dimensions. How deep in the ranking list the demarcation line should be drawn is determined by finding the proper balance between banks' refinancing needs for monetary policy operations and the required quality and transparency of the monetary policy collateral framework. The refinancing need for monetary policy operations may increase as crisis-era programs run off with excess liquidity drained. This should be considered when deciding the demarcation, since material changes in collateral eligibility should be infrequent, as they may induce portfolio shifts in the banking system.

31. **Collateral scanning is a process that compares banks' short-term liquidity needs against available collateral (Figure 2).** It informs assessments of banks' resilience to liquidity stress and the adequacy of the breadth of collateral eligibility. It provides input into a central bank's decision about the tradeoff between a narrower framework and a broader one with more risk, recognizing that inherently it will need to be quite broad to mitigate financial stability risks. With standard lending facilities, central banks unconditionally backstop counterparts' liquidity shortfalls, subject to specified terms and conditions. ELA may be conditionally provided to potentially cover all runnable liabilities.

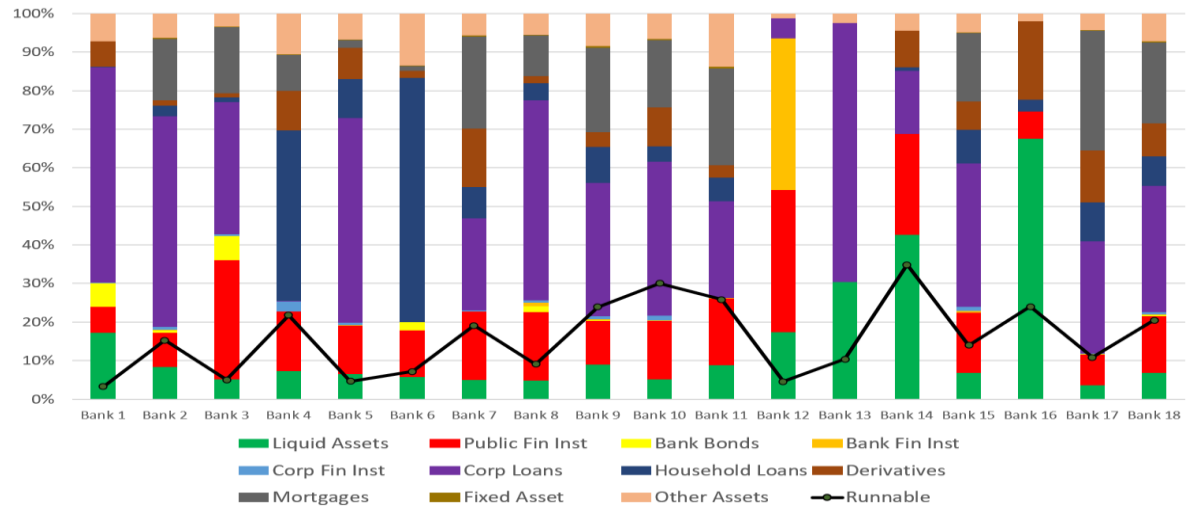
32. **Banks' bonds and CDs should no longer be eligible for monetary operations.** With the FCIC's expiry in July 2024, the BCCh should also roll back part of the program implemented in the aftermath of the GFC. Consistent with the 2021 FSAP, the mission highlights the high correlation risks of accepting banks' assets from counterpart banks. Additionally, bank bonds are a potential source of moral hazard due to hidden own-used risks.[6] Finally, based on the stylized scanning (Figure 2), banks for which these instruments represent a sizable amount of their balance sheets (indicated in yellow) have significantly small runnable liabilities and/or a high share of government securities to be used in monetary policy operations.

33. **Despite seemingly adequate coverage of runnable deposits, the BCCh should enhance its capacity to handle nonstandard collateral.**[7] In addition to the sight deposits ("Runnable" in the figure) (Figure 2), other types of bank liabilities should be considered, including short-term deposits, issuance of short-term debt securities, and interbank borrowings. In times of crisis, these are all potential funding sources that the BCCh may need to consider replacing. A comprehensive assessment of these liabilities, along with risk mitigation measures, will allow the BCCh to quantify the potential demand for liquidity arising from bank-specific or systemwide shocks.

[6] A security is prone to own-use risk when its issuer is also a central bank's counterparty.

[7] Sight deposits are fully guaranteed by the BCCh, and this may significantly reduce the extent to which these deposits run in a crisis.

Figure 2. Collateral versus Runnable Liabilities



Source: IMF staff.

Valuation

34. **The BCCh should develop its own market-based valuation algorithms.** Market prices of marketable assets are generally composite prices, aggregated from prices of quotes collected from market participants.[8] Because the quote aggregation process embodies the preference of the aggregating party, central banks do not rely on third parties to compute the market prices of their eligible marketable collateral. The BCCh should develop a pricing algorithm using market quotes that are as raw as possible. It should set its own quote cleaning parameters (e.g., acceptable bid-ask spread, quote age, quote staleness).[9] Additionally, it should build its own metric to find the consensus across market participants. Such an algorithm will also enable the BCCh to conduct its rating of market participants over time. Appendix III presents a stylized version of such a methodology.

35. **The BCCh should develop a theoretical valuation approach where there are no observable prices for individual marketable securities (Appendix IV).** Theoretical valuations of individual securities calibrate yield curves based on the BCCh-determined market-based price of liquid securities, to generate a discount factor for each coupon payment of the security. Nelson-Siegel (NS) methodology is a useful analytical framework for calibrating term structure curves and is widely used.[10] The methodology will inform the level, slope, and curvature of the yield curves (sovereign or corporate, and nominal or inflation indexed). To price illiquid market segments where, for example, no issuer curve can be calibrated, parameters of an already calibrated curve could be adjusted to account for a potential issuer-specific risk premia along the term structure.

36. **The BCCh should also establish methodologies for valuing illiquid and nonmarketable assets.** The efficient use of such assets (e.g., loans and mortgages) as collateral has a major bearing on the effectiveness of ELA and systemwide operations. The FCIC program revealed that

[8] For the collateral framework, the computation of the market price uses the quote's bid price.

[9] The quote age is a function of the last time a quote was edited. A quote is stale if its attributes, including bid, ask, and volume, have been unchanged by the contributor over a certain period (for example, three days).

[10] Buessing-Loercks, M., D. King, I. Mak, and R. Veyrune. July 2020. "Expanding the Central Bank's Collateral Framework in Times of Stress." IMF Special Series on COVID-19 note. International Monetary Fund, Washington, DC.

the BCCh was not sufficiently equipped to value those assets, due to a lack of proper reporting procedures. The BCCh ultimately chose to value loans at their outstanding amount, disregarding the cashflow to avoid undue operational costs. If necessary, the BCCh could solicit external expertise to evaluate nonmarketable assets, such as mortgages or fixed assets. An expert could establish methodologies for valuing each type of loan and mortgage, with a clear description of the required input data. Subsequently, the methodology should be validated and operationalized within the BCCh.

37. **Special attention should be given to monitoring potential arbitrage and mispricing between nominal and inflation-indexed securities (Box 1).**[11] During the mission, several market participants highlighted significant mispricing between nominal and inflation-indexed securities, attributed to differences in liquidity across the real and nominal yield curves. This liquidity differential is likely driven by "preferred habitat," with divergent preferences of international investors—who primarily focus on nominal bonds with short-term maturities—and local investors, who are more inclined toward long-term inflation-protected bonds. The BCCh should assess the potential for arbitrage between these two classes of securities and adjust its pricing models as necessary.[12] The BCCh should consider the following issues before implementing any changes. First, it would need to improve its valuation models—both theoretical and market-based. Second, it should be noted that the CLP-UF exchange rate, which clears Equation 1 in Box 1, is also determined by the BCCh.

Box 1. Arbitrage Test—Nominal versus Inflation-indexed Securities

Formally, if $z_{Bond,CLP}(t)$ and $z_{Bond,UF}(t)$ are the zero nominal and real rates at term t, the prices – in CLP and UF – of the bonds paying one unit of CLP and one unit of UF at the term t are respectively:

$$P_{\text{CLP}}(0,t) = e^{-\Delta^c(0,t) z_{Bond,CLP}(t)}$$

and

$$P_{\text{UF}}(0,t) = e^{-\Delta^c(0,t) z_{Bond,UF}(t)}$$

where $\Delta^c(0,t)$ is the year fraction of the period from the current date up to the term t.

An investor could buy 1 UF at horizon t by purchasing, in CLP, an UF-protected bond B_{CLP} paying out $GI_{0,t}$, with $GI_{0,t} = \frac{UF_t}{UF_0}$ being the UF-gross inflation, that is the ratio between the expected value of UF at time t, UF_t, and its current value UF_0. It then holds:

$$P_{B_{CLP}} = P_{\text{CLP}}(0,t) * GI_{0,t}$$

If V_0 is the value, in CLP, of 1 UF as published by CLP at the valuation date, then market is arbitrage-free if:

$$P_{B_{CLP}} = V_0 * P_{UF} \qquad (1)$$

or put differently, $e^{-\Delta^c(0,t) z_{Bond,CLP}(t)} * GI_{0,t} = V_0 * e^{-\Delta^c(0,t) z_{Bond,UF}(t)}$

In the case of the BCCh, equation (1) can be tested for bonds with maturities lower than two years since the forward inflation curves – needed to compute $GI_{0,t}$ – up to that maturity are liquid on trading platforms such as Bloomberg.

Source: IMF staff.

[11] Several studies have documented mispricing of inflation-indexed securities in several advanced economies. The studies include The TIPS-Treasury Bond Puzzle (wiley.com) for the US and Fleckenstein.pdf (uh.edu), which is the extended studies for G7-countries.

[12] See also Kerkhof, Jeroen. 2005. *Inflation Derivatives Explained*. Microsoft Word - IDE_last_noLinks.doc (earth.li).

Risk Mitigation Measures

38. **The BCCh's current approach could be improved to further mitigate the risks for both monetary policy and ELA operations.** First, the assumed settlement date of 10 days is not plausible. Liquidating collateral with a limited discount to market pricing will likely take longer than 10 days, given the volume of collateral generally mobilized relative to the absorptive capacity of the market. Second, because haircuts for different classes of marketable assets are priced with respect to their spreads to nominal government securities ("excess TIR"), the BCCh currently sets haircuts on government securities to zero but applies a 3.5 percent margin. For fixed-income securities, the market risk captures interest rate volatility, which is not zero—unless the sovereign curve is pegged. Finally, for government securities, the credit risk is measured by the country's sovereign risk, which, while being low—the country is rated A+—is not zero.

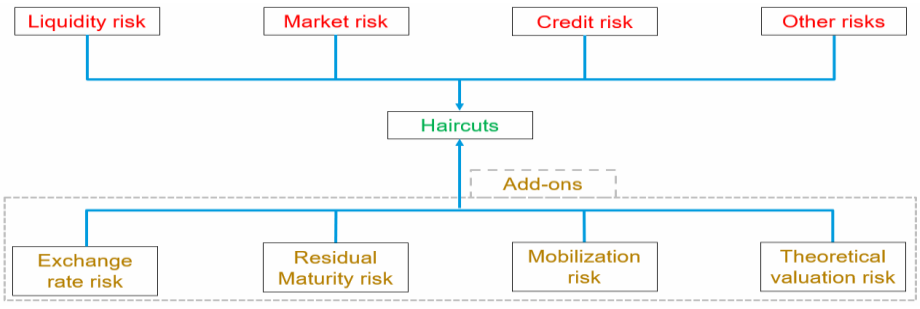
39. **It is recommended that the BCCh develops haircut calibrations, allowing it to effectively protect its balance sheet while achieving *risk equivalence* across asset classes.** Risk equivalence seeks to equate all risks across asset classes—that is, haircuts are calibrated such that expected losses are the same for all collateral types. To achieve risk equivalence, the haircut calibration should follow a model featuring key components of the financial risks (Figure 3), including:

- *Liquidity risk*—which captures the time-to-liquidation that is the expected time at which the collateral can be liquidated at a reasonable discount. The time-to-liquidation depends on the size of the position of the central bank relative to the market absorptive capacities.
- *Market risk*—the framework should model the price volatility over the time-to-liquidation period. For a marketable security, this typically boils down to interest-rate volatility models, with the considered yields derived from the security's discount curve.

- *Credit risk*—the model should explicitly account for the eventuality of the default of the ultimate debtor during the time-to-liquidation period and the related expected losses and/or expected shortfalls.

- *Additional risks*—for example, exchange rate risk for collateral denominated in foreign currencies, valuation risk accounting for pricing-model uncertainty for illiquid collateral, residual maturity risk where collateral cannot be sold, and mobilization risk (e.g., legal risk for assets held abroad, such as FX deposits).

Figure 3. Haircut Calibration Components



Source: IMF staff.

40. **There are analytical frameworks that allow for the modeling of risks while achieving a risk equivalence consistent with the BCCh's risk appetite.** One model was recently provided by the European Central Bank (ECB).[13] The methodology is based on expected-shortfall theory and proposes a closed-form formula for haircuts, whose parameters can easily be estimated using Chilean data. Alternatively, the BCCh could resort to VaR models that feature a direct modeling of loss functions (Appendix V). This approach allows for the estimation of expected losses through predictive densities and established models for the IRR of yield curves. These frameworks are applied at the sector level so that for each sector, haircuts are calibrated independently from the public sector.

41. **Further changes are recommended:**

- *Haircuts should be expressed as a percentage of the security's value*—because penalties on discount rates are meant to capture unmodeled pricing differentials between asset classes. The pricing differentials are generally due to arbitrage or observed spreads to a reference curve, both factors that are accounted for in the valuation.

- *Haircuts should be recalibrated at a relatively low frequency—recommended every two years.*[14] Frequent recalibration may lead to procyclicality, which could exacerbate crises or lead to excessive risk-taking in favorable times. The haircut models should be robust enough to avoid the buildup risks. This especially applies to monetary policy instruments because the transparency, as discussed above, required the disclosure of their haircuts.

42. **Other risks should be accounted for with "add-ons."** With both inflation-indexed bonds, denominated in UF (Unidad de Fomento), and nominal bonds, denominated in CLP, sovereign bonds are de facto priced in two different currencies. An exchange-risk-like add-on should thus be applied to inflation-linked bonds. Further, the BCCh is legally required to sell back government securities **temporarily** acquired via PWRA before their maturities. While short-term bonds typically have lower add-ons accounting for maturity risk, this legal requirement constrains the BCCh to sell them earlier, likely at a higher discount. Therefore, add-ons should differ depending on the mobilization modality of the security.

43. **Margins should be enforced through daily calls, while the "coverage percentage" can be dropped.** The current margin is mainly capturing interest rate risks related to the inflation-indexed curve, since it is calibrated via CVaR based on the IRR of the inflation-indexed sovereign curve. The haircut calibration models discussed above account for IRR risk more granularly, as the interest-rate risk (i.e., for fixed-income securities, market risks) component of haircuts is calibrated at the sector level. Similarly, interest rate risk on the two-year nominal yields currently accounted for by the coverage percentage is already captured in the calibration of the market risk.

44. **The BCCh should develop a new methodology for haircuts on all nonmarketable collateral that could potentially be eligible for ELA, or in systemwide programs.** The approach used for the FCIC program focuses solely on the sector of credit claims, thereby neglecting the cross-sector correlation of default probabilities—which make the method less likely to safeguard the

[13] European Central Bank (ECB). 2023. "The valuation haircuts applied to eligible marketable assets for ECB credit operations." ECB, Frankfurt.

[14] Optimally, the haircuts could be recalibrated every two to three years (as done by the Eurosystem) to provide counterparties with sufficient stability and predictability in their liquidity management. The recommended frequency should be seen as transitory given the time needed to train the calibration model.

risk-equivalence principle. Further, since the haircuts were calibrated based on the probability of default (PD) collected from banks, they represent PDs that do not reflect the BCCh's risk tolerance. Appendix VI presents a model that addresses these caveats. Finally, it is noted that expected-loss-based haircut models only capture credit risk. Other risks should also be accounted for, including (i) the market risk, which for nonmarketable assets could be the risk on the value of the underlying asset (e.g., real estate); (ii) the liquidation risk, determined by the market's absorptive capacity when the collateral is sold (e.g., the size of the credit-claim portfolio to be liquidated); and (iii) the inflation risk, to account for the indexation of nonstandard collateral to inflation.

45. **Haircuts and margin calls can be complemented by concentration-limit and overcollateralization provisions.** Concentration limits are generally used to control the central bank's exposure to a specific class of asset (e.g., to an issuer, a debtor, a sector, an asset type, etc.).[15] Setting such limits reduces risk through collateral-pool diversification. Overcollateralization aims to address risks specific to the ELA counterparty. The BCCh could resort to overcollateralization if the applicant's solvency is in doubt or as a tool to incentivize the counterparty to comply with ELA conditionality. Concentration limits are applicable for all operations, while overcollateralization is only applicable in the context of ELA.

III. Emergency Liquidity Assistance

A. Introduction

46. **The 2021 FSAP highlighted the need for the BCCh to develop an effective ELA framework, with four components:** (i) a *Legal Foundation* that supports discretionary lending; (ii) *Internal Procedures* that detail the conditions and policy parameters under which ELA is provided, and the allocation of divisional responsibilities within the BCCh; (iii) *Formalized Arrangements with the MoF and the CMF* covering each party's responsibilities and obligations, including the circumstances when a government indemnity may be granted; and (iv) *Transparency and Communication* measures that publicly communicate the central bank's approach to helping condition market behavior, and central bank accountability, both ex ante (at the time a decision to provide ELA is made) and ex post (at the time information is shared—with delay—on the provision of ELA).

47. **The three principles to consider when implementing an ELA framework in Chile include:**

- Operational preparation is essential for increasing the chances of ELA's being successful in mitigating the financial stability risks of idiosyncratic liquidity shocks.

- Close monitoring of eligible institutions will allow for the anticipation of liquidity strains, potentially reducing or eliminating the need for ELA.

- Financial stability is a shared responsibility requiring cooperation across numerous agencies (Box 2), with the MoF playing a relevant role in coordination through the FSC.

[15] https://www.elibrary.imf.org/display/book/9781616353995/ch005.xml.

Box 2. Current Crisis Coordination Arrangements

The Financial Stability Council (CEF)

The CEF is a statutory body that facilitates coordination and information sharing between the MoF, CMF, SP, and BCCh. It focuses on the prevention and management of crises that present a risk to the financial system. The CEF coordinates financial stability and macroprudential policies across the four authorities and is chaired by the MoF. Unlike the CMF and the SP, the BCCh is not a formal member, as a result of its autonomous constitutional status, but, in practice, the BCCh Governor is a permanent invitee and advisor to the CEF on all matters that relate to its mandates, including on financial stability and the orderly functioning of the payment system. The CEF meets monthly, and a MoU formalizes the coordination within the group, covering situations that could affect financial stability without prejudice to the legal responsibilities and functions of each institution. The CEF may publicly communicate on crisis management-related issues, but its policy recommendations are nonbinding. The MoU provides for information sharing through technical groups.

Memorandum of Understanding: The BCCh and CMF
A bilateral MoU provides the coordination mechanism between the BCCh and the CMF. It specifies the BCCh's and the CMF´s responsibilities, communications, and information sharing flows under different scenarios, including when banks and other covered institutions are facing severe financial stress. For ELA, the MoU requires the CMF Board to inform the BCCh of its decision on the viability of a bank. Specifically, the CMF Board assesses the solvency of a bank that requests ELA to address problems derived from a temporary lack of liquidity.
The CMF Board informs the BCCh of its decision on the viability of a bank, after which the BCCh Board decides on the provision of ELA (Article 36, No. 1, Central Bank Law). If an emergency loan is granted, the BCCh coordinates with the CEF to release a joint statement on the scope of the measure. The protocol provides no detail on the scope of a viability assessment or on the specific information to be exchanged.

Source: IMF staff, BCCh, CMF.

B. Legal Foundation

48. **The Constitutional Organic Law (LOC) (Article 36) and the FMRA provide the legal basis for the extension of ELA.** The LOC allows the BCCh to grant ELA in a discretionary manner to licensed banks to preserve the stability of the financial sector. The BCCh's mandate on financial stability is articulated so as to ensure the normal functioning of internal and external payments systems, including the role of lender of last resort to the banking system. This is interpreted as giving the BCCh broad responsibility for the stability of the financial system. The FMRA extended eligibility for ELA to central counterparties (CCPs) and to credit unions that comply with regulation and supervision standards equivalent to banks.

49. **While current legislation provides for some key elements (e.g., discretionary lending to preserve financial stability), some conditioning elements could be added.** The law rightly specifies term limits in that ELA can be provided to a viable financial institution for up to 90 days, with the possibility of extension for another 90 days. It does not, however, cover the issues that adequate collateral must be provided, that a penal interest rate will be charged, and that conditions may be applied on the requesting institution.

C. Internal Procedures and Policy Parameters

Current Situation

50. Currently, ELA applications are assessed on a case-by-case basis, and no standard procedures have been defined or published. The mission was informed that ELA disbursements must be approved by the BCCh Board and that such decisions could be made within the time required. Similarly, opinions on bank solvency and viability require CMF Board approval, which again, the mission was informed, could be made sufficiently quickly. The mission conducted a simulation exercise with relevant staff from the BCCh (and the CMF), and it highlighted the importance of clarity of individuals' roles, operational preparedness, and coordination (Box 3).

Box 3. Evaluation of an ELA Request: Departmental Responsibilities

1. Solvency assessment (CMF, BCCh Financial Policy Division (FPD))
2. Viability assessment (CMF, BCCh FPD, Financial Markets Division (FMD)
3. Systemic risk assessment (BCCh FPD)
4. Unavailability of alternative sources of funding (CMF, BCCh FMD)
5. Coordinated preparation and implementation of funding plans, including conditionality and escalation triggers (CMF, BCCh FPD, FMD, General Counsel, Corporate Risk Division (CRD))
6. Prescription of conditionality in the ELA agreement (CMF, BCCh FPD, FMD, General Counsel)
7. Calibration of ELA envelope (CMF, BCCh FPD, FMD, CRD)
8. Preparation of ELA agreement, collateral agreements, and indemnities (CMF, BCCh FMD, CRD, General Counsel)
9. Implications of ELA for monetary policy (BCCh FMD, Monetary Policy Division (MPD))
10. Information exchange with the MoF in relation to indemnities (BCCh Board)
11. Communication strategy (BCCh FPD, Institutional Affairs Division (IAD) and General Counsel, CMF, MoF)
12. BCCh disclosure (BCCh Administration and Technology Division (ATD, including Accounting), General Counsel)
13. Preparation of the proposal to the BCCh Board (ELA Working Group)
14. Preparation of the response to the counterparty's request (FPD, FMD under the control of the ELA Working Group)

Source: IMF staff.

Recommendations

51. An ELA Working Group (EWG) should be established to operationalize the ELA framework. A lead division should be appointed, ideally the Financial Policy Division. EWG membership should be drawn from relevant BCCh areas, including monetary policy, financial stability, legal, back office, and communications. A terms of reference should be composed, with the focus on preparedness and documented procedures, and with clarity of the obligations of each division to ensure that in times of crisis, policy responses are coherent, coordinated, and based on the best

available information. The EWG should meet regularly and report to a parent committee within the BCCh, which should sign off on key decisions.

52. **The BCCh should develop standard ELA documentation: (i) a request letter; (ii) an ELA master agreement; and (iii) funding templates.** Upon requesting ELA, the CEO of the requesting institution must sign the request letter confirming that the institution is solvent, is experiencing temporary liquidity stress, the reasons for that stress, the amount requested, the duration, and the collateral to be provided. The ELA master agreement is an exhaustive legal document covering all aspects of the ELA arrangement and should be tailored to the Chilean legal environment. Funding templates should be designed to allow for quick input and assessment of institution-specific information and facilitate scenario analysis.

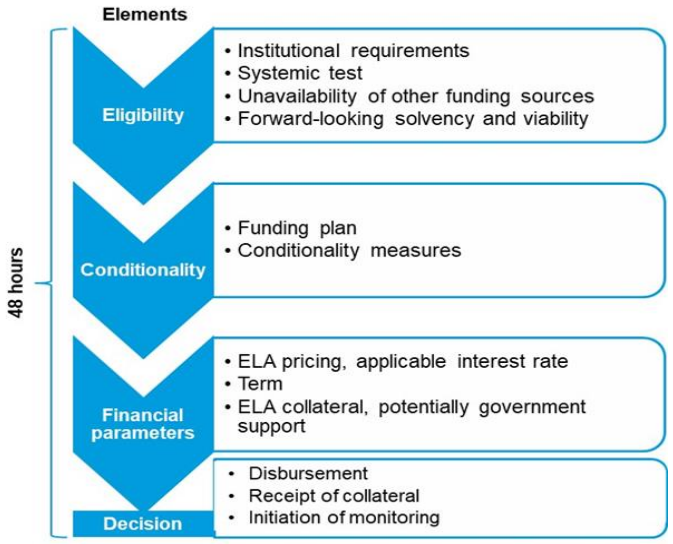
53. **The process for assessing an ELA request can be divided into three elements:** (i) assessing eligibility; (ii) assigning conditionality; and (iii) determining the financial parameters. ELA can only be disbursed after each of these elements has been addressed to the satisfaction of the BCCh Board, which has ultimate decision-making responsibility. Each element is considered in Figure 4.

Eligibility

54. **To qualify for ELA, institutions must:** (i) be eligible by law; (ii) be of systemic importance; (iii) have exhausted all other funding sources; and (iv) be solvent on a forward-looking basis and viable.

55. **All licensed banks are eligible by law (Article 36 LOC), and more recently, so too are some NBFIs.** The December 2023 enactment of the FMRA allows the BCCh to provide ELA to CCPs and to credit unions that comply with regulatory standards that are comparable to those for banks.

Figure 4. Steps in Assessing ELA Requests



Source: IMF staff.

56. **A systemic importance test must be conducted at the time of the request.** There is potential for a determination to go beyond the banks designated by the CMF ex ante, as systemically important. Such ad hoc assessment analyzes financial stability implications and complements the regular CMF assessment conducted with the agreement of the BCCh on an annual basis to determine systemic importance against the four recognized attributes—size, interconnectedness, complexity, and the degree of substitutability in its provision of financial services.[16] Six banks are classified[17] as systemic under the Basel III D-SIB classification methodology.[18] However, considering the size and

[16] See *CMF completes implementation of Basel III regulations in Chile*, December 2020 *and Basel Framework on domestic systemically important banks*.

[17] See CMF`s most recent report on rating of systemically important banks and imposes requirements, March 2023.

[18] Banco de Chile, Banco de Crédito e Inversiones, Banco del Estado de Chile, Banco Santander-Chile, Banco Itaú Chile, and Scotiabank Chile.

interconnectedness of the Chilean market, the scope of systemic institutions can be potentially larger from an ELA perspective.

57. **The BCCh and CMF should prepare a watchlist of potentially systemic institutions with coverage extended to credit unions and CCPs, as recently provided for in the FMRA.** The list should be a joint responsibility of the BCCh and CMF to support a quick determination by the CMF at the time of an ELA request. The concentration of risk and lack of substitutability of the service provided by CCPs likely make them systemically important, and there are scenarios where they may request ELA despite holding high-quality collateral. When a CCP participant defaults, CCPs must pay nondefaulting participants from resources held in cash and securities. While CCPs should have sophisticated risk management systems with a waterfall of resources available for meeting defaults, in extreme circumstances, some resources may not be available if markets in normally liquid assets suddenly freeze. Access to ELA would ensure continued operation of the CCPs and thus support financial stability.

58. **The authorities need to establish that an institution has exhausted all other funding sources.** The BCCh's monitoring of the institution's funding and liquidity conditions and markets in general (i.e., interbank activity and credit spreads) should allow it to assess whether the institution has exhausted all options for funding on the domestic markets: interbank, CDs, and bond markets. Further, the CMF must explore whether subsidiaries of foreign banks can borrow from their parent while considering that such a loan would be subject to large exposure restrictions. To this end, the CMF may request from the parent a letter or other form of communication confirming that all the subsidiary's parental and market sources of liquidity have been fully used.

59. **The key challenge in assessing eligibility is determining an institution's ability to recover from its liquidity stress, and to do that, it must pass forward-looking solvency and viability tests.**

    - **The forward-looking solvency requirement:** While a point-in-time assessment of solvency is appropriate for determining eligibility for regular monetary operations, a more flexible approach is needed for ELA.[19] A forward-looking determination allows ELA to be extended to a temporarily undercapitalized bank, which, if forbidden, could spread liquidity stress across the financial sector. A determination of forward-looking solvency requires that a credible prospect of capital be maintained or restored above the prudential minimum within a reasonable period (e.g., 12 months). Such a timeframe should be broadly defined internally by the CMF and not made public.

    - **The viability assessment by the CMF:** This covers an entity's broader business operations and outlook and likely requires input from financial markets and financial stability functions. The focus here could include the identification and assessment of potential weaknesses, including the entity's business strategy, its asset quality, governance and management, earnings, liquidity, or risk management processes. The assessment should identify any concerns about the ability of the institution to repay ELA and whether that ability is contingent on certain reforms (e.g., a change in lending practices or management) or if ultimately other solutions should be considered (i.e., resolution).

60. **The CMF and BCCh must be able to provide an opinion on a bank's financial condition on short notice.** They have the power to regulate, supervise, and where needed, impose corrective

[19] See IMF working paper on "The Lender of Last Resort Function after the Global Financial Crisis," January 2016.

actions on banks and set the minimum regulatory standards (i.e., capital and liquidity). Further, this requires regular reporting and, together with dialogue with banks' staff, makes the CMF and BCCh best placed to judge an institution's financial condition at any time—especially important in the event of an ELA request. The CMF, therefore, must be able to provide, within perhaps 24 hours, the BCCh with its view of an institution's forward-looking solvency and viability to inform the ultimate decision, and the BCCh's response should be similarly prompt. While this may be challenging, likely requests could be well anticipated through liquidity monitoring, real-time market pricing (i.e., credit spreads), and general market intelligence. Importantly, the CMF's routine analysis of a bank's financial condition, which is likely static and backward-looking, must be adapted for the specific requirements for the provision of ELA—that is, the focus must be wholly forward-looking on solvency and viability.

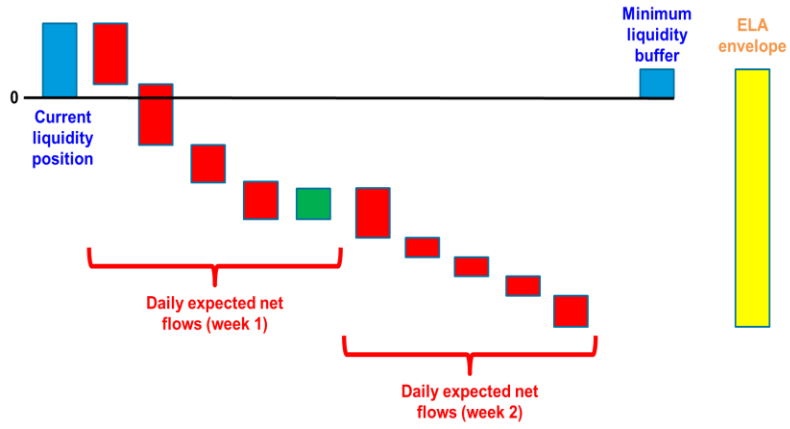
61. **With its resources and reputation on the line, the BCCh should form its own view on all critical aspects of an institution's ELA request, including on solvency and viability.** The BCCh needs to impose appropriate conditions (ELA conditionality is discussed next) to build confidence that ELA funds can be repaid in the specified time, and it must ensure that sufficient collateral is available to cover the risks. Finally, it also needs to conduct its own analysis and independently form a view on forward-looking solvency and viability. Because of resourcing and technical capacity constraints, the BCCh cannot and should not replicate the CMF's analysis. It should, however, be able to have candid discussions with the CMF, and also with the bank, where necessary, probing until it is satisfied that the requesting institution does indeed pass the necessary solvency and viability tests. In this regard, the BCCh may inquire about such issues as the drivers of liquidity problems, methodologies used in the analysis, and the key assumptions. It is stressed that this is not to question the CMF's competence on the issues, because the CMF has the capacity and primary responsibility. Rather, it is more about undertaking due diligence, given its potential exposure to financial and reputational risks.

Conditionality

62. **The preparation of an agreed and credible funding plan is the most important condition for providing ELA.** The plan should be prepared with the CMF and the institution's input as soon as possible. The plan facilitates the monitoring of how funds are used and should include a clear exit strategy with quantified milestones for continued support.

63. **An ELA envelope should be calibrated based on the institution's forecasted (typically, over a two-week period) liquidity requirement (Figure 5).** The bank should submit to the BCCh a detailed cash flow forecast for the following two weeks, which should distinguish the different flows relating to deposits, loans, securities, interbank operations, and other factors.

Figure 5. Calibration of an ELA Envelope



Source: IMF staff.

64. **The forecast should be based on the observed flows from recent days and weeks.** The size of the ELA envelope reflects the difference between the bank's current liquidity position and the minimum liquidity threshold required for the bank to continue normal operations, adjusted by total net cash flows projected for the two following weeks.

65. **The BCCh and CMF should assess whether additional conditions are needed to ensure that the funding is used solely for core business activities, which could include that:**

    - Equity buybacks should be prohibited, as these are essentially capital-related activities, although funds can be used to meet debt repayments as they become due.

    - Funds should not be used to facilitate nonessential or risky lending practices, the distribution of dividends, or bonuses/salary increases for management.

    - Institution-specific measures should be developed to address governance and risk management failures (as may have arisen during the viability assessment).

    - In the case of foreign subsidiaries, protection against funds being "upstreamed" to their parent. The CMF should have formalized arrangements with the host supervisor for sharing prudential information.

66. **The BCCh should be prepared to provide ELA in foreign currency, but only under exceptional circumstances and with strict safeguards.** The level of dollarization is material; for banking sector loans and deposits, as a percentage of the total, it is 17.5 percent and 25.1 percent, respectively. In the nonbank sectors of the financial system, institutional investors (i.e., pension funds) have a positive net foreign asset position. By regulation, banks' short foreign exchange positions due in 30 days cannot exceed long positions by more than the bank's capital.

67. **Should the need arise, strict conditions should be applied to ELA provided in foreign currency given constraints supply.** The extension of FX ELA to foreign-owned branches or subsidiaries could entail additional risks. Liquidity problems in the local entity may indicate wider problems in the group and as such may entail a risk of FX liquidity being upstreamed. The best solution would be for the foreign-owned bank to obtain liquidity from its parent, if necessary, supported by the home authorities (i.e., the home authorities first provide liquidity). The constraints on providing ELA in FX underscore the importance of ensuring prudential tools to contain the buildup of foreign currency-related exposures.

Financial Parameters and Collateral

68. **The existing law appropriately allows for providing ELA for a maximum of 180 days (i.e., 90 days with one extension of 90 days).** Disbursements should be provided based on a two-week approved envelope, setting the maximum liquidity that can be extended without requiring further approval. This approach minimizes the need for frequent approvals for ELA extensions, especially when there are no changes in an institution's financial status or balance sheet composition. The amounts allocated should follow the funding plan and be based on anticipated cash flows and ELA needs over the next two weeks. Within this two-week period, ELA should roll daily, allowing any liquidity surpluses at the start of the next business day. At the end of the two-week period, the forecasted ELA need is recalibrated for the forthcoming two weeks, and a new ELA envelope is allocated, which may be larger or smaller than the previous fortnight, in line with funding plan targets.

69. **ELA should be priced at a margin above the BCCh's standard lending facility (SLF) rate to reduce moral hazard and to incentivize timely repayment.** The rate should be set at a margin above the SLF rate, which initially could be set relatively high, at around 200–300 basis points. As knowledge of the institution grows along with compliance of conditionality, the BCCh could consider reducing the spread to, say, 100–150 basis points. While the cost of ELA is intended to be punitive, it must not be set at a level that pushes an otherwise viable institution into a nonviable situation.

70. **ELA-eligible collateral should be considered within the overall collateral framework (Section II).** As with standard monetary operations, for ELA, there should be clearly defined eligibility criteria, robust processes for valuation, and adequate risk mitigation measures. The ELA-relevant part is, in essence, an extension of the standard collateral framework that covers standard operations. Such extension implies that eligibility criteria are broader, with challenges in valuing less liquid collateral (e.g., credit claims), and requiring more tightly calibrated risk mitigation measures (i.e., higher haircuts). Such measures cover the increased risks (market, liquidity, and credit risks) of the lower-quality collateral while also recognizing that lending to a liquidity constrained counterparty is riskier than lending to a counterpart that maintains market access.

71. **The BCCh's acceptance of credit claims under its FCIC program provided valuable experience in dealing with nonstandard collateral.** Credit claims are potentially an important collateral type in ELA given they are often a material part of banks' assets. They do require, however, dedicated and sometimes challenging procedures to assess credit quality and ensure there is a legally robust process for title transfer. Feedback during the mission included that operational lead times for the FCIC program were more than a month for the identification and mobilization of eligible credit claims. This timeframe may be manageable for a systemwide program seeking to address dysfunction in one segment (i.e., credit supply to small and medium-sized enterprises), but it is not acceptable for dealing with an idiosyncratic liquidity shock in a systemically important institution where there are elevated risks of contagion.

72. **To improve crisis preparedness, the BCCh should encourage banks to pre-position collateral and conduct regular tests for its mobilization.** Pre-positioning involves identifying, verifying eligibility, and validating collateral. During this stage, the legal title to the collateral is not transferred to the central bank. Once due diligence is satisfactorily completed, the collateral is considered pre-positioned and ready to be drawn against, subject to the approval of the central bank.

73. **The BCCh should conduct testing exercises with key counterparties on the identification and mobilization of nonstandard collateral, in particular, credit claims.** In an initial phase, mandatory tests should be conducted with the six domestic systemically important banks (D-SIBs). In the next phase, the BCCh should broaden the set of counterparties and include smaller banks and eligible NBFIs. To shorten lead times for mobilization and to reduce operational risks, the BCCh could share minimum procedural and eligibility requirements for the identification and mobilization of credit claims and conduct exercises built on experience gained during the FCIC program. Information sharing with counterparties on nonbinding eligibility requirements for nonstandard collateral should enable counterparties to identify such available and unencumbered assets ahead of time. BCCh communication in this regard must be balanced, as successful participation in the exercise and the disclosure of eligibility criteria should not diminish BCCh's discretion in circumstances when ELA is requested.

D. Formalizing Arrangements: BCCh/CMF/MoF

74. **The BCCh, CMF, and MoF should establish a Crisis Management Group (CMG).** The group should develop a common understanding—encapsulated in a MoU—of the entire ELA process and clarify the individual responsibilities, especially regarding the forward-looking solvency and viability assessments and the potential need for a government indemnity. Membership should be the BCCh's relevant divisional heads (FPD, FMD, CRD) and the General Counsel, together with representatives of comparable seniority from the other two agencies. Clarity on roles and responsibilities within this group will support the necessary time-critical assessments being conducted effectively and efficiently.

75. **Because the MoF has a key role in all BCCh Board decisions, including about providing ELA, it is imperative that they be informed in the process from the outset.** The LOC (s19) states that the MoF can attend BCCh Board meetings and has the right to suspend the implementation of any decision passed for a period not to exceed 15 days. However, if all BCCh Board Members disagree with the proposed suspension, then the Board can unanimously overrule the suspension. The Minister has never exercised such a right, but nevertheless, there is a need for coordination to fill the gap in the institutional arrangements that would potentially be very serious if a warranted disbursement was delayed for any reason.

76. **Government indemnity may be required if there are concerns about the solvency or viability of the institution or about the adequacy of collateral.** The rationale for an indemnity stems from the magnitude of the financial risks relative to the size of the BCCh's balance sheet. Any such indemnity would be an obligation of the government to make good any losses associated with the provision of ELA and should be unconditional, irrevocable, and callable on demand by the BCCh. The MoF and the BCCh should agree on a framework for granting an indemnity, together with procedures to be followed when one is granted.[20]

77. **The BCCh and the MoF should assess how legislation may need to change to allow the MoF to grant indemnity to the BCCh sufficiently quickly when needed.** The Chilean constitutional framework currently requires that for such indemnity to be provided, a specific law would have to be passed, making it highly unlikely that such indemnity could be available in the limited time for an ELA request to be decided.

78. **The CMG should initiate joint preparatory work.** The simulation exercise conducted with the BCCh and CMF highlighted the need for such work, including, for example, development of standardized approaches to banks' funding plans. Further, there should be a watchlist of financial institutions that are generally considered critical for financial stability and hence eligible for ELA. The CMG's MoU should facilitate the exchange of information, market intelligence, and assessments on liquidity conditions and ensure that early warnings can be shared among the three members.

E. Transparency and Communication

Ex Ante Transparency

79. **The BCCh has no public document and should therefore consider developing a publicly available ELA regulation.** The objective of such a regulation would be to articulate selective

[20] Government indemnities are effective risk mitigation tools that several other countries (e.g., Australia, Brazil, Morocco, New Zealand, Serbia, and South Africa) have implemented successfully.

elements of the ELA framework to: (i) manage banks' expectations on the conditions for providing ELA; (ii) highlight that ELA is for solvent and viable institutions; and (iii) ensure central bank accountability.[21] The ELA regulation would thereby expand the current LOC, based on which the BCCh could provide ELA and enhance legal certainty also for the BCCh. It should outline the broad terms and conditions when ELA is granted, with specific coverage of:

- The discretionary nature of the intervention, which is grounded in the BCCh's financial stability mandate.
- Institutional eligibility: the set of entities that are generally eligible for support.
- Conditionality and supervisory intrusion: the ability of the BCCh/CMF to collect, monitor, and assess information on whether the use of the liquidity provided is consistent with the objectives of the liquidity support and the supervisor's power to adopt early intervention measures.
- The requirement for full collateralization.
- Discretionary financial parameters, including reference to a penalty rate, the maximum maturity of 180 days, and the broad range of eligible collateral that goes beyond the standard collateral framework, but with additional risk mitigation measures.

Ex Post Communication

80. **The BCCh should develop ex post communications guidelines ensuring authorities' accountability and ensuring that disclosures do not exacerbate liquidity stress.** While central bank transparency is generally supported for its objectives and operations, there is a need for caution during times of stress. Premature disclosure of liquidity support to an individual institution could result in the stress spreading, thereby increasing risks to financial stability. Identifying the ELA recipient may be required under public disclosure requirements at some point, and this ideally should be done at least a year after the ELA has been repaid. It is possible, however, that information indicating that an institution is facing stress is deduced through market pricing and contacts together with the periodic publication of a central bank's balance sheet or monetary data.

IV. Systemwide Support Measures

A. Background

81. **Systemwide problems impact one or more segments of the financial system, with the potential for contagion or asset fire sales, ultimately undermining the solvency of otherwise viable entities.** When assessing liquidity stresses, it is important to differentiate between an idiosyncratic issue impacting an individual entity and broader pressures impacting one or more market segments. ELA (Section III) covers the central bank response to idiosyncratic issues, which are essential for preventing liquidity stresses from spilling over to the financial system more broadly. Systemwide stresses may require broad-based responses with measures

[21] The IMF's Central Bank Transparency Code (CBT) provides detailed guidance on the appropriate transparency on the ELA framework's governance, policies, operations, and outcomes.

including large-scale asset purchases and the broadening of central bank lending in terms of maturity, volume, collateralization, and counterpart eligibility.

82. **An effective response to market stress needs a clear diagnosis, and here it is useful to distinguish between market liquidity and funding liquidity—distinct but related concepts.** Market liquidity is the ability to trade without affecting the price, reflected in metrics such as market breadth and depth (and the Amihud ratio). Funding liquidity refers to the ease with which entities can obtain funding, usually with reference to the money markets. The two are linked in that traders' ability to support market liquidity depends on their access to funding. If access is unexpectedly constrained, requiring forced sales, market liquidity could suffer as securities are liquidated. Further, traders' funding (i.e., capital and margin requirements) depends on the assets' market liquidity. A loss of market liquidity will increase volatility and margins, thereby reducing the amount of funding available for a given volume of securities. With margins destabilized, market liquidity and funding liquidity are mutually reinforcing, which can lead to liquidity spirals (Brunnermeier and Pedersen 2006).

Box 4. Principles for Central Bank Liquidity Support to Financial Markets

Seven policy principles should be followed when designing market support programs while stressing that such measures address liquidity and not solvency concerns:

1. Intervention objectives should be well specified, particularly as regards addressing market dysfunction.
2. The objectives should also be set realistically, considering the intervention impact may be small and/or short lived, while recognizing that other fundamental factors also drive market activity.
3. Intervention triggers should be focused on metrics of liquidity and not prices.
4. Interventions should be large enough to address the identified market dysfunction while considering the potentially significant risks of fiscal dominance, moral hazard, and financial risks to central bank balance sheets.
5. Program design should facilitate self-liquidation, such as through pricing (i.e., setting appropriate spreads) or involving short-term operations that roll off the balance sheet relatively quickly.
6. Central banks should be well prepared so that programs can be launched quickly in the event of a shock.
7. In some cases, interventions have significantly increased risks to central bank balance sheets, raising issues of policy solvency and operational independence.

Source: IMF staff.
Note: See Eckhold et al. (2024).

B. BCCh Programs

83. **The BCCh's COVID-19 pandemic response followed earlier support measures implemented in response to social unrest in November 2019.** Chile in a short period faced two episodes of market disruption—one domestic and one global— that illustrate the risks and benefits of interventions in an emerging market and development economy (EMDE) with inflation targeting, a fully flexible exchange rate, and high central bank credibility. Since the adoption of inflation targeting and a floating exchange rate in 1999, the BCCh has intervened in FX markets only four times. In late 2019, it implemented following social unrest liquidity and FX intervention programs that provided timely and extensive liquidity to the FX, and local money and securities

markets. The subsequent COVID-19 shock saw the BCCh provide further support to markets with programs that are analyzed in the rest of this section.

Foreign Exchange Market Support Measures

84. **The efficient functioning of the FX spot market is critical for the stability of the Chilean financial system.** Chile is a small, open commodity-based economy with a liberalized capital account and a relatively deep financial system. This exposes the economy to external shocks, necessitating the exchange rate to act as the primary absorber of such shocks. Consequently, domestic economic agents (NBFIs and NFCs) have significant exchange rate risk, which they hedge using derivatives, while the exchange rate is a critical channel of monetary transmission within the central bank's inflation-targeting regime.[22]

85. **The COVID-19 pandemic saw a global shortage of USD funding while a simultaneous spike in spot CLP volatility threatened at a systemic level.** Given their FX exposures and the significant exchange rate volatility, economic agents rely to some extent on hedging instruments. The market for FX derivatives is therefore relevant for financial stability and makes banks' intermediation capacity pivotal during episodes of market turbulence. Banks' market-making ability, in turn, depends both on the volatility of the underlying asset price and the banks' capacity to fund their own risk-absorbing activity. The latter includes the necessary capital charge for additional risk added to the balance sheet, and the access to FX liquidity to manage their exposure and, if necessary, to maintain the margin requirements in their derivative positions. A crisis episode impacts all these components simultaneously and can create nonlinearities among them, potentially resulting in a vicious cycle.[23]

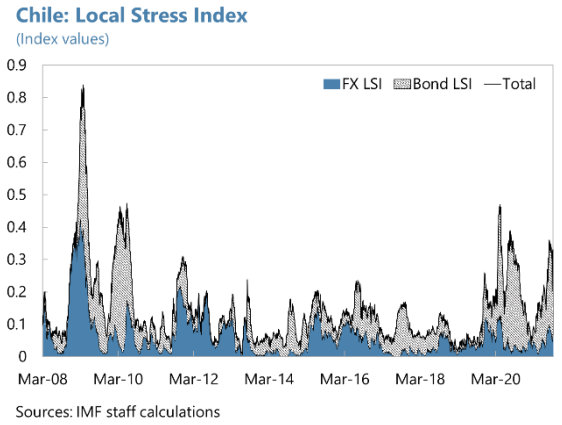
86. **To break a negative feedback loop, the BCCh intervened in the spot FX market to attenuate exchange rate volatility and set up FX swaps to provide domestic banks with USD liquidity.** The social turmoil in 2019 caused significant outflows by nonresidents. While the economy was resilient to this capital flow reversal due to a favorable external financial position and the mitigating effects of its floating exchange rate, the outflows caused volatility in domestic markets and contributed to USD liquidity stress. The FX spot sales, NDFs, and swaps measures introduced by the BCCh for relatively long maturities (30 and 90 days initially, then 180 days) helped provide the USD liquidity needed by some banks and reduce their USD funding costs, while others managed to continue relying solely on their usual USD funding sources (such as correspondent banks and issuances abroad).

[22] The central bank's FX interventions are well documented and align with the principles of a floating exchange rate regime. The central bank announces the explicit definitions of the periods and amounts involved and clearly explains the reasons for the intervention. It publishes the auction results daily and the level of international reserves weekly.

[23] For example, if the volatility of the exchange rate increases, market participants will face margin calls on their derivative positions, which requires FX liquidity. To obtain FX liquidity, they will either rely on the FX spot market, adding to its volatility, or the FX swap market, putting additional upward pressure on the FX funding cost.

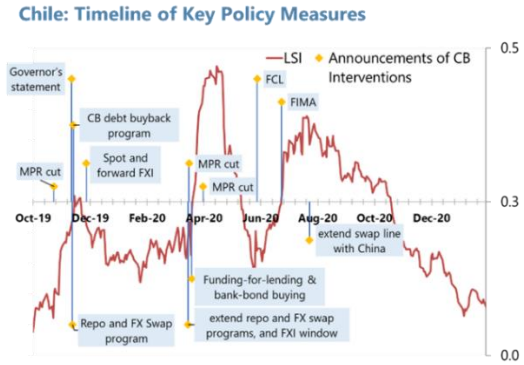
Figure 6. Indicators of Market Disruption

Stress in the bond market was significantly greater than in the FX market.



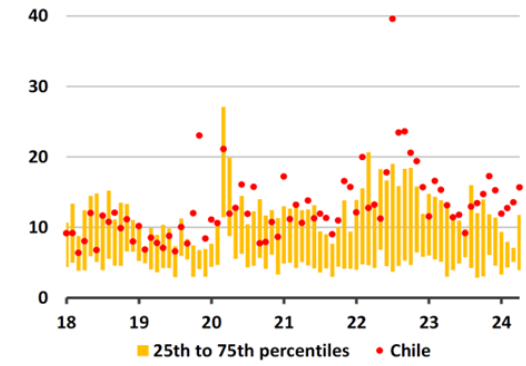
Sources: IMF staff calculations

Most central bank support measures were announced in response to spikes in market stress.

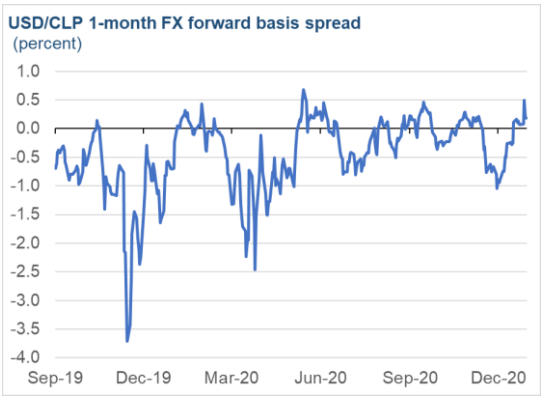


Sources: BCCh, Haver, IMF staff calculations.

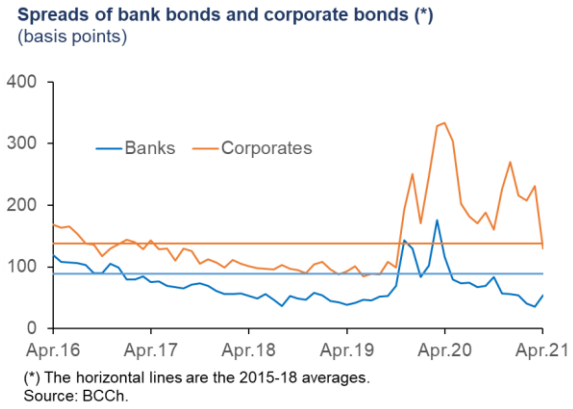
The exchange rate volatility remained elevated...



…but FX funding cost spikes reversed quickly.

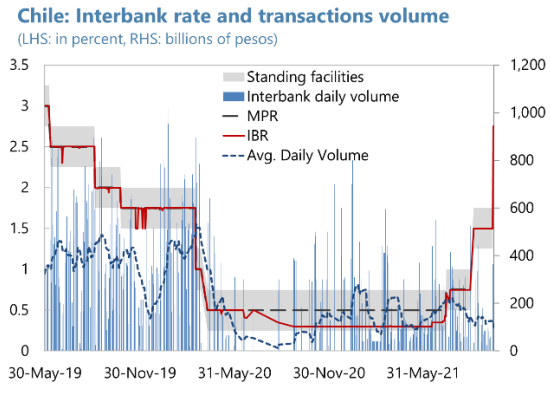


Bond spreads returned to their long-term averages.



(*) The horizontal lines are the 2015-18 averages.
Source: BCCh.

Interbank market activity remained subdued with elevated excess reserves.



Sources: Central Bank of Chile, IMF staff calculations.

87. **The FX market support programs were effective in arresting the spike in volatility and the increase in USD funding cost.** Spot exchange rate volatility receded following the interventions to levels typical in emerging market currencies (see the middle-left chart in Figure 6). Increasing USD funding costs reflected in deeply negative basis spreads were reversed relatively quickly after the launch of the NDF and swap programs (see the middle-right chart in Figure 6). It is important to note that the CLP exchange rate is still among the most volatile in emerging markets, highlighting that the actions of the authorities were targeted at the market dysfunction while remaining committed to the floating exchange rate regime.

88. **Prior experience and good design facilitated a smooth exit from FX funding market support measures.** The BCCh included end-dates for its FX liquidity programs with each announcement. While these programs could be extended, the announcements created clear market expectations and a timeline for reviewing the ongoing need for intervention. This clarity aided the exit from FX interventions and the FX swap program. As exchange rate volatility and conditions in the USD funding market normalized, the stock of NDF contracts was gradually reduced, reaching zero by end-October 2020. Similarly, the volume of FX swaps was reduced to zero by end-June 2020 despite FX swaps being available until January 2021. The pricing of USD funding support clearly established the facilities as backstops (LIBOR + 400 basis points), which, therefore, naturally liquidated as market conditions normalized.

Securities Markets Support Measures

89. **Chile has a large bank bond market and nonbank financial sector in comparison with many EMDEs.** Domestic securities issued by banks were almost double those issued by the government at end-2019. There is a deep domestic investor base with mutual and pension funds important providers of funding to the domestic banking system—mutual funds provide about half of time deposits and pension funds are the largest buyers of bank bonds. Foreign investors have played a lesser role in recent years despite increasing their holdings, particularly in government securities. The BCCh could not purchase securities in the secondary market of government bonds or accept them under PWRA during the COVID-19 pandemic due to the prohibition of buying government debt or financing public spending. A legislative change in August 2020 has lifted that restriction for exceptional periods.[24]

90. **Mutual and pension funds withdrew from bank funding markets due to redemptions and changes that permitted extraordinary withdrawals from pension funds.** The Chilean Congress approved three rounds of withdrawals (in June 2020, December 2020, and April 2021), which resulted in the withdrawal of more than USD 48 billion from pension funds, equivalent to 23 percent of 2020 total assets (nearly 20 percent of GDP). These outflows severely impacted banks, as NBFIs contribute about half of total bank liabilities. While liquidity declined in the government bond market, there were fewer concerns compared with bank bonds, as the government was able to use its sovereign wealth fund to finance its COVID-19 programs and did not need to suddenly increase government securities issuance.

91. **The BCCh implemented measures to address stress in securities markets:**

- **A bank bond purchase program was launched on March 20, 2020, to contain the effects of high volatility events in the fixed income market.** The eligible assets were nominal or inflation-

[24] In August 2020, Chile's Congress approved a law to allow the central bank to buy government bonds in the secondary market in exceptional circumstances. Any bond purchase had to be approved by four out of five of the central bank's directors, and the bonds would be resold by the bank in the open market once the "extraordinary circumstances" passed. The central bank previously was prohibited from acquiring debt issued by any state organization. Primary market government bond purchases remained prohibited.

linked bank bonds issued by banks with less than five years of remaining maturity. The operations were carried out in “purchase windows” with a preannounced total amount and fixed prices. The prices were set as spreads over the corresponding swap rate according to the credit rating of the bond (AAA: swap + 250 bps, AA: swap + 260 bps, A: swap + 280 bps). The total amount of the program was initially USD four billion, which was later increased to USD 8 billion, but only USD 3.3 billion was eventually used, and demand faded after about two months. The stated objective of this program was to curb secondary market volatility.

- A special asset purchase program was announced on June 17 and targeted bank bonds and BCCh bonds. The program’s term was six months, and its total approved amount was USD eight billion. No information was published on the allocation mechanism. The objective of this program was to boost banks’ funding liquidity.

- A bank bond buy-/sellback (CC-VP) program was targeted at pension funds to prevent fire sales after pension fund withdrawals were allowed as an extraordinary measure. The amount of the program was about USD 16 billion. The stated objective was to contain the market volatility arising from forced sales by pension funds to pay for withdrawals.

92. **The securities market support program was effective in curbing the widening of bank and corporate bond spreads but provided little help to prop up market activity.** The spreads of bank bonds, which were targeted by the interventions, receded from their peaks significantly faster than those of government bonds, which were excluded from the support programs (see the bottom-left chart in Figure 6). However, trading volumes in the secondary market dropped to less than half of typical pre-pandemic turnover levels and have not since recovered. This, together with the relatively persistent increase in the Local Stress Index (LSI),[25] particularly its bond market component, suggests that market functioning remained somewhat impaired.

93. **Exit from the bank bond purchase program was prolonged and BCCh financial risks will remain elevated.** The bank bond purchases transitioned from crisis intervention measures to quantitative easing, serving as a mechanism to facilitate ongoing withdrawals from pension funds that were approved by the Congress. These mixed objectives complicated exit, as there was an ongoing need for monetary accommodation after bank bond market conditions had normalized. Purchases were eventually phased out when the BCCh halted quantitative easing, although the BCCh decided to maintain a fixed stock of bank bonds supported by a new Bank Bond Reinvestment Program in January 2021 (entailing reinvestment of coupons and maturities). When the BCCh raised the policy rate (mid-2021), it stopped reinvesting coupons and redemptions. The BCCh balance sheet doubled, with bank bonds accounting for around 50 percent of assets, significantly increasing its financial risks.

Money Market Support Measures

94. **In early 2020, a significant increase in the demand for precautionary liquidity impacted the functioning of money markets and impaired the transmission of monetary policy, as observed in many other countries.** While policy rates were cut too close to the effective lower bound, higher risk premia threatened to weaken transmission to longer-term rates. Transmission was impaired by concerns that banks lacked sufficient collateral to access BCCh liquidity and

[25] The October 2020 edition of the IMF’s *Global Financial Stability Report* introduced the Local Stress Index (LSI), which is constructed from local currency market liquidity and stress indicators—such as bid-offer spreads, realized volatility, and other risk-premium measures for local currency bonds and exchange rates.

higher perceived credit risks, reducing banks' willingness to lend. Bank funding markets came under pressure, as evidenced by wider credit spreads (see the bottom-right chart in Figure 6).

95. **The BCCh's money market support programs had two objectives: to halt the rise in bank funding costs and reduce the rollover risk of short-term funding.** The sudden increase in funding costs pressured banks' liquidity and solvency. A consequent increase in reliance on short-term funding exposes banks to rollover risk, impacting their ability to refinance liabilities and to extend credit. The BCCh responded with a combination of measures to underpin liquidity in funding markets. A funding for lending program (Box 5) directly targeted a risk of market failure in the supply of credit to households and firms. In addition to the securities market support program to support banks' funding, the BCCh took the following measures:

- **A repo program:** The operation provided funding for 30 days, and later for 90 days, to address banks' immediate liquidity needs while allowing for regular reassessment and adjustment based on evolving market conditions. The interest rate was set at the central bank's monetary policy rate (TPM).

- **The Liquidity Credit Line Facility (LCL):** The LCL is uncollateralized lending, although limited in size to the amount of a bank's reserve requirement. Although limited by the reserve requirements, such a practice transfers significant credit risk to the central bank balance sheet, which is not a prudent approach. The limit was updated monthly, and in the event of a reduction in the reserve requirement below the amount loaned, the bank had to prepay the BCCh the difference or refinance through the FCIC. At year-end 2020, the amount outstanding was CLP 5.2 trillion, against the limit of CLP 5.8 trillion with policy rate prevailing at the time of 0.5 percent. Access and use of this facility was subject to the same loan-growth conditions associated with the FCIC. The loans provided in this facility had a prepayment option, but the BCCh considered that unlikely given the low fixed interest rate. The facility was fully refinanced with the FCIC in March 2022 and completely wound down by August 2022.

- **A time deposit purchase program:** This program, with the objective to reduce banks' funding costs, was announced to BCCh counterparties in July 2020. The total amount was USD eight billion, but only 0.5 billion was purchased, and the program was discontinued in October 2020.

- **Collateral expansion:** The main asset class accepted by the BCCh is bank bonds, which are broadly available and generally liquid. In response to the COVID-19 pandemic, the BCCh expanded eligibility to (nonbank) corporate bonds and commercial loans for specific programs (see section on Collateral Framework).

Box 5. Funding for Lending

The Conditional Financing Facility for Increased Loans (FCIC) was the largest intervention and aimed at ensuring the availability of credit to households and firms. This funding-for-lending program was available for periods of up to four years, with an interest rate set for the whole period at 0.5 percent, which was the policy rate at the time of the announcement. The collateral accepted under this program was expanded to include credit claims and corporate bonds, requiring extensive modification to the BCCh's operations (see section on Collateral Framework). The program volume peaked at around USD 40 billion and was completely wound down by July 1, 2024. The LCL (introduced first) and three rounds of the FCIC indirectly helped alleviate pressures in the bank bond market, because banks could use funding from the BCCh as a substitute for funding from bond issuance and deposits.

Source: BCCh and IMF staff.

96. **The programs were effective in addressing banks' funding stress while interbank market activity declined.** Interbank trading declined significantly: between March 2019 and February 2020, the average daily interbank trading volume was around CLP 400 billion, while after the COVID-19 shock, between March 2020 and February 2021, this dropped to CLP 277 billion. In the first period, almost all trading days registered nonzero trading volume, while in the second period, less than 50 percent of the days had any market activity. Understandably, excess liquidity created by the BCCh's operations undermined banks' incentives to trade with each other. Banks' funding stress was, however, eased effectively, as evidenced by the fact that the banking system's LCR remained well above 100 percent throughout the review period and the weakest bank's value dropped to 90 percent for only one day.

C. Assessment and Recommendations

97. **The BCCh acted swiftly and decisively to address disruptions to the functioning of core funding markets in the wake of the twin crises of 2019–20.** The wide range of measures implemented were effective in supporting market functioning, albeit resulting in a significant increase in financial risk on the BCCh balance sheet. The magnitude of the required response could have been less, however, had there been a functioning repo market, because some liquidity pressures would have been absorbed through a robust secured-lending segment of the money market (see section on Repo Market Development). From the assessment of the BCCh's programs, several observations can be made:

98. **Programs' design should minimize the risks to the BCCh and facilitate exit.** Risks for securities market programs are lower when structured as buy-/sellbacks (as with the CC-VP) instead of outright purchases for two reasons: (i) the counterparty would need to fail and the value of the collateral fall for the BCCh to incur a loss; and (ii) haircuts (and margins) can be calibrated to the desired risk tolerance (see section on Collateral Framework). Further, the temporary nature of buy-/sellback transactions simplifies exit through self-liquidation at maturity. However, there may not always be a choice. If the problem is a loss of market liquidity, with no obvious constraint on dealer funding, then outright purchases may be the only option to support market functioning.

99. **Pricing should incentivize the resumption of market activity and also facilitate exit.** Market support programs should be priced in a way that incentivizes take-up at launch and facilitates exit. Linking the operation to a floating rate (as with the FX swap program) is an effective way to achieve this, even if the funding provided is for a longer term. This way, rollover risk is reduced without compromising the effectiveness of monetary policy transmission. In contrast, a key feature of the LCL and the three rounds of FCIC was the low and fixed cost, which disincentivized early repayment, as noted in the BCCh 2021 Annual Report.

100. **Transparency can increase effectiveness and help mitigate risks.** With high institutional credibility, ex ante transparency on the objectives supports overall effectiveness while conditioning the markets for a smooth exit. Ex post transparency enhances central bank credibility, helping to manage reputational risks, such as those arising from an expanded balance sheet and increased financial risks. In the case of the BCCh's bank bond purchase programs, only the total purchase amounts were published. The BCCh should consider publishing more granular data about the acquired bonds to provide more accurate information on the support provided to individual entities and about the credit risk transferred to the BCCh's balance sheet.

101. **Infrequent FX intervention places a stronger need for transparency when interventions do take place.** With high credibility and developed financial markets, there is infrequent need for the

BCCh to intervene in FX markets, as outlined in various BCCh documents. The FX intervention during the social unrest of October 2019 was accompanied by an announcement of the key objectives, yet it seems they were not fully clear to market participants. Accordingly, the BCCh could consider ex ante, disclosing its FX intervention objectives more clearly, and ex post, disclose its evaluation of how effectively those objectives were met.

V. Repo Market Development

A. Current Situation

102. The Chilean repo market is small, short term, and largely illiquid. The outstanding volume of the domestic repo market was at end-2023 just over USD 12 billion, equivalent to about four percent of GDP. This compares with 10 percent in Mexico and 20 percent in Brazil. The average daily turnover in 2022 was estimated at just under USD 2.5 billion, although market-based turnover is lower because BCCh repos are included. About two-thirds of transactions were for less than
USD one million, with an average size of around USD 200,000. Tenors were concentrated in the overnight to one-week range for cash borrowing by financial institutions and up to six months for cash lending. Repo rates are significantly above the TPM, and with a wide spread between the repo and reverse repo rates—averaging TPM + 405 basis points and TPM + 795 basis points, respectively, in 2022—that is, an average spread of 390 basis points.

103. The domestic repo market is narrow, being largely between banks and brokers on the one hand and nonfinancial customers on the other. Brokers accounted for 68 percent of transactions and 44 percent of outstanding value. There are two types of brokers: stock exchange brokers (corredores de Bolsa), who intermediate equity and fixed income securities, and OTC brokers (agentes de valores), who only intermediate fixed income. It would appear therefore that most repo is used as a short-term commercial lending tool. Interbank repo was worth just
USD 850 billion in outstanding value and contributed less than one percent of bank funding and three percent of bank lending.

104. There is an active cross-border market in US dollar repo, amounting to over one-quarter of outstanding transactions. These transactions are against both peso- and dollar-denominated collateral and documented under the ICMA global master repurchase agreement (GMRA). While there was a net repo position in peso transactions (meaning domestic financial instructions were net borrowers in pesos), there was a net reverse repo position in dollars (meaning domestic financial instructions were net lenders in USD). The average deal size is much larger than in peso, accounting for 27 percent of the outstanding value of repo in 2023 but only three percent of the number of transactions. The USD repo market shows that there are sophisticated users of repo in Chile.

B. Assessment

105. The fundamental drivers of an active repo market do not currently exist in Chile. A repo market is not an end in itself; instead, it is an important component supporting the efficient pricing and distribution of securities and (secured) cash, when the underlying conditions allow. Those conditions include both: (i) active secondary markets, where intermediaries actively trade between investors and also on their own account, trading out anomalies along the yield curve (collateral motivation); and (ii) liquidity conditions that require participants to borrow in the money

market through collateralized arrangements (cash motivation). Such conditions do not currently exist in Chile, despite the otherwise well-developed and diversified financial sector. While these underlying conditions in Chile need to change, in addition, several constraints must be addressed to support activity in the segment. Some of these issues were highlighted in the BCCh repo survey, which revealed that respondents generally thought that the repo market was being held back by the volatility of asset prices, illiquidity, and regulatory concerns.

Fundamental Drivers

An Active Secondary Market in Securities

106. **The key reason for the lack of an active repo market in Chile is the absence of an active secondary market in fixed-income securities.** The Chilean securities market is essentially one of buy-and-hold investors, such that there is little supply of liquid collateral for the repo market, that is, collateral that can be accurately valued and readily liquidated. The lack of bond trading also means that there are no specialist bond dealers, who are the natural users of repo and most often the driving force behind repo development. They use repo as they do not have access to other sources of cheap funding for their low-margin market-making business while also needing to cover short positions in individual securities. In contrast, banks have retail and wholesale funding options and limited incentives to invest in the collateral management operations required to support repo until the repo market starts to offer good liquidity. In essence, repo markets are primarily driven by securities market activity and not by cash motivations.

107. **The Chilean Debt Management Office (DMO) is seeking to boost secondary market trading of government bonds by introducing official market-makers.** Participants designated as market-makers (i.e., primary dealers) would be supported with a "greenshoe option" and exclusive access to a securities lending facility.[26] This facility would lend new securities issued by the DMO solely for the purpose of alleviating a temporary acute shortage of a particular issue and, as such, would not add to public debt. The DMO has recently been granted necessary legislative approval to amend the Financial Markets Resilience Act.

108. **The dominance of inflation-linked securities is unique to Chile but does not seem to be a barrier for use as collateral in repo transactions.** To be acceptable as collateral, securities need to be plentiful and information insensitive. A plentiful supply underpins liquidity and is needed to generate sufficient demand for repo to be a viable business. Information insensitivity is needed so that parties lending against collateral can use it to mitigate the risks of adverse selection, moral hazard, and default resolution costs. In Chile, there is a reasonable supply of government securities (24 percent of GDP at end-2022), with 60 percent being inflation linked (i.e., CPF-denominated securities). This compares with just 0.7 percent in US Treasury bonds and 10.7 percent in UK gilts. The mission discussed whether government CPF bonds are information insensitive. This quality depends not just on the issuer's creditworthiness and the liquidity of the security, but also on the complexity of the cashflow structure, as this complicates valuation. The complexity of indexed securities is a key reason they are not widely used as collateral outside Chile. But there are exceptions. These include the US Treasury market, where 10.7 percent of repo collateral held by primary dealers in May 2024 were Treasury Inflation-Protected Securities (TIPS). And in Chile, CPF bonds are commonplace, and all market

[26] A greenshoe option allows underwriters to issue additional shares and then buy them back to support the price of an IPO. It has rarely been used in bond markets.

participants the mission met believed that government CPFs would among domestic institutions be universally acceptable as collateral.

An Active Wholesale Cash Market

109. **Structural excess liquidity arising from BCCh crisis-related actions have, as expected, contributed to the reduction in money market activity.** The BCCh expanded its balance sheet in the wake of the social turmoil and COVID-19 pandemic (Figure 1). In so doing, short-term liquidity risks were removed from the market—in essence, the aggregate amount of liquidity supplied was more than the market demanded, while individually, most (if not all) banks had excess liquidity. Banks that the mission met said that on the rare occasions when they needed liquidity, they had adequate unsecured interbank lines with no need to engage in repo activity. They also saw no need for repo, even on a contingent basis, if, for example, their liquidity needs were to suddenly increase. The current interbank activity is largely in the form of the issuance and trading of CDs. These accounted for 42 percent of interbank exposures in Q1 2022, down from 59 percent in Q4 2018. Bank bonds accounted for another 22 percent of interbank exposures, up from 16 percent in Q4 2018. Interbank transactions are included in the reservable base for the purposes of reserve requirements, and this likely is a deterrent against money market (including repo) activity.

110. **The Chilean banking sector is relatively concentrated, which may impact money market activity.** Even when excess liquidity is withdrawn, money market activity, including in repo, may be held back by a lack of competition, given that six banks account for 88 percent of all deposits (May 2024). Such concentration can lead to market segmentation if the largest banks decide not to deal with smaller banks, perhaps because of an unwillingness to assess and accept the credit risk of the latter—putting lines in place with small counterparts may not be seen as profitable business. On these issues, a full analysis of the distribution of excess reserves and bilateral transaction-level data is needed to assess the extent of segmentation.[27]

Enabling Conditions

Diversified Financial Sector

111. **The diverse and well-developed nonbank financial sector in Chile is fertile ground for a repo market.** NBFIs are well placed to benefit from and contribute to an active repo market. Repos are ideal for money market mutual funds, as they provide a secure short-term investment and can be used as a liquidity management (borrowing) instrument, subject to regulatory constraints, to cover redemption pressures, thereby avoiding forced sales of securities. Pension funds can enhance yields by repoing out securities in demand by dealers needing to cover short positions. Both pension funds and mutual funds can also use repo to support efficient portfolio management to reduce risk and enhance return.

112. **Regulatory constraints and inertia prevent pension funds from using repo.** A pension fund manager the mission met saw little need for repo, given that pensions are defined-contribution schemes with little redemption risk—although, this was severely challenged with the sanctioning of extraordinary withdrawals in 2020-21. Liquidity risks are mostly managed using money market mutual funds and short-term bond markets. The pensions regulator noted a general lack of interest among managers in having the prohibition on repo removed. He observed that pension funds do not engage in securities lending, which is allowed and functionally analogous to repo.

[27] The mission did not have the necessary data to conduct this analysis.

However, pension funds have had some experience with repos in the form of the emergency BCCh CC-VP transactions (see “Systemwide Support Measures”). The BCCh’s survey showed that the absence of pension funds in the repo market hindered market development.

Legal Framework

113. **Recent legislative changes that provide for enforceability of closeout netting represent a major step forward for the repo market.** The ability to terminate, value, aggregate, and settle repos with a defaulting party, even if that party is being wound up or reorganized, is a critical legal safeguard for repo participants. In most jurisdictions, securing a right to close-out netting is a major hurdle because of the difficulty of amending bankruptcy law. In Chile, the recent FMRA provides the right to close-out netting to financial institutions executing repo under a recognized master repurchase agreement (MRAs), bringing repo in line with derivatives. The necessary implementing regulation, which will formally recognize eligible MRAs, is expected to be published later in 2024. However, there is no widely accepted domestic agreement, although most parties use bespoke versions of the GMRA. Of concern, the BCCh’s survey revealed that participants had some doubts about the transfer of ownership in repo and the right to liquidate collateral.

114. **Several other, albeit lesser, legal issues still need to be resolved.** Most importantly, there is a risk that the stay of enforcement—which can be exercised by the regulator under bank recovery and resolution rules on the termination of contracts with, and the disposal of collateral from, an insolvent systemically important financial institution—might undermine the contractual right to close-out netting under the FMRA. This risk is evident elsewhere, with doubts expressed about the initial recovery and resolution rules in developed markets such as Germany and some other EU member states, which would have been downgraded to the status of a non-netting jurisdiction had their rules not been revised to limit the stay of enforcement.

Regulation

115. **The regulatory framework recognizes the benefit of collateralization, but the regulation needs clarifying.** Chile follows the Simple Approach under the Basel Framework for counterparty risk weights when calculating regulatory capital. The BCCh survey revealed concern over the clarity of regulations. One question was whether this incentive will be made apparent to securities dealers, who potentially are main users of repo. The question is whether the capital relief on repo and capital cost of unsecured lending is passed on in the costs applied to dealers or absorbed at a higher level—such as by the treasury across all instruments. Banks were concerned about the lack of clarity in some of the conditions for a 10 percent counterparty risk weight (see Box 6), specifically, what is meant by the phrase “liquidation of the operation in a proven system for this kind of transaction.” In fact, this requirement is that the repo should be settled on a proven settlement system.

116. **Some regulatory issues may be a matter of (mis)interpretation by the regulator.** One such issue is the requirement (under Capitulo B7, No.1, Compendio de Normas Contables) for repos to be treated as commercial loans for the purpose of calculating loan loss provisions. This means collateralization is ignored and provision is made against the gross amount of the repo lending. Although there are high thresholds on large exposures, particularly for repo, market participants argued that these might not be enough in the case of business with asset managers. Subject to clarification from the authorities, this problem may be the result of the transposition of the method of calculating regulatory limits on large exposures to loan loss provisioning. Moreover, government and central bank securities do not count toward large exposures under Basel regulations.

Box 6. Market-based Approach: Simple Risk Weight Method

The Simple Approach substitutes the counterparty risk weight of the repo counterparty with that of the collateral issuer subject to a floor of 20 percent, except that the floor can be reduced to: (i) 10 percent—in the case of a repo against zero risk-weighted collateral that can be liquidated within five days of a default, has no currency risk, is an overnight transaction or is margined daily, is subject to standard legal documentation, and is settled in a proven repo settlement system; or (ii) zero—in the case of a repo with a core market participant (e.g., a bank) against zero risk-weighted collateral that has no currency risk and is subject to a collateral haircut of 20 percent in the capital calculation.

Source: IMF staff.
Note: Basel Committee on Banking Supervision. Calculation of RWA for credit risk. December 2019. s31.31.

117. **Several concerns were expressed about regulatory costs.** Banks see the Basel leverage ratio (LR), liquidity coverage ratio (LCR), and net stable funding ratio (NSFR) as burdens weighing on the attractiveness of repo. However, these regulations apply to all lending and, in the case of the LCR, they favor repos using high-quality liquid assets (HQLA) such as government bonds.

118. **The specification of the reserve requirement penalizes repo and other interbank borrowings because they are included in the reservable base.** Conceptually, for the reserve requirement to be an effective monetary instrument, it should be based only on the deposits of the banking system in aggregate.[28] Where it is applied to interbank transactions, there is double counting of that portion of the deposit base, which increases the effective ratio—currently nine percent for sight deposits and 3.6 percent for term deposits below one year. More importantly, from a repo market development perspective, banks are dissuaded from such transactions because they increase the costs of borrowing when the requirement is unremunerated, as is the case in Chile.

Taxation

119. **Uncertainty about tax treatment is an obstacle.** The tax authority (SII) has abrogated the application of capital gains tax to the purchase and repurchase legs of a repo and confirmed that repo interest will be taxed like deposit interest. This clearly is positive. However, there are still gray areas where more specifics and detail on the tax treatment could be applied, such as the application of stamp duty, the burdensome nature of reporting requirements for tax refunds, and, more generally, uncertainty over the taxation of collateral pools and collateral securities trading special, as well as repo lifecycle events such as collateral substitution.

Accounting

120. **While Chile follows International Financial Reporting Standards (IFRS), there is uncertainty over its application to repo transactions.** Generally, there appears to be a dearth of expertise in the application of IFRS to repo, although there must be pockets of experience, given the use of cross-border repo. One area of uncertainty is accounting for the re-use of collateral, which requires the creation of a negative asset, and this may be difficult for local accountants to accept without authoritative assurance. Until clarification is provided, at least some banks will not countenance re-use, which precludes intermediation (i.e., running a matched repo book of repos and reverse repos). Then repo activity would be a gross balance sheet charge—one way only.

[28] MCM Technical Assistance Handbook: Reserve Requirements https://www.imf.org/en/Publications/miscellaneous-publications/Issues/2022/01/18/monetary-and-capital-markets-department-technical-assistance-handbook.

121. **Some specific accounting issues were clarified.** For example, there was uncertainty (among insurance companies) about the implications of the variation margining required under MRAs for portfolio valuation. Variation margining depends on the marking-to-market of collateral, whereas investment portfolios are valued at amortized cost. It was explained that repo does not require a change in the valuation of securities used as collateral, as they stay on the balance sheet of the repo seller, and that variation margining was a contractual obligation that was independent of accounting obligations. It was also noted that the variation margin given in repo, although owned by the holder, does not represent profit and must be returned once the underlying exposure is eliminated. This issue illustrates the general need for the clarification of accounting rules.

Infrastructure

122. **The existing infrastructure is suitable to support secure and efficient settlement of repo.** In particular, the securities settlement system, which is linked to the RTGS for wholesale payments in central bank money, offers delivery-versus-payment (DvP) for the purchase and repurchase legs of repo and free-of-payment (FoP) transfers of securities for margin and substitution. There is also a trade repository to receive regulatory transaction reporting, although currently only for derivatives.

123. **Extending post-trade services to a CCP to include repo is premature.** The BCCh's survey revealed significant support among participants for a repo CCP, although subject to doubts about the cost and commercial viability. ComDer (the derivatives central counterparty) and some banks argue that a CCP would encourage repo, by mitigating credit risk, by helping reduce the burden of the leverage ratio and NSFR through netting and, possibly, by reducing cost through cross-margining against derivatives. However, CCPs need volume to be commercially viable and for netting to be cost-effective. Central-clearing is therefore a late-stage innovation in the development of repo markets. Clearing repo is also more challenging than clearing derivatives because repos involve securities transfers and are therefore not fungible and cannot be compressed into cash (except at default). Cross-margining is rarely found between repo and derivatives.

124. **Triparty repo is also mentioned as a potentially useful post-trade infrastructure, but it too should not be a priority.** Triparty repo is typically cash driven and a dealer-to-customer business and, because of overheads, requires scale to be viable. This scale does not yet exist in Chile. Moreover, there is often an assumption that triparty agents can solve the problem of valuation in an illiquid market. In fact, like everyone else, they rely on prices from markets to function.

125. **Assessments of alternate trading infrastructures should identify the costs and benefits in the context of the market's medium-term potential.** Regulators would like to move away from a purely OTC market, with market participants keen for increased transparency and ways to contain the overhead costs of trading. Therefore, new market infrastructures are being considered that automate both trading and post-trade processes. Pension funds may also be required by regulation, when trading repo, to transact on an organized market. Many market participants seem to believe that the automation of trading creates liquidity. While it is true that an efficient marketplace can catalyze new liquidity, there needs to be a certain level of liquidity as a starting point. The most sophisticated repo trading technology takes the form of automatic trading systems (ATS) that operate central limit order books (CLOB). They are only suited to high-volume interdealer repo markets in low-margin low-risk repos, which are the type of repo that benefits most from balance sheet netting. The next level of automation is request-for-quote (RFQ) platforms. These are dealer-to-customer platforms that tend only to be economic for large

nonbank financial customers because of the overhead costs of the technology. Both technologies would be premature in Chile at this early stage of market development.

C. Recommendations

Fundamental Drivers

126. The authorities should seek to identify and address the issues constraining the two fundamental drivers of repo market activity, and it therefore recommended that they:

- **Promote an active domestic market in fixed-income securities.** The DMO's proposal to introduce official market-makers in government bonds may help. The design of such an arrangement, however, needs to carefully balance the incentives provided against obligations (i.e., liquidity provision). More generally, there needs to be investigation into the significant mispricing of securities and the barriers to participants—foreign and domestic—arbitraging out this mispricing, which if achieved, would lead to more efficient financial markets (i.e., better resource allocation).

- **Support an active wholesale market in short-term cash by draining structural excess liquidity.** Conditions will be more conducive for short-term money market activity by the end of 2024 as the crisis-related invention programs are wound back, removing the large structural excess liquidity. The BCCh should, however, closely monitor the distribution of excess reserves and bilateral activity in unsecured and secured interbank markets to assess whether there is segmentation, recognizing that market inefficiencies reduce resilience and may undermine the transmission of monetary policy.

Enabling Conditions

Diversified Financial Sector

127. The authorities should assess the barriers to broader participation in the repo market. Restrictions on NBFIs dealing in the repo market should be removed as soon as possible, subject to the time needed to draft appropriate regulations to safeguard end-users and to adopt a standard domestic legal agreement. If access is open, banks may start to market repo and customers may take the initiative and investigate. But the big question is, why are there no hedge fund-type arbitrageurs exploiting the mispricing of securities and derivatives? Are there hidden barriers to entry for such unregulated entities?

Legal Framework

128. The BCCh should publish a version of the GMRA as the standard for use in Chile. This ideally should be done by the time the FMRA regulation implementing the right to close-out netting is promulgated. The right to close-out netting is restricted to recognized MRAs, and it is recommended that the GMRA be used for this purpose, although this is an English law contract designed for cross-border repo (although several domestic markets have adopted the English law version). Use in the domestic market will probably require a change in the governing law from that of England to that of Chile. Other changes will also be required to fit into the Chilean legal framework and market structure; for example, it may be necessary to add Acts of Insolvency to ensure the list in the GMRA is complete. A choice may also have to be made between the use of

the repurchase transaction and the buy-/sellback (this will depend on the ability to make manufactured payments without incurring legal or tax problems).[29]

129. **Amendments to the standard GMRA should be attached as an annex.** Amendments to the text of the standard agreement should be avoided. The BCCh should consult legal counsel about the necessary changes, which could involve the firm that has been commissioned by ICMA to produce the legal opinion on the enforceability in Chile of the standard GMRA in cross-border transactions. It is also important that the BCCh consult with the market to ensure that the draft annex is acceptable. Many banks will have in-house legal experts familiar with the GMRA from its use in cross-border trades. For banks without such expertise and for customers, the BCCh should consider capacity-building measures such as presentations by legal staff from experienced banks and the provision of background information explaining the purpose and mechanics of the GMRA. Given some of the uncertainty expressed in the BCCh's survey, background information for wider circulation might include clarifying statements about title transfer, the right to re-use collateral, and rights in default.

130. **The stay of enforcement when a systemically important bank being taken into the recovery and resolution process should be as short as possible.** The CMF should clarify its view on the duration of the stay of enforcement under the bank recovery and resolution rules, at least with respect to repos. This period should be short, with two days being typical.

Regulation

131. **The CMF should redraft its regulations to clarify the treatment of repo transactions:**

- **Counterparty risk weights.** The conditions applying under the Basel Simple Approach to lower counterparty risk weights in the calculation of regulatory capital requirements for repo should be clarified and communicated to the market, including with worked examples. It would also be helpful to state whether the securities settlement system operated by the CSD (Deposito Central de Valores), has the status of a proven repo settlement system for the purpose of the regulatory capital calculation.

- **Loan loss provisioning.** It has been suggested in the analysis that there has been a transposition of the method of calculating regulatory limits on large exposures to loan loss provisioning. This needs to be confirmed and, if correct, rectified.

132. **The authorities should explicitly clarify that collateral securities can be reused by repo buyers, including to sell short.** The right to sell short is the essential indicator of a transfer of title to collateral securities. In some repo markets where title transfer takes place, there are often regulatory or informal policy prohibitions that invalidate title transfer. It is important for the authorities to be clear to the market that this exercise of property rights is allowed. However, short-selling may require additional reporting, and some institutions (e.g., money market funds) may be subject to short position limits for prudential reasons.

133. **It is essential that the reduced cost of capital is attributed down to the trading desk level.** Relief from regulatory capital requirements has typically been a major driver of migrations from unsecured money market transactions into repo. However, if reduced capital costs are not

[29] Manufactured payments are made by the buyer to the seller when income is paid on the collateral held by the buyer. Economically but not legally, they are a pass-through of the income on the collateral. They are intended to compensate the seller for retaining the risk on the collateral. If there are difficulties with these payments, parties can adopt the buy-/sellback structure. Under the GMRA, this will require the application of the Buy-/Sellback Annex.

attributed down to trading desks, the capital incentive to trade repo will not be realized. The CMF should therefore require and monitor trading profit and loss attribution in banks.

134. **All interbank transactions should be exempted from the reserve requirement's reservable base.** All unsecured and secured (i.e., repo) transactions should be exempted because, as noted earlier, including them results in double counting of that portion of the deposit base while significantly distorting the costs of activity in the money markets.

Taxation

135. **The authorities should conduct an audit of the tax treatment of a repo across its lifecycle.** Tax obstacles have derailed attempts to establish active repo markets in many countries. The challenge is that there are multiple possible events in the life of a repo that could attract tax. The tax authorities, sometimes not being familiar with repo and its legitimate functions, may be suspicious of the potential use of repo (and securities lending) to evade tax by changing ownership over coupon payment dates. The BCCh and the CMF should therefore open a dialogue with the tax authorities, to inform regarding the functioning of repo operations and agree on solutions where taxation could obstruct the use of repo. The aim should be a neutral taxation framework that treats repo on the basis of its economic substance, not its legal structure, thereby requiring a focus on cashflows and not collateral.

Accounting

136. **Uncertainty around the accounting treatment of repo must be addressed.** Banks will not use an instrument for which they cannot account, and there seems to be a lack of experience in Chile with the application of IFRS rules to repo transactions. The BCCh and the CMF should engage an authoritative source to facilitate guidance to the market, on both general principles and day-to-day accounting treatment. Such guidance should address the specifics raised in BCCh discussions with market participants and in its repo survey. Those banks already actively using repos could be engaged to help educate the rest of the market on this issue.

Infrastructure

137. **Post-trade infrastructures such as CCPs and triparty agents are premature at this stage.** The authorities should adopt a neutral attitude and allow infrastructure providers to make commercial decisions. In due course, a repo-CCP may become an economic proposition.

138. **The BCCh could facilitate the market's collective choice of trading infrastructure by bringing in possible providers and moderating discussions with participants.** An appropriate approach would be the sort of low-cost dedicated electronic messaging system (i.e., chat line) offered by some information vendors. These can be used to provide some transparency (using quotes posted by market participants) as well as to automate the confirmation of trades and reporting to the regulator and to provide the first stage in straight-through processing (STP) through to settlement. A discussion is required with the market about how transparency can be provided (basically, whether the posting quotes would be voluntary or subject to some degree of obligation and whether access would be restricted to the interbank/interdealer market or include wholesale customers). Platform technology could be supplemented by voice brokers, who are traditional interdealer intermediaries in repo markets and are already active in other products in Chile. A comprehensive cost/benefit analysis should be undertaken to avoid overinvestment and the distraction of overambitious trading technology.

139. **A policy on failed deliveries should be developed to incentivize efficient settlement.** While not crucial at this point, such a policy will be important as activity in the securities markets increases—for both outright trades and in repo. The BCCh should consider cash penalties calibrated to incentivize efficient settlement practices while not disincentivizing market-making.

Repo Market Development Strategy

140. **A more organized and targeted approach to repo market development is essential:**

- **The BCCh should take the lead in addressing issues with the other authorities.** Although repo market development cuts across many institutions, the BCCh should take the lead because of the relevance for its price and financial stability mandates. To improve ownership and demonstrate seriousness, a senior official (a champion) could be tasked with leading an initiative bringing together the relevant authorities (BCCh, MoF, CMF, SP, and SII). This initiative should have a clear strategic objective, milestones, and a division of responsibilities among the various authorities. A starting point could be a detailed scope covering all relevant issues included in this report—legal, regulatory, tax, accounting, and infrastructure.

- **The BCCh should establish reporting requirements for repo transactions across the whole money market.** Currently, a small amount of data is available. Granular reporting covering turnover, outstanding, and transaction-level data is needed for both developmental and financial stability reasons. Reporting should be automated where possible, with care taken not to unduly impose costs in the early stages of development. Initial reporting should therefore be limited to essential data and be low frequency (at least monthly but perhaps starting weekly). When reporting can be automated, submissions of an expanded array of data can be made directly to the trade repository.

- **A forum of market participants should also be formed.** An association or permanent working group of repo dealers should be formed to exchange information on market developments; identify issues creating friction or generating disputes; formulate consensus solutions; develop conventions and best practices to facilitate safe, orderly, and efficient trading; and represent the market in discussions with the authorities. The BCCh should encourage market participants in this direction, but ultimately, it is up to the market. One option also is to have the BCCh participate in such forums as an observer. This is not essential, but it is important to have a good communication channel between this forum and the BCCh.

Appendix I. BCCh Programs and Asset Eligibility

Instrument	Historically Accepted Instruments in Normal Times	Instruments Accepted during and after the 2008 Crisis	Accepted Instruments (including FCIC)
CBC Securities	✓	✓	✓(+ Liquidity Deposit)
TGR Securities	✓ (pledge)	✓ (pledge)	✓ (pledge)
Banks debt instruments: Mortgage Notes Mortgages Deposits Bank Bonds	✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
Corporate Bonds			✓
Credits			✓

Appendix II. Collateral Acceptance Ordering

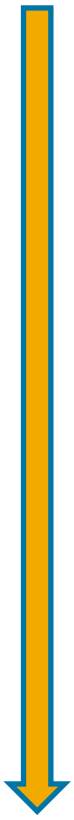
A granular classification of assets along desirable characteristics informs an acceptance order for all collateral, although only relevant for ELA, because monetary operations counterparties have the right to choose from any eligible collateral. Asset classes are rated (1 (most desired) to 5 (least desired) along nine characteristics; and standalone rating aggregated provides an overall rating (last row). While rating with respect to qualitative characteristics (e.g., legal certainty, confidentiality of mobilization) would require expert judgment, rating along quantitative properties like volume, liquidity, or volatility could be more data based. Once the collateral classification exercise is complete, the whole collateral framework can be depicted (Figure A2).

Figure A1. Collateral Classification

	Low Credit Risk/Volatility	Liquidity	Observable Market Price	Legal Certainty and Transferability	Low Operational Costs	Abundance in the Banking System	Volume	Discretion and Confidentiality	Low Correlation with Bank Default	Total
BCCh bonds	1	1	1		1	2	3	1	1	11
Govt. bonds	2	1	1		1	2	2	1	1	11
Certs. of Deposit	1	1	2		2	3	3	2	5	19
Secured bonds	2	2	3		2	4	3	2	3	21
Corporate bonds	2	2	3		2	4	3	2	3	21
Bank bonds	3	2	2		2	3	3	2	5	22
Foreign Public Bonds	2	3	2		1	3	4	1	1	17
Corp. Fin. Instruments	2	3	3		2	5	5	2	2	24
Corp. Loans	2	4	5		4	2	2	4	3	26
Foreign Corp. Fin. Instr.	2	3	4		2	5	5	2	2	25
Mortgage (notes)	3	3	3		3	3	2	3	3	23
FX Deposits	3	2	2		2	3	4	1	3	18
Derivatives	5	2	2		2	3	4	1	3	22
Bank loans	2	2	4		3	5	4	4	4	28
Household loans	2	5	5		5	1	1	3	3	25
Fixed assets	2	5	4		5	5	5	5	3	34
Sec. For. Cent. Bank	2	1	2		2	5	4	1	1	18
Bank Fin. Instr.	2	2	3		2	4	4	2	3	22
For. Bank Fin. Instr.	2	3	4		2	4	5	3	3	26

Figure A2. Collateral Eligibility and Preference

Collateral	Score	Operations
BCCh bonds	11	
Govt. bonds	11	Monetary instruments
Foreign Public bonds	17	(No preference order and transparency)
Sec. For. Cent. Bank	18	
FX Deposits	18	
Certs. of Deposit	19	
Secured Bonds	21	
Corporate Bonds	21	
Bank Bonds	22	
Derivatives	22	Financial stability instruments
Bank Fin. Instr.	22	(With preference order and discretion)
Mortgage (Notes)	23	
Corp. Fin. Instruments	24	
Foreign Corp. Fin. Instr.	25	
Household Loans	25	
Corp. Loans	26	
For. Bank Fin. Instr.	26	
Bank Loans	28	
Fixed Assets	34	



Appendix III. Market-Based Valuation

The market-based price of a security can be inferred from market quotes as a composite price by means of the following four-step algorithm.

Step 1: Quote cleansing

Quote cleansing consists of filtering quotes for outliers. Potential criteria are:

Bid and/or ask price are missing.
Bid price is unreasonably large (e.g., threshold 120).

- Bid price is bigger than ask price.

The spread between bid and ask price is bigger than a given threshold (e.g., 20 percent).
Quote staleness (the PD submits the same quotations for a certain number of days).

Remaining (valid) quotes are considered in Step 2.

Step 2: Discriminating between good and bad quotes

Good quotes satisfy the deviation condition:

$$|q_i - OIM_i(ISIN)| < Threshold$$

- With the observation-independent median (OIM) of quote q_i, that is the median of all quotes excluding the quote q_i.

- $Threshold$ is set according to the central bank risk tolerance.

Alternatively, the dispersion of the valid quote could help find good quotes. The dispersion method begins with computing the proximity measure by normalizing the quote deviation with the median:

$$PROX_i = \frac{|q_i - OIM_i(ISIN)|}{MAD(ISIN)},\ MAD(ISIN) = \underset{all\ q_i\ of\ this\ ISIN}{\text{median}} |q_i - OIM_i(ISIN)|$$

Since 50 percent of quotes have a proximity measure larger than one (median of the quote distribution), a quantile-based approach can be used to find good quotes.

Step 3: Price aggregation

The security price could be obtained by calculating the median of the good quotes.

Step 4: Dealer reliability

The BCCh might assess the quality of a dealer internally. One approach is to systematically compare the PD's quotes with actual trades whenever they occur. Further, the quality of the dealer could be computed as the share of good quotes (based on Step 3) submitted by the dealer.

Appendix IV. Theoretical Valuation

Yield Curve Calibration

Calibrating a yield curve consists in disciplining parameters of an analytical model by means of observed bond market prices $P^M(B_i) \dots P^M(B_n)$[6] and their theoretical values $P_{B1} \dots P_{Bn}$. The idea reposes on the price of a hypothetical zero-coupon used for payments discounting. Recall, if $z_{Bond}(t)$ is zero rate at term t, C the coupon rate and $t_1, \dots, t_N$ the coupon dates, the bond theoretical price is given by,

$P_B = \sum_{i=1}^{N} P_{\text{risky}}(0, t_i)C + P_{\text{risky}}(0, t_n)$ where $P_{\text{risky}}(0, t) = e^{-t * z_{Bond}(t)}$

Let now $P(B; z)$ denote a function which returns the theoretical price of bond B given a yield curve z, the vector of theoretical prices ($\vec{t}$) is given by:

$$\vec{t} = \begin{pmatrix} P(B_1; z) \\ \vdots \\ P(B_n; z) \end{pmatrix}.$$

Let $\vec{m}$ denote the vector of the bonds' market prices, with

$$\vec{m} = \begin{pmatrix} P^M(B_1) \\ \vdots \\ P^M(B_n) \end{pmatrix},$$

Then the vector of absolute[4] pricing errors ($\overrightarrow{\epsilon_A}$) is defined by

$$\overrightarrow{\epsilon_A} = \vec{t} - \vec{m}.$$

Following these notations, the vector of relative pricing errors ($\overrightarrow{\epsilon_R}$) can be written as

$$\overrightarrow{\epsilon_R} = \begin{pmatrix} (P(B_1; z) - P^M(B_1))/P^M(B_1) \\ \vdots \\ (P(B_n; z) - P^M(B_n))/P^M(B_n) \end{pmatrix}.$$

If $\overrightarrow{\epsilon_{Sq}}$ is the vector of squared relative pricing errors, that is:

$$\overrightarrow{\epsilon_{Sq}} = \begin{pmatrix} \epsilon_{R,1}^2 \\ \vdots \\ \epsilon_{R,n}^2 \end{pmatrix}.$$

Calibrating the yield curve consists of minimizing,

[6] That is (composite) market-based prices determined as in Appendix IV

[4] Here, "absolute" is the actual value of the difference and not the "absolute value of the difference."

the cost function F measuring the squares of sum of squared relative pricing errors:

$$F(z) = \left\| \overrightarrow{\epsilon_{Sq}}^{T} \right\|,$$

Where T is the transposition operator. That is finding $\hat{z}$ so that $\hat{z} = \arg\min_{z} F(z)$.

Yield curve models

Among Nelson-Siegel models discussed in the main text are:

(1) The original Nelson-Siegel (NS) yield curve parametrical function

$$\boldsymbol{NS(\tau; \beta_0, \beta_1, \beta_2, \lambda_0) = \beta_0 + \beta_1 \cdot \frac{1 - e\left(-\tau/\lambda_0\right)}{\tau/\lambda_0} + \beta_2 \cdot \left(\frac{1 - e\left(-\tau/\lambda_0\right)}{\tau/\lambda_0} - e\left(-\tau/\lambda_0\right) \right)},$$

Where τ is a given time interval and $(\beta_0, \beta_1, \beta_2, \lambda_0)$ are given parameters.

(2) The function's monotone form obtained by applying the constraint:

$$\beta_2 = -\beta_1 ,$$

Such that:

$$NS(\tau; \beta_0, \beta_1, -\beta_1, \lambda_0) = NS_{monotone}(\tau; \beta_0, \beta_1, \lambda_0) = \beta_0 + \beta_1 \cdot e\left(-\tau/\lambda_0\right).$$

(3) The six-parameter Nelson-Siegel-Svensson model:

$$\boldsymbol{NS(\tau; \beta_0, \beta_1, \beta_2, \beta_3, \lambda_0, \lambda_1) = \beta_0 + \beta_1 \cdot \frac{1 - e\left(-\tau/\lambda_0\right)}{\tau/\lambda_0} + \beta_2 \cdot \left(\frac{1 - e\left(-\tau/\lambda_0\right)}{\tau/\lambda_0} - e\left(-\tau/\lambda_0\right) \right) + \beta_3 \cdot \left(\frac{1 - e\left(-\tau/\lambda_1\right)}{\tau/\lambda_1} - e\left(-\tau/\lambda_1\right) \right)}$$

Pricing Illiquid Securities

Parameters of the NS (Table A1) match the slope, level, and curvature of the term structure curve. They can be used to move parts of the curve up and downward to generate other curves that can be used to value securities from issuers with particularly illiquid or with unpopulated maturity buckets.

Table A1. Interpretation of the Nelson-Siegel Parameters

Parameter	Interpretation
$\boldsymbol{\beta_0}$	The parameter is independent of time to maturity, and so it is often interpreted as the long-run yield level.
$\boldsymbol{\beta_1}$	The parameter is weighted by a function of time to maturity. This function is unity for $\lambda = 0$ and exponentially decays to zero as λ grows. Hence, the influence of this parameter is only felt at the short end of the curve.
$\boldsymbol{\beta_2}$	The parameter is weighted by a function of λ, but this function is zero for $\lambda = 0$. As λ grows, it first increases and then decreases back to zero. It thus adds a hump to the curve.
$\boldsymbol{\lambda}$	The parameter affects the weight functions for β_1 and β_2; in particular, it determines the position of the hump.

Appendix V. Haircut—Marketable Securities

Introduction and definition

A time t the price of a zero-coupon bond with τ-year maturity and yield $y_{t,\tau}$ is given by:

$$B_t = \exp(-y_{t,\tau}\tau)$$

and the central bank (Lender)'s exposure to a counterparty given a haircut h is:

$$E_t = (1-h)B_t$$

The loss function at the time $t + \Delta t$ when the collateral is liquidated, assuming a liquidation discount are of g is given by:

$$L_{t+\Delta t} = \max(E_t - B_{t+\Delta t}(1-g),0) = E_t \max(1 - \frac{B_{t+\Delta t}}{B_t} \cdot \frac{1-g}{1-h}, 0)$$

In addition, the loss per unit of exposure is:

$$L = 1 - \frac{1-g}{1-h}\frac{B_{t+\Delta t}}{B_t} = 1 - \frac{1-g}{1-h} exp\big(-\big(y_{t+\Delta t,\tau} - y_{t,\tau}\big)\tau\big)$$

A stylized haircut model for government bonds

If, for simplification, we assume the government yields follow a random walk (RW):

$$y_{\tau,t+\Delta t} = y_{\tau,t} + \sigma_{y,\tau}\epsilon_{\tau,t}$$

If $\bar{L}$ is the assumed threshold loss, then the haircut rate can be determined by means of the VaR:

$$h = \inf(h: \Pr(L_{t+\Delta t} > \bar{L}) = 1 - \alpha)$$

$$\text{where } L_{t+\Delta t} = 1 - \frac{1-g}{1-h}\exp\big(-\sigma_{y,\tau}\tau \cdot \epsilon_{\tau,t}\big)$$

Solving for haircut rate leads to: $h^* = 1 - (1-g)\exp\big(-\sigma_{y,\tau}\tau \cdot \Phi^{-1}(1-\alpha)\big)$,

with Φ^{-1} is inverse cumulative distribution function of $\epsilon_{\tau,t}$ and α the central bank risk appetite. The cumulative density Φ could be estimated by means of volatility models such as X-EGARCH.

Appendix VI. Haircut—Nonmarketable Securities[1]

The calibration of haircuts for nonmarketable assets is based on the dynamic version of the Asymptotic Single Risk Factor (ASRF) model for loan portfolio. The model was adopted in the Internal Rating Based (IRB) approach in Basel regulation. A dynamic version of the original ASRF allows the central bank to protect itself more conservatively by considering events at the bottom of the cycle.

The credit quality of i –th firm X_i is driven by two factors: macro M_t and idiosyncratic factors ϵ_t

$$X_{i,t} = \sqrt{\rho_i} M_t + \sqrt{1-\rho_i}\epsilon_T$$

With M_T and ϵ_T standard normal distributed

Default occurs at time T when $X_{i,T}$ is below the default level D_i ($X_{i,T} < D_i$), that is (Figure XX),

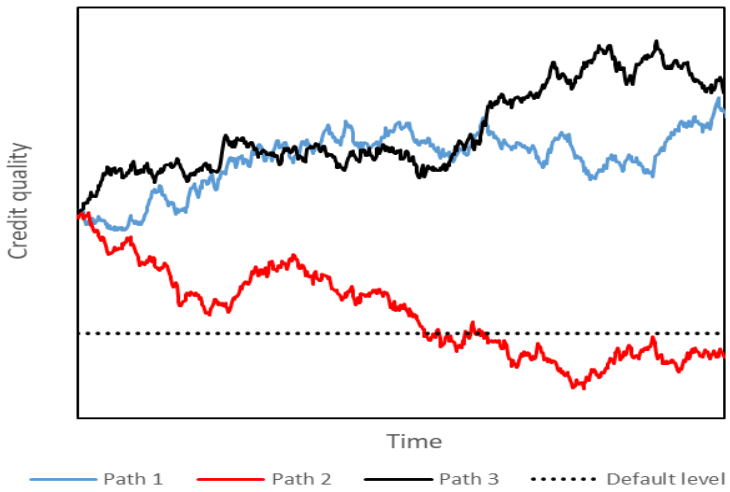
$$PD_\alpha = P\left(X_{i,T} < D_i\right) = 1 - \alpha$$

The haircut for the i-th firm would then be:

$$h_{i,\alpha} = LGD_i \cdot PD_{i,\alpha}$$

Where LGD_i is the firm's loss given default.

Figure 1. Credit Quality



[1] See also Tarashev and Zhu, 2008, Specification and Calibration Errors in Measures of Portfolio Credit Risk: The Case of the ASRF Model (ijcb.org), and Somnath Chatterjee, 2015, Modelling credit risk (bankofengland.co.uk).

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