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The Statistical Appendix may be accessed from:


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Definitions and Conventions

As used in this report, the term “country” does not in all cases refer to a territorial entity that is a state as understood by international law and practice. As used here, the term also covers some territorial entities that are not states but for which statistical data are maintained on a separate and independent basis.

In this report, the following groupings are used:

- “ASEAN-5” comprises Indonesia, Malaysia, Philippines, Singapore and Thailand.
- “AE” refers to advanced economies comprising Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.
- “EM Asia” comprises Asian economies such as China, Hong Kong, India, Indonesia, Malaysia, Singapore, South Korea and Thailand.
- “EM” refers to emerging economies comprising EM Asia economies as well as Argentina, Brazil, Chile, Columbia, Czech Republic, Hungary, Mexico, Poland, Russia, Saudi Arabia, South Africa and Türkiye.
- “Eurozone” comprises Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain.
- “G3” comprises the Eurozone, Japan, and the United States.

Abbreviations used for financial data are as follows:

- Currencies: Australian Dollar (AUD), British Pound (GBP), Chinese Yuan (CNY), Euro (EUR), Hong Kong Dollar (HKD), Indian Rupee (INR), Japanese Yen (JPY), Korean Won (KRW), Malaysian Ringgit (MYR), New Taiwan Dollar (TWD), New Zealand Dollar (NZD), Singapore Dollar (SGD), Thai Baht (THB), US Dollar (USD).

Other abbreviations:

<table>
<thead>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AE</td>
<td>Advanced Economy</td>
</tr>
<tr>
<td>AUM</td>
<td>Assets under Management</td>
</tr>
<tr>
<td>BCBS</td>
<td>Basel Committee on Banking Supervision</td>
</tr>
<tr>
<td>BIS</td>
<td>Bank for International Settlements</td>
</tr>
<tr>
<td>BoE</td>
<td>Bank of England</td>
</tr>
<tr>
<td>CAR</td>
<td>Capital Adequacy Ratio</td>
</tr>
<tr>
<td>CBS</td>
<td>Credit Bureau Singapore</td>
</tr>
<tr>
<td>CCB</td>
<td>Capital Conservation Buffer</td>
</tr>
<tr>
<td>CCyB</td>
<td>Countercyclical Capital Buffer</td>
</tr>
<tr>
<td>CCP</td>
<td>Central Counterparty</td>
</tr>
<tr>
<td>CCR</td>
<td>Core Central Region</td>
</tr>
<tr>
<td>CDS</td>
<td>Credit Default Swap</td>
</tr>
<tr>
<td>CET1</td>
<td>Common Equity Tier 1</td>
</tr>
<tr>
<td>CIS</td>
<td>Collective Investment Scheme</td>
</tr>
<tr>
<td>COVID-19</td>
<td>Coronavirus Disease 2019</td>
</tr>
<tr>
<td>CPF</td>
<td>Central Provident Fund</td>
</tr>
</tbody>
</table>
CPRS  Climate Policy Relevant Sectors
CO  Commodity
CR  Credit
DDRS  Depository Trust & Clearing Corporation Data Repository (Singapore) Pte Ltd
DOS  Singapore Department of Statistics
D-SIB  Domestic Systemically Important Bank
D-SII  Domestic Systemically Important Insurer
EBITDA  Earnings Before Interest, Tax, Depreciation and Amortisation
ECB  European Central Bank
ECL  Expected Credit Losses
EDB  Economic Development Board
EFS-eWCL  Enhanced Enterprise Financing Scheme—SME Working Capital Loan
EM  Emerging Markets
EME  Emerging Market Economy
EPG  Economic Policy Group
EQ  Equity
ES  Expected Shortfall
ESG  Enterprise Singapore
ESMA  European Securities and Markets Authority
FCI  Financial Conditions Index
FI  Financial Institution
FMC  Fund Management Company
FSAP  Financial Sector Assessment Program
FSB  Financial Stability Board
FSR  Financial Stability Review
FVI  Financial Vulnerability Index
FX  Foreign Exchange
FY  Fiscal Year
GDP  Gross Domestic Product
GLS  Government Land Sales
GHG  Greenhouse Gas
HDB  Housing Development Board
HHI  Herfindahl-Hirschman Index
HQLA  High-quality Liquid Assets
HTM  Held-to-Maturity
HY  High-yield
ICR  Interest Coverage Ratio
IG  Investment Grade
IMF  International Monetary Fund
IOSCO  International Organization of Securities Commissions
IPCC  Intergovernmental Panel on Climate Change
IR  Interest Rate
IWST  Industry-Wide Stress Test
LCR  Liquidity Coverage Ratio
LGD  Loss Given Default
LMT  Liquidity Management Tool
<table>
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<th>Abbreviation</th>
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<tr>
<td>LTD</td>
<td>Loan-to-deposit Ratio</td>
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<tr>
<td>LTV</td>
<td>Loan-to-value Ratio</td>
</tr>
<tr>
<td>MAS</td>
<td>Monetary Authority of Singapore</td>
</tr>
<tr>
<td>m-o-m</td>
<td>Month-on-month</td>
</tr>
<tr>
<td>MSD</td>
<td>Macroprudential Surveillance Department</td>
</tr>
<tr>
<td>MTM</td>
<td>Marked to Market</td>
</tr>
<tr>
<td>NAV</td>
<td>Net Asset Value</td>
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<tr>
<td>NBFI</td>
<td>Non-bank Financial Institution</td>
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<tr>
<td>NFC</td>
<td>Non-financial Corporate</td>
</tr>
<tr>
<td>NGFS</td>
<td>Network for Greening the Financial System</td>
</tr>
<tr>
<td>NIM</td>
<td>Net Interest Margin</td>
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<td>Non-performing Assets</td>
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<tr>
<td>NPL</td>
<td>Non-performing Loan</td>
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<tr>
<td>NSFR</td>
<td>Net Stable Funding Ratio</td>
</tr>
<tr>
<td>NUS-CRI</td>
<td>National University of Singapore Credit Research Initiative</td>
</tr>
<tr>
<td>O&amp;G</td>
<td>Oil &amp; Gas</td>
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<tr>
<td>OA</td>
<td>Ordinary Account</td>
</tr>
<tr>
<td>OCR</td>
<td>Outside of Central Region</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OIF</td>
<td>Offshore Insurance Fund</td>
</tr>
<tr>
<td>OTC</td>
<td>Over-the-counter</td>
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<tr>
<td>PD</td>
<td>Probability of Default</td>
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<tr>
<td>PDI</td>
<td>Personal Disposable Income</td>
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<tr>
<td>PSTASSA</td>
<td>Professional, Scientific, Technical, Administrative, Support Service Activities</td>
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<tr>
<td>q-o-q</td>
<td>Quarter-on-quarter</td>
</tr>
<tr>
<td>RBC 2</td>
<td>Revised Risk Based Capital Framework</td>
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<tr>
<td>RCR</td>
<td>Rest of Central Region</td>
</tr>
<tr>
<td>RHS</td>
<td>Right Hand Side</td>
</tr>
<tr>
<td>ROA</td>
<td>Return on Assets</td>
</tr>
<tr>
<td>RWA</td>
<td>Risk-weighted Assets</td>
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<tr>
<td>SFT</td>
<td>Securities Financing Transaction</td>
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<td>SGS</td>
<td>Singapore Government Securities</td>
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<td>SGX</td>
<td>Singapore Exchange</td>
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<tr>
<td>SIF</td>
<td>Singapore Insurance Fund</td>
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<tr>
<td>SME</td>
<td>Small and Medium-sized Enterprise</td>
</tr>
<tr>
<td>SORA</td>
<td>Singapore Overnight Rate Average</td>
</tr>
<tr>
<td>S-REIT</td>
<td>Singapore-listed Real Estate Investment Trust</td>
</tr>
<tr>
<td>STI</td>
<td>Straits Times Index</td>
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<tr>
<td>TBLP</td>
<td>Temporary Bridging Loan Programme</td>
</tr>
<tr>
<td>TDSR</td>
<td>Total Debt Servicing Ratio</td>
</tr>
<tr>
<td>TNA</td>
<td>Total Net Assets</td>
</tr>
<tr>
<td>URA</td>
<td>Urban Redevelopment Authority</td>
</tr>
<tr>
<td>y-o-y</td>
<td>Year-on-year</td>
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Preface

The Monetary Authority of Singapore (MAS) conducts regular assessments of Singapore’s financial system to identify potential vulnerabilities and review its resilience to potential shocks and risks. The analyses and results are published in the annual Financial Stability Review (FSR), which aims to contribute to a better understanding of issues affecting Singapore’s financial system among market participants, analysts and the public.

Section 1 of the FSR provides a discussion of the risks in the external environment. This is followed by an analysis of the Singapore corporate and household sectors in Sections 2 and 3 respectively. A review of the financial sector is then provided in Section 4. The final section features specific topics on financial stability.

The production of the FSR is coordinated and prepared by the Macroprudential Surveillance Department (MSD) of the Economic Policy Group (EPG) that comprises Ang Wei Han, Cheryl Ho, Khoo Ye-Min, Koh Zhi Xing, Sherwin Lau, Eugene Lee, Wendy Lee, Leou Jie Dong, Aloysius Lim, Kalena Lim, Janice Loh, Low Yen Ling, Lye Royii, Ng Ding Xuan, Ng Heng Tiong, Desmond Ong, Alex Phua, Edward Robinson, Celine Sia, Glenda Soh, Tan Shu Yan, Tan Siang Meng, Tan Wei Ting, Teoh Shi-Ying, Tu Chang, Christopher Walker and Davis Yep. Special Feature 1 was prepared in collaboration with Professor Stefano Battiston (University of Zurich and University of Venice), Professor Irene Monasterolo (Utrecht University) and Professor Antoine Mandel (Paris School of Economics). We are also grateful to Professor Sumit Agarwal (National University of Singapore Business School), who collaborated with EPG on Special Feature 3.

The FSR also includes contributions from other MAS departments including Anti-Money Laundering Department, Banking Departments I, II & III, Corporate Finance & Disclosures Department, Economic Analysis Department, Economic Surveillance & Forecasting Department, Enterprise Knowledge Department, Insurance Department, Investment Intermediaries Department, Markets, Infrastructures & Intermediaries Department, Prudential Policy Department and Technology & Cyber Risk Supervision Department.

The FSR may be accessed in PDF format on the MAS website:

Overview

The global financial system faces increased risks from the interaction of higher-for-longer rates and latent vulnerabilities

The global economy has shown resilience to the cumulative effects of monetary tightening thus far. However, growth could moderate in the coming year as major central banks maintain sufficiently restrictive monetary policy stances to achieve their inflation targets. The sharp increase in both short- and long-term interest rates over the past year has induced a tightening of financial conditions and a repricing of financial assets.

While these developments are symptomatic of monetary tightening, interactions with the financial vulnerabilities and market fragilities built up during the COVID-19 pandemic could amplify the effects of interest rate increases and disrupt the functioning of the financial system. The March 2023 US bank failures exposed weaknesses in some banks’ management of duration and liquidity risks in a rising rate environment. Globally, property prices, particularly in the commercial real estate sector, corrected against higher interest rates and declining end demand. Highly leveraged businesses and households could come under pressure as they refinance their debt at higher interest rates, amid weaker earnings and softer labour market conditions.

Emerging market economies (EMEs) could also face deepening public debt sustainability concerns with several debt defaults over the past year. More broadly, EMEs could be susceptible to increases in risk aversion and capital outflows. The functioning of international core funding markets could also be impaired amid heightened market volatility, generating liquidity distress for market participants, especially non-bank financial institutions (NBFIs).

The current macrofinancial backdrop is made even more precarious with the overlay of other risk drivers such as geopolitical tensions and climate change, which have the potential to rapidly materialise into significant financial stability risks. In particular, an escalation of the Israel-Hamas conflict or Russia’s ongoing war with Ukraine would pose further downside risks to the conjuncture. Within the region, a more pronounced slowdown in China from its property sector difficulties could weigh further on the global economy. Singapore’s financial institutions (FIs) are cognisant of the above risks, from the findings of the half-yearly Systemic Risk Survey that MAS introduced this year.
Corporates, households and the financial sector in Singapore have remained generally resilient amid a challenging environment

Corporates, households and banks in Singapore have remained resilient. Overall bank credit quality is strong as most corporates and households have weathered the pass-through of interest rate increases well thus far, with no significant uptick in loan delinquency.

- The financial positions of corporates in Singapore have been resilient despite the challenging macroeconomic environment. Firms’ leverage risk has remained stable reflecting interest rate hedging practices and active deleveraging. Continued liquidity resilience from the build-up of precautionary buffers during the pandemic and well termed-out debt maturity profiles have helped to alleviate refinancing risk.

- Household financial vulnerabilities have risen slightly over the past year, but the overall vulnerability level remains low based on historical standards. Maturity risk has edged up as credit card balances expanded towards pre-COVID levels. However, leverage risk has declined, as households reduced debt in response to elevated interest rates. Continued wage growth has cushioned the impact of higher mortgage rates.

- Singapore’s financial sector has maintained its strong balance sheet position through multiple shocks over the past year. The banking sector has strong capital and liquidity positions. Similarly, the non-bank sector has weathered the stresses from high market volatility; insurers remain well-capitalised and investment funds have been able to meet redemptions.

The economy’s overall resident credit-to-GDP ratio declined from 153% in Q3 2022 to 147% in Q3 2023, driven by nominal GDP growth and a decline in resident credit volumes. Accordingly, the resident credit-to-GDP gap remained negative in Q3 2023. MAS will maintain the Countercyclical Capital Buffer (CCyB) at 0% for 2024.

Singapore’s corporate, household, and financial sectors have adequate buffers against shocks but should be vigilant to macroeconomic uncertainty

MAS’ stress tests show that the corporate and household sectors have adequate buffers to manage shocks to incomes and financing costs. Most firms are expected to remain resilient given the current strength of their balance sheets, while prevailing buffers and macroprudential measures to discourage overleveraging have built up households’ resilience against shocks. However, a small proportion of highly leveraged corporates and households that are vulnerable to balance sheet and income shocks may face challenges in servicing their debt, and should remain vigilant to downside risks.

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1 For more details on the CCyB and its inclusion in MAS’ macroprudential policy framework, refer to Box H of the 2015 Financial Stability Review.
The results of the Industry-Wide Stress Test (IWST) 2023 exercise show that banks have adequate capital and liquidity buffers to weather potential downside risks. Nevertheless, the challenging economic environment and tight financial conditions from higher-for-longer interest rates could heighten credit and liquidity risks for FIs. Banks should continue to manage credit risk prudently and maintain adequate provisioning buffers. More broadly, banks and NBFIs should also closely monitor potential liquidity risk and strengthen their liquidity profiles where needed.

Macrounprudential Surveillance Department, Economic Policy Group
Monetary Authority of Singapore
27 November 2023
1 Global Macrofinancial Environment

1.1 Global financial developments and vulnerabilities

Risks to global financial stability increased in 2023. The international financial system faced rising interest rates, slowing economic growth and elevated cost pressures, which interacted with existing vulnerabilities built up during the preceding extended period of low interest rates. The March 2023 US bank failures highlighted weaknesses in some banks’ management of duration and liquidity risks in a rising rate environment. Globally, property prices, particularly in the commercial real estate sector, corrected against higher discount rates and reduced post-pandemic occupancy rates. Public debt sustainability concerns in emerging market economies (EMEs) deepened, with several countries defaulting on debt repayments.

The cumulative effects of restrictive monetary policy are still working their way through the international financial system, posing further challenges to financial stability. Global growth continues to slow from the pass-through of interest rate increases implemented over the past year and a half. Even as the rate-hike cycle appears to be peaking, real interest rates are rising as inflation expectations decline, exerting a further drag on growth. Tighter financial conditions have also driven up credit risk premia and moderated the flow of credit, potentially impacting the supply side of the global economy. Country-specific headwinds in major economies, such as China, could weigh significantly on global economic activity. At the same time, a worsening of geopolitical tensions such as a broadening of the Israel-Hamas conflict or an escalation in Russia’s ongoing war with Ukraine would pose further downside risks to the conjuncture.

The interaction of the above drivers and latent vulnerabilities is testing the resilience of the global financial system. Salient risks include:

- Reduced debt servicing ability of vulnerable households and corporates, particularly those that are due to refinance their loans at markedly higher rates.
- Possible impairment to international core funding and interbank markets that could affect the liquidity and solvency of various market participants.
- Repricing of overvalued commercial real estate assets that may challenge the ability of banks globally to manage their credit risk amid higher interest rates, liquidity and market risks.
- Fiscal challenges in some advanced economies (AEs) and EMEs from increased debt accumulated during the COVID-19 pandemic.
- Capital outflows from EMEs that are highly reliant on external financing.

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2 Board of Governors of the Federal Reserve System, Review of the Federal Reserve’s Supervision and Regulation of Silicon Valley Bank, April 2023; FDIC, FDIC’s Supervision of Signature Bank, April 28, 2023.
The continued pass-through of high interest rates will test the debt servicing ability of the non-financial sector globally

At the start of the monetary tightening cycle, most borrowers could rely on low fixed rate loans and precautionary savings built up during the pandemic to buffer against policy rate increases. However, as interest rates stay higher-for-longer and more debt comes due for refinancing, some borrowers could face sharper stresses in servicing their debt as their savings run down.

Globally, non-financial corporates (NFCs) are vulnerable to higher financing costs amid elevated debt levels. Since Q3 2022, credit to corporate borrowers has been trending up (Chart 1.1). At the same time, corporate borrowing costs have risen significantly since 2022, with EME yields tracking those in the US closely (Chart 1.2). While many corporates benefited from the low interest rate environment during the pandemic by terming out their debt, around 35% of total debt outstanding is coming due in the next two years and will have to be refinanced at much higher rates (Chart 1.3). Moreover, as the initial boost from the post-pandemic reopening fades, corporates’ earnings will come under pressure amid slowing growth, further weighing on their debt servicing ability (Chart 1.4).

**Chart 1.1** Corporate debt in EMs has increased more than in AEs and is trending up

Credit to NFCs as a percentage of GDP

<table>
<thead>
<tr>
<th></th>
<th>AE</th>
<th>EM</th>
<th>EM Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>70</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>2020</td>
<td>75</td>
<td>95</td>
<td>120</td>
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<tr>
<td>2021</td>
<td>80</td>
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</tr>
<tr>
<td>2022</td>
<td>85</td>
<td>105</td>
<td>140</td>
</tr>
<tr>
<td>2023</td>
<td>90</td>
<td>110</td>
<td>150</td>
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</tbody>
</table>

Source: BIS, MAS estimates

Note: EM Asia is computed using simple average.

**Chart 1.2** Corporate borrowing costs have also risen sharply since 2022

USD corporate bond index effective yields

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>EM</th>
<th>EM Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2020</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2021</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2022</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>2023</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Oct</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: ICE Data Indices, LLC, retrieved from Federal Reserve Economic Data (FRED), Federal Reserve Bank of St. Louis
Household balance sheets will also need to adjust to a potentially protracted period of elevated interest rates. Until now, pandemic-induced savings, relatively stable leverage, and strong income gains made over the past few years (Charts 1.5 and 1.6) have helped to insulate households around the world from the full impact of monetary tightening. However, as interest rates remain elevated and labour market conditions soften, households’ saving buffers are eroding. While prudential regulations such as caps on loan-to-value and debt servicing ratios limit the adverse impact on financial stability, some households could be vulnerable to income and interest rate shocks, as well as to potential property valuation declines (Chart 1.7). These would have a negative impact on household wealth and banks’ asset quality.
A combination of higher public debt (Chart 1.8), much of which was incurred during the pandemic, and elevated interest rates on government bonds (Chart 1.9) has raised the debt service burden on fiscal authorities around the world. The increase in short-term rates and unwinding of asset purchases programs by some of the major central banks, as well as greater bond supply, have contributed to the rise in long-term sovereign bond yields. Nonetheless, EM Asia bond yields have risen at a more measured pace, suggesting limited spillovers from the broader repricing in higher-rated AE countries at this juncture.

While government bond yields should ease as the global monetary policy cycle eventually turns, market pricing suggests that they are expected to remain fairly elevated, with 1- to 2-year ahead market-implied expected yields of 10-year US Treasuries reaching 5.0% as of October 2023, a level last seen in 2007. Accordingly, global government net interest payments as a percentage of GDP are projected to rise in the coming years (Chart 1.10). Debt sustainability concerns could emerge more prominently should growth fail to keep pace with higher interest costs. These unfavourable debt dynamics increase the risk of sudden stops and constrain the use of fiscal policy as an instrument to respond to external shocks.

The sovereign-bank nexus could act as a potential amplifier of financial stress. Globally, linkages between the sovereign and banking sectors are significant, as commercial banks hold a large proportion of outstanding domestic government debt and consequently have large balance sheet exposures to domestic sovereigns. These linkages are particularly deep in EMEs (Chart 1.11). A deterioration in public debt sustainability that triggers an increase in sovereign risk premia would thus adversely affect banks’ asset quality. A liquidation of these assets by distressed banks would add to the increase in sovereign risk premia and lead to bank losses, creating adverse feedback loops. In such a scenario, confidence in the banking system could be lost and destabilising runs could develop. In extremis, fiscal authorities could be hamstrung in mounting a credible response to support the financial system without further losing fiscal credibility.
**Chart 1.8** Sovereign debt levels are above pre-COVID levels and projected to rise further

General government debt as a percentage of GDP

Source: IMF, Haver Analytics, MAS estimates

Note: Dotted lines are IMF forecasts published in the October 2023 IMF Fiscal Monitor. Numbers indicate the average annual change in the ratio of debt-to-GDP between 2015–19 and 2023–27. EM Asia is computed using a simple average.

**Chart 1.9** Government borrowing costs are at elevated levels

10-year local currency government bond yields

Source: Bloomberg, MAS estimates

Note: G3, EM and EM Asia are computed using simple averages.

**Chart 1.10** Sovereign interest payment burdens are expected to rise further

Government net interest payments as percentage of GDP

Source: IMF, Haver Analytics, MAS estimates

Note: Net interest payments are calculated as the difference between overall fiscal balances and primary balances. Dotted lines are projections.

**Chart 1.11** The sovereign-bank nexus is more pronounced in EMs

Domestic banks’ holdings of domestic sovereign debt in 2022

Source: IMF, Haver Analytics, National authorities, MAS estimates

Note: % of sovereign debt % of banking sector assets

EMEs reliant on external financing are vulnerable to the risk of large and disorderly capital outflows

An outlook of higher-for-longer interest rates in AEs and slower global growth materially increases the risk of capital flight for EMEs. Tightening monetary policy in AEs since 2022 has narrowed or even reversed EME-AE interest rate differentials, as monetary policy adjustment in EMEs has in many cases diverged from that in AEs (Chart 1.12). Notably, nominal USD rates have continued to rise in recent months—concurrent with USD strength—and could remain elevated for a prolonged period, while many EME central banks have stood pat or may even be contemplating cutting rates to support growth. This reduced or negative carry has eroded
the appeal of EM assets, which has resulted in a moderation in bond inflows and a weakening of EM currencies since March 2022. A similar driver could be a potential tightening of monetary policy by the Bank of Japan, including an exit from its yield curve control policy, which may lead to a disorderly unwinding of yen-funded carry trades. Interest in EME equities has also been largely flat (Chart 1.13). Compared to the broader EM space, EM Asia has seen a greater reduction in inflows to equity markets, driven by large outflows from China. EM Asia currencies have depreciated though by less than the EME average (Chart 1.14). Thus far, these developments have not been destabilising.

**Chart 1.12** EME-AE interest rate differentials have declined since 2022

**Chart 1.13** Portfolio inflows from foreign investors have fallen

**Chart 1.14** EM currencies have weakened through the monetary policy tightening cycle

A related risk is that lower export demand could weaken the external balances of EMEs, rendering them susceptible to sudden stops in capital flows. The IMF has projected global growth to decline in 2024, falling below the historical average.3 Within the region, a slowdown

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in China from its ongoing property sector difficulties could spread to the rest of the Chinese economy, with potential spillovers to other markets.

A pullback in external capital could threaten EM financial stability by increasing market interest rates beyond debt servicing capacities and raising credit risk premia. Currency depreciation triggered by capital outflows could lead to losses from balance sheet mismatches. To maintain external stability, EM policymakers may need to keep rates higher than they otherwise would, at the cost of slower growth, reduced fiscal sustainability, and added stress on the corporate sector. Under some circumstances, foreign currency intervention may be warranted to ease this policy conundrum.

Global financial intermediaries could be tested by higher credit, market and funding risks

Higher interest rates could induce a deterioration in bank asset quality around the world, materialising through higher non-performing loan (NPL) ratios. Though NPLs have remained subdued (Chart 1.15), loan delinquencies may rise in the coming year as refinancing needs increase. Credit losses could also be exacerbated by a decline of collateral values that reduce recovery rates on defaulted loans. Losses could be more significant for banks with portfolios concentrated in the weakest segments of the economy, such as commercial real estate.

**Chart 1.15** NPL ratios have remained at relatively low levels

![NPL ratios chart](chart1.15.png)

**Chart 1.16** Interest expense has risen in recent quarters

![Interest expense chart](chart1.16.png)

On the other side of the ledger, rising funding costs may also impair bank profitability. Interest expense has risen gradually through the tightening cycle, but the pace could intensify as banks compete for funding amid higher market interest rates (Chart 1.16). Banks with less pricing power, such as those situated in financial systems with more developed non-bank alternatives, will likely see a stronger pass-through of higher policy rates to deposit costs.

Regardless of the causes, weak profitability could rapidly develop into liquidity and solvency crises for banks should depositors lose confidence. Idiosyncratic issues may develop into systemic risk if depositors’ fears spill over to other banks in the system, precipitating cascading failures. The failures of several banks in the US and Switzerland in early 2023
demonstrate the speed at which crises may develop. These events illustrate the importance of robust risk management in financial institutions (FIs), adequate supervisory oversight of FIs’ operations and deep understanding of their vulnerabilities by the relevant authorities.

To assess the vulnerability of banks to potential financial distress from corporates, households and sovereigns, many authorities have worked with banks to stress test their loan portfolios. At a micro-level, banks and other FIs need corporate governance and risk management processes commensurate with their risk profiles. Macroprudential policy tools, such as loan-to-value ceilings and debt servicing limits, can help to enhance banking system resilience.

Beyond banks, higher interest rates and a deterioration of credit quality could exacerbate existing vulnerabilities in the global NBFI sector, particularly for institutions whose business models have over-relied on a protracted period of low interest rates and ample liquidity. Certain segments of the NBFI sector globally, such as hedge funds and money market funds, could face severe liquidity and funding challenges during a risk-off situation. There could also be contagion to the rest of the global financial system as the NBFI sector accounts for nearly 49% of global financial assets (Charts 1.17 and 1.18). In view of these developments, MAS conducted an in-depth study on the size and the type of NBFs in Singapore, as well as their potential vulnerabilities (see Special Feature 2 “Analysing Vulnerabilities of Non-bank Financial Institutions in Singapore”).

**Chart 1.17** NBFI’s holdings of financial assets have increased

| Source: FSB, MAS estimates |

**Chart 1.18** NBFIs in EMs have been growing more quickly than those in AEs

| Source: FSB, MAS estimates |

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**A sharp repricing of assets could impair market functioning internationally**

Forecasts of key macroeconomic variables currently exhibit substantial dispersion above long-term averages (Chart 1.19). Reflecting the uncertainty, market participants’ pricing of central bank policy rates has been volatile (Chart 1.20) and has tended to be overly optimistic, often anticipating rate cuts well ahead of the trajectory communicated by central banks. Asset prices—which respond to policy rate expectations—could undergo sharp adjustments should market consensus on the interest rate trajectory shift markedly.
On top of this economic uncertainty, structural risk drivers such as escalating geopolitical tensions and deepening economic fragmentation could lead to heightened risk aversion and elevated market volatility globally. Tensions between major economies and the implementation of protectionist policies could also weigh on expectations of global growth and perceptions of geopolitical stability, particularly if they result in like-for-like retaliation.

**Chart 1.19** Dispersion in macroeconomic forecasts in key AEs remains elevated

Cross-sectional dispersion of inflation forecasts

<table>
<thead>
<tr>
<th>Year</th>
<th>US</th>
<th>Euro area</th>
<th>US 2015-19 average</th>
<th>Euro area 2015-19 average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>0.0</td>
<td>0.4</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>2020</td>
<td>0.4</td>
<td>1.2</td>
<td>1.6</td>
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<tr>
<td>2021</td>
<td>0.8</td>
<td>1.6</td>
<td>2.4</td>
<td>3.2</td>
</tr>
<tr>
<td>2022</td>
<td>1.2</td>
<td>2.0</td>
<td>3.0</td>
<td>3.8</td>
</tr>
<tr>
<td>2023</td>
<td>1.6</td>
<td>2.4</td>
<td>4.0</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Source: Federal Reserve Bank of Philadelphia, ECB, MAS estimates

Note: Data are dispersion measures for 1-year ahead projections from respective jurisdictions’ Survey of Professional Forecasters. Dispersion is calculated as the difference between the 75th and 25th percentile point forecast.

**Chart 1.20** Market pricing of future short-term interest rates has been volatile

1-year forward interest rate swaps

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
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</thead>
<tbody>
<tr>
<td>Jan</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Feb</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Mar</td>
<td>3.0</td>
<td>3.5</td>
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<td>2.5</td>
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</tr>
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<td>Apr</td>
<td>3.5</td>
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<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>May</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
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<td>Jun</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Jul</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Aug</td>
<td>3.5</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
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<tr>
<td>Sep</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Oct</td>
<td>2.5</td>
<td>3.0</td>
<td>3.5</td>
<td>2.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Source: Bloomberg, MAS estimates

A repricing in international asset markets could interact with liquidity vulnerabilities among market participants, amplifying the shock to the global financial system. FIs with large asset-liability mismatches and exposures to affected asset markets are at risk, if they do not have sound risk management practices in place. For example, open-ended funds could face high redemption volumes should many end-investors seek to divest at the same time. If redemption volumes exceed their liquidity buffers, funds would be forced into fire sales of assets to meet liquidity needs. This would amplify selling pressures, especially in asset markets with fewer market makers or those that are inherently more illiquid. Any ensuing market dysfunction would propagate stresses to other FIs with exposures to the same market or underlying instruments.

Leveraged trading strategies could contribute to global market volatility. Recently, the Bank for International Settlements, the Federal Reserve Bank and the International Monetary Fund have highlighted the outsized leveraged positions taken by some hedge funds in the Treasury futures basis trade—a strategy that exploits price differences between cash Treasury securities and Treasury futures.\(^4\) Outsized leverage positions are vulnerable to unexpected risk-off events that force sudden unwinding, setting off a feedback loop of deleveraging.

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forced selling, one-sided markets and further price declines. An example of this took place in March 2020, when the “dash for cash” caused Treasury yields to spike, leading to a reversal of the basis, and ultimately forcing some funds to unwind their positions to limit losses or meet margin calls. Dysfunction in core funding markets, such as sovereign debt markets, would be especially destabilising due to their critical functions as pricing benchmarks and high-quality collateral.

Systemic Risk Survey shows FIs are keenly aware of risks

Key FIs in Singapore shared their views on the aforementioned risks through the MAS Systemic Risk Survey. This half-yearly survey was introduced in April 2023 to poll Chief Risk Officers about risks to Singapore’s financial system. For the October 2023 edition, respondents cited declining borrowers’ credit quality due to challenging macrofinancial conditions, and potential liquidity stresses as salient risks. Beyond the macrofinancial conjuncture, risk managers also highlighted geopolitical and technology & cyber risks. They also identified structural risks, including FIs’ use of artificial intelligence, and the management of climate risk. The survey and its findings are discussed in more detail in Box A “Systemic Risk Survey of Singapore's Financial Sector”.

This FSR covers several analyses of the key vulnerabilities and risks highlighted by survey respondents. In Chapter 3, Box B “Assessing Mortgage Repayment Risk in an High Interest Rate Environment” assesses the vulnerability of Singapore’s households amid higher refinancing risk. In Chapter 4, Box C “Industry-Wide Stress Test of D-SIBs” discusses MAS’ annual industry-wide stress test (IWST) of banks in Singapore, which features enhancements to model the solvency-liquidity feedback loop. Special Feature 1 “Assessing the Impact of Climate Transition Risk on the Financial System” presents the results of a top-down analysis on the impact of transition risk to banks and insurers. Special Feature 2 “Analysing Vulnerabilities of Non-bank Financial Institutions in Singapore” examines the systemic vulnerabilities and risks of the NBFI sector in Singapore, including by simulating liquidity stress among investment funds. Separately, Special Feature 3 “Impact of COVID-19 Credit Easing Measures on Bank Lending to SMEs” analyses the effectiveness of unconventional credit easing schemes in supporting the flow of credit to Singapore corporates through the COVID-19 pandemic, and finds that they had a large and positive impact during that unprecedented crisis.
Box A
Systemic Risk Survey of Singapore’s Financial Sector

Singapore’s financial institutions continue to regard monetary tightening as the biggest risk to the financial outlook, just as they did six months ago, with several noting that sustained higher interest rates are likely to lead to higher credit risk. Geopolitical and technology & cyber risks are a close second and third, also as before, but risks from money laundering have moved up the list to the fourth position. Most institutions appear to have a clear understanding of the risk environment detailed throughout this report.

MAS introduced a half-yearly survey in April 2023 to gather key FIs’ assessments of systemic risk to Singapore’s financial system. Chief Risk Officers (CROs) of major banks, insurers, fund managers, exchanges and broker-dealers operating in Singapore were asked to list pertinent risks, and to rank them in order of potential impact. The inaugural survey saw a response rate of 96% from 46 FIs, while the second survey in October 2023 had a response rate of 97% from 56 FIs.

The surveys allow for a structured comparison of FIs’ views in terms of (i) percentage of citations of risks, (ii) impact ranking of risks, and (iii) changes in FIs’ perceptions of risks over time. Similar to the April 2023 survey, the top three most cited and impactful risk categories in the October 2023 survey were macrofinancial, geopolitical and technology & cyber risks. Other notable risk categories were money laundering and terrorism financing (ML & TF), AI developments, and climate change, which were highlighted by a larger share of respondents. Details are in Table A1 below.

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5 Surveys are commonly used among central banks to collate risk assessments from the financial sector. For example, the Federal Reserve Bank of the United States and Bank of England also conduct half-yearly surveys on systemic risk to their respective financial systems.

6 While geopolitical risk featured prominently in the October 2023 survey results, the survey closed on 6 October 2023. As such, the survey responses do not reflect respondents’ assessment of the geopolitical risks linked to the Israel-Hamas conflict that broke out on 7 October 2023.
Macrofinancial risk

Macrofinancial risk arising from the cumulative effects of restrictive monetary policy by major central banks, slower global economic growth, and contagion from a slowdown in China remained the top-cited risk, and was also assessed to be the most impactful in the October 2023 survey. Several respondents highlighted rising credit risk as a concern, noting that financially weaker households and corporates would face increasing debt repayment difficulties as their cash buffers diminish under higher-for-longer interest rates and weaker growth. Concerns about credit risk were less prominent in the April 2023 survey as market expectations at the time were for an earlier easing in monetary policy.

Some respondents were also concerned that market liquidity in core international funding markets could come under strain should assets reprice sharply amid heightened macroeconomic uncertainty. Under this scenario, highly leveraged participants in these markets could be forced to conduct fire sales of assets to meet margin calls and additional collateral demand. The spillovers to Singapore’s financial system could come through contagion in USD funding markets and a broader rise in market volatility and risk aversion.

Geopolitical risk

Respondents were concerned that a further escalation of geopolitical tensions, such as the US-China strategic rivalry or the war in Ukraine, could lead to sharp market and commodity price volatility, and cause supply-chain disruptions. Such developments could increase market stability.
and credit risks for FIs. Financial fragmentation, and the ensuing increase in operational risk for FIs, was also cited as a specific concern amid heightened geopolitical tensions.

**Technology & cyber risk**

Technology & cyber risk remained pertinent following the recent banking service disruptions in Singapore. Some respondents highlighted vulnerabilities associated with the financial industry’s reliance on key third-party service providers, which could cause widespread disruption should systems and services from these few providers become unavailable. A few respondents also highlighted cyber-attacks and scams as a perennial risk to the security and integrity of customer data and monies.

**Other notable and emerging risks: ML & TF, artificial intelligence applications and climate change**

Some respondents highlighted ML & TF risk in light of the recent incidence of money laundering in Singapore. They noted that ML & TF risk would continue to be a major challenge for global financial hubs given their open capital accounts and large gross capital flows. It is therefore important for MAS to continue working closely with the industry to identify and disrupt illicit activities, in order to maintain a trusted and thriving financial system in Singapore.

A few respondents also shared their concerns about FIs’ growing use of AI. Respondents recognised that while usage of AI could increase operational efficiency and enhance risk management, it could also introduce biases in decision-making and expose FIs to technology & cyber risks through their use of a few third-party service providers specialising in this area.

Climate change was another notable risk, with respondents citing the 2023 El Niño effect as an example of the realisation of physical risk. Respondents also expressed concerns about the potential for sharp asset revaluations and stranded assets in the event of a compressed and disorderly transition to net zero.

**Conclusion**

The Systemic Risk Survey consolidates FIs’ views on the risks to Singapore’s financial system, and enhances MAS’ macrofinancial surveillance toolkit. The survey findings have affirmed FIs’ awareness of prevailing macrofinancial risks and vulnerabilities. This informs MAS’ internal risk assessments, and enhances the broader surveillance and analysis published in the Financial Stability Review (FSR). At the same time, MAS also works closely with the industry to manage identified risks through supervisory engagements and policy reviews. For example, MAS has been engaging FIs on the need to (i) maintain high system availability, by ensuring that critical systems and services can be restored expeditiously following an outage; (ii) strengthen intelligence sharing and defence against cyber threats, such as through initiatives with the standing committees on cyber security under the Association of Banks in Singapore and the insurance associations; (iii) enhance surveillance and defence against ML & TF risk, including through the Collaborative Sharing of ML/TF Information and Cases.
(COSMIC)\textsuperscript{7} platform that will be introduced in 2024; and (iv) implement climate change transition planning in their business strategies.

\textsuperscript{7} COSMIC is a digital platform MAS is co-developing with participating banks in Singapore that will allow these banks to share with one another information on customers whose profile or behaviour exhibits potential financial crime concerns.
2 Singapore Corporate Sector

Amid slower growth and rising interest rates, Singapore firms’ financial positions—as indicated by the y-o-y change in the corporate sector FVI as of Q2 2023—have remained resilient. While borrowing costs have risen with the pass-through of higher interest rates, leverage risk has stayed relatively stable, with deleveraging and interest rate hedging cushioning the impact. Stable debt maturity profiles—as shown by the broadly unchanged maturity risk indicator—have helped to alleviate potential refinancing concerns. Firms continued to have adequate liquidity buffers even as they deployed cash reserves built up during the pandemic to reduce interest expenses. Separately, foreign currency mismatch risk eased marginally with the moderate decline in foreign currency borrowing. Firms that are externally oriented were generally more vulnerable to the global economic slowdown, although most of their financial ratios remained stronger than those of domestic-oriented firms.

The outlook for the Singapore economy is heavily dependent on external demand conditions, which continue to be weighed down by higher-for-longer global interest rates and geopolitical uncertainties. The challenging external macrofinancial environment could continue to place pressure on firms’ profitability and debt servicing ability. However, MAS’ stress tests suggest that most firms have adequate buffers to manage earnings and interest rate shocks. There is, though, a segment of corporates that are highly leveraged with weaker cash reserves that are at greater risk.

<table>
<thead>
<tr>
<th>Corporate sector FVI (y-o-y changes)</th>
<th>Q2 2022</th>
<th>Q2 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall corporate FVI</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Leverage risk</td>
<td>↓</td>
<td>→</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Maturity risk</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Foreign currency risk&lt;sup&gt;8&lt;/sup&gt;</td>
<td>→</td>
<td>↓</td>
</tr>
</tbody>
</table>

The computation of foreign currency risk did not include a large foreign currency bond that was issued in Q2 2023 as the bond was considered to be naturally hedged. The proceeds were used specifically to fund the acquisition of a firm whose assets were denominated in the same currency (see section 2.2).
2.1 Financing conditions in Singapore

Domestic financing conditions have remained relatively stable over the past year

Following a sharp increase in H2 2022, SGD interest rates\(^9\) rose further in 2023 but at a slower pace in line with the global rate hike cycle. In the coming year, SGD interest rates are likely to remain at elevated levels based on market forward pricing (Chart 2.1).

Notwithstanding the higher interest rates, domestic financing conditions have remained relatively stable over the past year (Chart 2.2). Firms, including SMEs, retained access to credit, even as lending conditions moderately tightened in recent quarters.\(^10\) Notably, banks continued to onboard SME borrowers, with the number of customers rising at a steady pace of nearly 5% y-o-y in June 2023\(^11\) (see Chart Panel 2A “Small and Medium-sized Enterprise Financing Conditions”, Chart 2A2). In capital markets, the Straits Times Index (STI) was marginally higher in Q3 2023 compared to a year ago. Spreads of Singapore investment grade corporate bonds have narrowed since Q3 2022, though they remained above pre-COVID levels (Table 2.1).

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\(^9\) Represented by the 3-month compounded Singapore Overnight Rate Average (3M SORA).

\(^10\) See Chapter 4 “Singapore Financial Sector” for more details on credit growth trends.

\(^11\) Based on a survey conducted by MAS as of June 2023.
Table 2.1 Indicators of domestic financing conditions

<table>
<thead>
<tr>
<th></th>
<th>Q4 2019</th>
<th>Q3 2022</th>
<th>Q1 2023</th>
<th>Q3 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic FCI (Standard deviation from mean)</td>
<td>−0.52</td>
<td>0.07</td>
<td>0.04</td>
<td>−0.12</td>
</tr>
<tr>
<td>3-month compounded SORA (%)</td>
<td>1.37</td>
<td>1.45</td>
<td>3.21</td>
<td>3.69</td>
</tr>
<tr>
<td>10-year SGS yields (%)</td>
<td>1.74</td>
<td>2.92</td>
<td>3.05</td>
<td>3.17</td>
</tr>
<tr>
<td>STI (points)</td>
<td>3188.7</td>
<td>3210.1</td>
<td>3276.5</td>
<td>3238.1</td>
</tr>
<tr>
<td>CEMBI Investment Grade + SG Spread* (bps)</td>
<td>113.0</td>
<td>139.1</td>
<td>129.0</td>
<td>133.7</td>
</tr>
</tbody>
</table>

Source: Bloomberg, J.P. Morgan Markets, MAS
Note: Figures are quarterly averages.
* This measure is computed by J.P. Morgan Markets as the spread of the yield of USD corporate bonds over the yield of the US Treasury bond.

2.2 Assessment of vulnerabilities

Firms’ borrowing costs have risen moderately with the continued pass-through of high interest rates

Firms’ borrowing costs have risen in the past year, though at a slower pace than the broader increase in interbank interest rates. Median borrowing costs for both domestic- and external-oriented firms rose by about 100 bps from Q2 2022 to Q2 2023, well below the 300 bps rise in 3-month compounded SORA (3M SORA) over the same period (Charts 2.3 and 2.4).

Chart 2.3 Borrowing costs have risen over the past year...
Interest expense as a share of total debt of SGX-listed firms

![Chart 2.3](chart_2.3.png)
Source: Refinitiv Eikon, MAS estimates

Chart 2.4 ... for both domestic- and external-oriented firms
Interest expense as a share of total debt of SGX-listed firms, by firm type

![Chart 2.4](chart_2.4.png)
Source: Refinitiv Eikon, MAS estimates
Corporate deleveraging alongside interest rate hedging has cushioned rising interest costs

Interest rate hedging may partly account for the moderate borrowing cost increases. Corporate financial statements indicate that most Singapore Exchange (SGX)-listed firms, especially those with larger absolute debt holdings and with relatively higher leverage ratios, were hedged against interest rate risks through interest rate derivatives or fixed rate borrowing. Among listed firms, the Singapore-listed Real Estate Investment Trust (S-REIT) sector had the highest proportion of firms that hedged their interest rate risk exposure given their inherently highly leveraged positions.12

In addition to hedging, firms have been actively deleveraging and slowing the pace of investments since the start of the monetary tightening cycle. Corporate debt as a share of GDP had fallen from its peak in Q1 2021, reaching a decade-low in Q1 2023 before ticking up slightly in Q2 2023 due to a firm-specific M&A.13 Banks noted that some firms have drawn on cash holdings to pay down existing debt or fund their operations, while others have held back on taking on new debt to fund expansion or refresh their capital stock (Chart 2.5).

**Chart 2.5** Corporate debt-to-GDP has fallen since its peak in Q1 2021, to a decade-low in Q1 2023, but rose slightly in Q2 2023

Singapore’s corporate debt, % of GDP

Source: BIS, Dealogic, MAS estimates

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12 S-REITs generally take on more debt as they finance their acquisition of properties with debt with a view to distribute the net income to shareholders.

13 This was funded by large bond issuances by the firm in Q2 2023. System-wide corporate debt-to-GDP had otherwise remained at the decade-low level in Q2 2023.
Firms’ debt servicing has remained manageable

Most firms continued to generate sufficient earnings to service their debt, with the median interest coverage ratio (ICR) of SGX-listed firms at a relatively robust 2.8 in Q2 2023, down moderately from 3.6 in Q2 2022 (Chart 2.6). After recovering from the pandemic, firms’ earnings dipped slightly as shown by the decline in median return on assets (ROA) (Chart 2.7). This was more pronounced for external-oriented firms, reflecting some normalisation to still healthy pre-COVID levels (Charts 2.8 and 2.9).

**Chart 2.6** Firms’ debt servicing ability fell in 2023...

**Chart 2.7** …as did their profitability

**Chart 2.8** External-oriented firms saw a larger fall in debt servicing ability...

**Chart 2.9** … and also in profitability

*Source: Refinitiv Eikon, MAS estimates*
Refinancing concerns were alleviated by adequate liquidity buffers and stable debt maturity profiles

Even as firms draw on their cash reserves to actively reduce debt, liquidity buffers continued to help mitigate refinancing risk. Firms had adequate current assets to cover their current liabilities, as indicated by a median current ratio of SGX-listed firms of 1.6 in Q2 2023, similar to Q2 2022 (Chart 2.10). In addition, cash was more than sufficient to cover repayment of short-term debt at short notice, as reflected by an increase in the median cash coverage ratio from 1.6 in Q2 2022 to 1.9 in Q2 2023 (Chart 2.11). Both domestic- and external-oriented firms had healthy liquidity positions, although external-oriented firms kept larger precautionary buffers (Charts 2.12 and 2.13).

A key reason for the continued liquidity resilience was the earlier build-up in precautionary buffers at the height of the pandemic. As interest rates rose subsequently, firms continued to set aside a portion of their earnings, possibly in anticipation of a sharp decline in profitability should a downturn ensue. Higher interest income from the rise in interest rates has also contributed to higher liquidity. The median SGX-listed firm’s interest income doubled from Q2 2022 to Q2 2023.

Maturity risk remained stable with the proportion of short-term debt to total debt relatively unchanged in 2023 across both domestic- and external-oriented firms (Charts 2.14 and 2.15). Further, the bond maturity profile of Singapore firms was well termed-out, with bonds due by 2024 comprising less than 10% of total outstanding bonds as of Q3 2023.

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**Chart 2.10** Current ratios have remained healthy in 2023...

Current assets to current liabilities of SGX-listed firms

<table>
<thead>
<tr>
<th>Ratio</th>
<th>2019 Q2</th>
<th>2020 Q2</th>
<th>2021 Q2</th>
<th>2022 Q2</th>
<th>2023 Q2</th>
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</thead>
<tbody>
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<td>25th to 75th percentile</td>
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<tr>
<td>Median</td>
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<td>1.6</td>
<td>1.6</td>
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</tr>
</tbody>
</table>

Source: Refinitiv Eikon, MAS estimates

**Chart 2.11** ...alongside an increase in cash coverage ratios

Cash to short-term debt of SGX-listed firms

<table>
<thead>
<tr>
<th>Ratio</th>
<th>2019 Q2</th>
<th>2020 Q2</th>
<th>2021 Q2</th>
<th>2022 Q2</th>
<th>2023 Q2</th>
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</thead>
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<tr>
<td>Median</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>4.5</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Refinitiv Eikon, MAS estimates
Current assets to current liabilities of SGX-listed firms, by firm type

Chart 2.13 ... and also better cash coverage ratios

Cash to short-term debt of SGX-listed firms, by firm type

Source: Refinitiv Eikon, MAS estimates

Chart 2.14 Short-term debt to total debt ratios have remained relatively stable ...

Short-term debt to total debt ratios of SGX-listed firms

Source: Refinitiv Eikon, MAS estimates

Chart 2.15 ... across both domestic- and external-oriented firms

Short-term debt to total debt ratios of SGX-listed firms, by firm type

Source: Refinitiv Eikon, MAS estimates

Foreign currency risk remained stable

Foreign currency risk has remained low and stable. Foreign-currency-denominated bonds have accounted for about 60% of total outstanding corporate bonds in Singapore since 2018. Based on their latest financial disclosures, most SGX-listed firms hedged against FX risks either through natural hedging or with derivatives. Further, Singapore’s exchange-rate-centred monetary policy framework helps to limit corporate exposures to excessive exchange rate fluctuations.
Probability of default of listed firms and corporate non-performing loan ratios kept at relatively low levels despite higher interest costs

A forward-looking measure of listed corporates’ vulnerability is the probability of default (PD) indicator, which assesses a firm’s default risk over the next 12 months. Notwithstanding higher interest costs and weaker profitability, listed firms remain resilient, with their PDs stable in 2023 at around their long-term average levels. In particular, the PDs of the riskier firms, as proxied by the 75th percentile level of the PD distribution, have remained at relatively low levels (Chart 2.16).

The overall corporate NPL ratio also remained healthy at a relatively low level of 2.2% in Q3 2023 (Chart 2.17), even though most business loans are on floating rates which have increased since last year. Within the sector, the impact of higher interest costs on smaller businesses has been manageable, with the SME NPL ratio remaining stable at 3.1% over the period of December 2022 to June 2023 (see Chart Panel 2A, Chart 2A5).

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14 The PD indicator is based on firms’ balance sheet strength and market-based financials, as well as broader macrofinancial indicators. For more details, see “Special Feature 3: Enhancing Corporate Surveillance with Probability of Default Model” in MAS’ 2021 Financial Stability Review.

15 Under the new MAS Notice 610/1003 reporting requirements implemented in July 2021, some data are not comparable with historical periods (pre-July 2021) due to a change in data definitions. Please refer to the Data Annex in MAS’ 2021 Financial Stability Review for more details.
2.3 Outlook

The challenging macrofinancial environment continues to pose downside risks for leveraged corporates

Business sentiment in the manufacturing and services sectors has improved slightly over the past year according to the Business Expectation surveys by the Economic Development Board (EDB) and the Department of Statistics (DOS). In the latest Q4 2023 surveys, both sectors reported further net improvements in sentiment for the period between Q4 2023 and Q1 2024 (Chart 2.18).

Within manufacturing, transport engineering firms were the most optimistic about the near-term business outlook in view of strong global air travel demand and a strong pipeline of orders relating to the oil & gas and renewable energy industries. Electronics firms also expected a pickup in business conditions alongside the broader gradual recovery in the global IT cycle. In the services sector, the improvement in sentiment was broad-based, led by the travel-related and tourism industries amid the upcoming year-end festive period and the continued recovery of travel post-reopening. A SME survey16 conducted by a bank also reported a positive business outlook among most SMEs. About half of SMEs surveyed expected better performance over the next six months, while 38% assessed the outlook to remain stable, and only 13% had a negative view of their business prospects.

Despite such signs of optimism, the business outlook is subject to considerable downside risks from a potentially prolonged high interest rate environment, and geopolitical conflicts. In the event of a broadening of the Hamas-Israel conflict, fossil fuel supply could be disrupted, with an ensuing rise in energy prices. Domestically, SGD interest rates could remain at elevated levels weighing on firms’ profitability. Against this backdrop, weaker earnings and elevated interest expenses could erode buffers and test the resilience of the corporate sector. Some marginal weakness in the asset quality of banks’ corporate loans emerged in Q3 2023, with the special mention ratio and the share of loans that were less than 90 days past due rising slightly (see Chapter 4 “Singapore Financial Sector”).

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16 The OCBC SME Business Outlook poll was conducted between 5 September 2023 and 3 October 2023, collecting more than 1,400 responses from SME business owners in Singapore.
**Chart 2.18** Business outlook remained positive and improved slightly in 2023

General business outlook for manufacturing & services sector (net weighted balance)

Source: DOS, EDB

Note: The latest data point (based on surveys conducted from September to October 2023) refers to the business outlook for October 2023 to March 2024. “Net weighted balance” is the difference between the weighted percentages of respondents with a positive outlook and those with a negative outlook. A positive percentage indicates a net positive outlook and a negative percentage indicates a net negative outlook.

**MAS’ stress test suggests that Singapore’s corporate sector would continue to be resilient against further shocks**

MAS conducted a stress test on SGX-listed corporates to assess how the sector would respond to a joint shock from lower demand and higher interest rates, i.e. a 10% decline in earnings\(^{17}\) and a 300 bps rise in interest rate\(^{18}\) from Q2 2023 levels.

The results suggest that most corporates are resilient to such an interest rate and earnings shock, with cash reserves providing buffers. Against their Q2 2023 financial position, the percentage of firms-at-risk (defined as having ICR less than one) under the stress scenario increases from 31% to 34% of all corporates, while the debt-at-risk (defined as debt held by firms-at-risk) rises from 5% to 10% of overall corporate debt (Chart 2.19). However, after taking net cash reserves and hedging into consideration, the share of firms-at-risk and debt-at-risk after stress declines to 15% and 8%, respectively. Firms in both the external-oriented and domestic-oriented sectors contributed to debt-at-risk, with those with capital-intensive business models and higher operating leverage being less resilient to the shocks.

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\(^{17}\) The assumption references the decline of the corporate sector’s gross operating surplus in past crises.

\(^{18}\) The 300 bps increase assumes a further pass-through of the rise in 3M SORA since Q2 2022 (200 bps) and an additional 100 bps increase to simulate an even more restrictive monetary policy stance by major central banks.
**Chart 2.19 Most Singapore corporates would remain resilient under simultaneous adverse shocks to interest rate and earnings**

Listed firms with ICR less than 1 (as a share of total number of listed firms, and as a share of total listed firms’ debt)

Source: Refinitiv Eikon, MAS estimates

**Firms should remain vigilant to downside risks**

Firms have been able to cushion the impact of the challenging macrofinancial environment thus far through active deleveraging, healthy financial buffers and appropriate financial hedging. Corporate NPLs have remained low notwithstanding the pass-through of rising interest rates. Under the adverse scenario of an intensification of macrofinancial shocks, stress test results suggest that most listed firms would remain resilient.

Nevertheless, there is a segment of highly leveraged firms with thinner buffers, including those with business models that are predicated on low and stable interest rates, which may come under strain as interest rates remain high for a prolonged period and macroeconomic weaknesses persist. Given the heightened macrofinancial uncertainties, firms should be prudent in financial management, and stay vigilant to downside risks.
Financial Stability Review | November 2023

Chart Panel 2A  Small and Medium-sized Enterprise Financing Conditions

SME loans largely declined over the past year alongside the fall in overall resident lending. However, the number of SME customers increased.

Chart 2A1 SME loans outstanding

![SME loans outstanding chart](chart)

Source: MAS estimates

The Property and Development of Land sector accounts for the largest share of non-financial SME loans. The share of outstanding SME loans secured by property has been stable.

Chart 2A3 SME loans by sector (as of September 2023)

![SME loans by sector chart](chart)

Source: MAS

Note: PSTASSA refers to Professional, Scientific, Technical, Administrative, Support Service Activities.

The SME NPL ratio has remained stable over the period of December 2022 to June 2023 despite higher interest rates.

Chart 2A5 SME NPL ratio

![SME NPL ratio chart](chart)

Source: MAS survey

19 Historical data prior to September 2022 are estimates by MAS, to account for an ongoing restatement of figures by one survey participant.
Singapore Household Sector

The household sector has remained resilient amid increases in costs of living and debt servicing burdens in recent quarters. Leverage risk has fallen as households saw healthy income gains and paid down their debt, with credit quality of housing loans remaining strong. While overall household financial vulnerabilities rose slightly y-o-y in Q3 2023, driven by an uptick in maturity risk, the level of the FVI has remained low by historical standards.

<table>
<thead>
<tr>
<th>Household sector FVI (y-o-y changes)</th>
<th>Q3 2022</th>
<th>Q3 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall household FVI</td>
<td>→</td>
<td>↑</td>
</tr>
<tr>
<td>Leverage risk</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Maturity risk</td>
<td>→</td>
<td>↑</td>
</tr>
</tbody>
</table>

With interest rates likely to remain higher-for-longer, debt servicing costs could rise for households that are due for mortgage refinancing in the near term. However, stress tests of such borrowers show that most would be able to weather the increase in monthly repayments even under conservative assumptions of higher interest rates and income losses (see Box B “Assessing Mortgage Repayment Risk in a High Interest Rate Environment”). Income growth and financial buffers built up over the years should cushion households against an increase in debt servicing costs. Nevertheless, borrowers should remain prudent and continue to maintain sufficient liquidity buffers to withstand potential shocks.

3.1 Assessment of leverage risk

The household sector has continued to deleverage in 2023

Household deleveraging continued in 2023 in the face of higher interest rates. In Q3 2023, aggregate household debt as a share of personal disposable income (PDI) fell for the eighth consecutive quarter to a decade-low multiple of 1.2 (Chart 3.1). A confluence of moderation in household debt and continued healthy income growth contributed to the deleveraging trend. Households have exercised caution in taking on additional loans in view of the increase in interest rates since H2 2022, resulting in a decline in the household debt level from a year ago. This was led by the drop in personal loans (about a quarter of aggregate household debt) (Chart 3.2).

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20 Maturity risk is proxied by short-term debt (credit card borrowings) as a share of income estimates. Outstanding credit card balances expanded slightly due to increased travel and retail spending.
Chart 3.1 Household debt-to-PDI has fallen further in Q3 2023

Household debt-to-PDI in Singapore

![Graph showing household debt-to-PDI in Singapore]

Source: DOS, MAS estimates

Chart 3.2 Y-o-y growth in household debt has been negative since Q2 2023

Household debt in Singapore

![Graph showing y-o-y growth in household debt in Singapore]

Sources: DOS, MAS estimates

Housing loan growth has moderated amid higher interest rates

Housing loans make up about three-quarters of aggregate household debt as of Q3 2023. Mortgages grew at a subdued pace of about 1% y-o-y in Q3 2023 as some existing borrowers paid down their mortgages (Chart 3.3). At the same time, new housing loans have also moderated (Chart 3.4), in tandem with reduced transaction activity in the property market (see section 3.4 below).

Chart 3.3 Outstanding housing loans have moderated

Outstanding housing loans

![Graph showing outstanding housing loans]

Source: MAS estimates

Note: Housing loans granted by FIs for private and public housing; excludes loans granted by the Housing Development Board (HDB).

Chart 3.4 New housing loans declined from the highs of the past two years

New housing loans

![Graph showing new housing loans]

Sources: MAS estimates

Note: Housing loans granted by FIs for private and public housing; excludes loans granted by HDB.
3.2 Assessment of maturity risk

Maturity risk has risen as borrowers took on more short-term debt

Households’ short-term debt, as proxied by outstanding credit card balances, increased further in 2023, leading to an increase in maturity risk. The higher use of unsecured credit was underpinned by the continued recovery of resident outbound travel and domestic retail sales, alongside the resumption of large-scale entertainment events in Singapore and the region. Nonetheless, outstanding credit card balances as a share of PDI remains below its long-term average (Chart 3.5).

**Chart 3.5** Outstanding credit card balances as a share of PDI has increased but remains below its long-term average

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Rollover balances as a share of PDI inched up from 2% in Q3 2022 to 2.2% in Q3 2023 (Chart 3.6), alongside an increase in the number of credit card holders and growth in outstanding balances. However, revolvers\(^{21}\) accounted for only about 20% of all card holders, below the historical average (Chart 3.7). The credit card charge-off rate\(^{22}\) rose to 4.5%, lower than the 10-year average (Chart 3.8).

With the increase in credit card interest rates and late payment fees, credit card holders should ensure that outstanding bills are paid in full and on time, to avoid incurring additional charges. They are also strongly encouraged to prudently assess their financial situation before committing to large purchases financed by short-term debt. Borrowers who might be facing financial difficulties should approach their lenders early to explore possible loan refinancing and repayment solutions. Options include debt consolidation plans offered by the industry and customised debt management plans.

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\(^{21}\) Revolvers are credit card holders who have not paid off their balances in full.

\(^{22}\) Credit card charge-off rates measure bad debts written off as a share of rollover balances.
3.3 Assessment of household debt servicing abilities

Households’ debt servicing has remained manageable, while adequate equity provides an important buffer

Most households with existing mortgage loans are well placed to manage the impact of higher interest rates, reflecting conservative credit assessment practices by banks which were part of macroprudential policies put in place earlier. Recent adjustments to macroprudential measures such as the Total Debt Servicing Ratio (TDSR) limits have ensured continued financial prudence among borrowers in their property purchases in a higher interest rate environment.

Existing housing loan-to-value (LTV) measures have also helped in building up significant buffers for FIs and borrowers against falling property valuations. As of Q3 2023, the average LTV ratio has remained low at 41% (Chart 3.9). This reflects the limits imposed on the loan...
amount for property purchases, even as households continued to pay down their existing mortgage loans.

**Chart 3.9 Average LTV ratio has stayed low**

Average LTV ratio

![Average LTV ratio chart](chart)

Source: MAS

**Strong household balance sheets and adequate liquidity cushion the impact of higher interest rates**

Household sector net wealth rose by 7.6% y-o-y to SGD2.7 trillion in Q3 2023 (**Chart 3.10**), largely supported by sustained growth in liquid assets and in the value of residential property assets. Liquid assets such as cash and deposits—comprising about 20% of total assets as of Q3 2023—continued to exceed total liabilities (**Chart 3.11**), with growth of the former outpacing that of the latter since Q1 2022. The still relatively high personal saving rate has trended down slightly from 35.1% in Q3 2022 to 34.6% in Q3 2023 on the back of higher travel and domestic retail spending (**Chart 3.12**). Looking ahead, households should continue to ensure that they have sufficient funds to handle emergencies.
Chart 3.10 Aggregate household net wealth continued to be healthy

Household net wealth

Source: DOS, MAS estimates

Chart 3.11 Liquid assets remain much larger than overall household debt

Household cash and debt

Source: DOS, MAS estimates

Chart 3.12 Singapore’s personal saving rate remains high relative to its long-term average

Personal saving rate

Source: DOS, MAS estimates
Credit quality of housing loans has remained resilient despite significant pass-through of higher interest costs

Most FI-extended mortgages have transitioned to higher interest rates and households have weathered the impact well. The housing NPL ratio has stayed low at 0.2% as of Q3 2023 (Chart 3.13), while mortgage loans in arrears have been broadly stable, inching up slightly from 0.4% in Q2 2022 to 0.5% in Q3 2023. Further, the number of foreclosed residential units has remained low at 27 units thus far in 2023.

Chart 3.13 NPL ratio stayed low even as higher mortgage rates passed through

More households could face higher debt servicing costs, although the impact is expected to remain manageable

Looking ahead, borrowers who are expected to refinance in 2024, especially those on existing fixed rate loan packages, would likely see a step-up in mortgage rates. MAS’ adverse stress scenario simulation covering borrowers expected to refinance in 2024 shows that most of these households would still be able to service their mortgages under conservative assumptions of higher interest rates and income loss. A small segment of highly leveraged borrowers could be more vulnerable to repayment risk (see Box B “Assessing Mortgage Repayment Risk in a High Interest Rate Environment”).

For borrowers facing difficulties in repayment, government agencies and FIs have preemptively established standardised interventions when late repayments occur. These include potential loan restructuring solutions, early referrals to appropriate social service agencies and in certain limited cases, arranging for alternative HDB accommodation where foreclosures are unavoidable.

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23 Mortgage loans with more than 30 days past due that are reported to Credit Bureau Singapore (CBS).
3.4 Private residential property market

The momentum in the property market has shown signs of moderation

After the latest round of cooling measures announced in April 2023 and against a backdrop of elevated interest rates and weakness in economic growth, price pressures in the private residential property market have eased. Property price growth moderated over two consecutive quarters, from 11.4% y-o-y in Q1 2023 to 4.4% y-o-y in Q3 2023 (Chart 3.14).

The easing in price momentum was broad-based, though to different degrees across market segments (Chart 3.15). Price growth moderated but remained positive in the Rest of Central Region (RCR) and Outside of Central Region (OCR). However, property prices in the Core Central Region (CCR) fell for the first time on a y-o-y basis since end-2020, registering a 1.3% decrease in Q3 2023.

Transaction activity has slowed and stabilised to pre-COVID levels. Overall transaction volume\textsuperscript{24} in Q3 2023 was about 15% lower than in the same quarter the year before, with the moderation in transactions observed across both new sales and resales. As with prices, the slowdown in transactions was most pronounced in the CCR, where transaction volume fell 40% y-o-y in Q3 2023, compared to a decline of 8% in the RCR/OCR, suggesting relatively weaker underlying demand in the CCR (Chart 3.16).

The composition of buyers by residency is expected to stabilise. Foreign demand doubled from about 3% in 2021 amid the pandemic to over 6% in Q4 2022 and Q1 2023 following the easing of travel restrictions (Chart 3.17). However, following the announcement of the cooling measures in April 2023, foreign demand has fallen to about 4% of total transaction activity in 2023 to date.

\textsuperscript{24} Transaction volume figures exclude Executive Condominiums (ECs), unless indicated otherwise.
Transaction volumes have moderated

Number of private residential property transactions

Transactions by residency

Source: URA

Rental momentum continued to ease amid large supply completions

Rents continued to rise but at a much slower pace of 0.8% q-o-q in Q3 2023, marking the fourth consecutive quarter of temperance in rent increases, and the smallest quarterly gain since end-2020 (Chart 3.18). The rising supply of completed units after the dissipation of COVID-19-related disruptions to construction activity helped contain rental pressures. In Q3 2023, the private residential stock increased by about 8,400 units, more than three times the average quarterly increase in 2022. At the same time, with occupation demand easing slightly, the overall vacancy rate increased to 8.4% in Q3 2023, exceeding its long-term average of 6.8% (Chart 3.19).

Looking ahead, rental pressures should continue to abate as a large number of units are slated to be completed. Close to 40,000 private residential units (including ECs) are expected to be completed over 2023 to 2025, double the 20,000 units completed between 2020 and 2022.  

For more details, see URA’s release of the Q3 2023 real estate statistics: https://www.ura.gov.sg/Corporate/Media-Room/Media-Releases/pr23-39.
Supply-demand dynamics in the private residential property market are coming into better balance

In the near term, demand is expected to be restrained by high interest rates and moderation in wage growth. On the supply side, the stock of unsold units remained below the 10-year historical average, but it has increased from its trough in Q1 2022 (Chart 3.20). The government has continued its ramp-up of private housing supply via the Government Land Sales (GLS) Programme to meet demand (Chart 3.21), and will closely monitor market developments including price pressures, with the objective of promoting a sustainable property market.

Chart 3.18 Rental increases have slowed in recent quarters

Private property rental price index (q-o-q change)

Source: URA

Chart 3.19 Vacancy rate exceeded its long-term average after ten consecutive quarters below it

Vacancy rate for private residential property

Source: URA

Chart 3.20 While the unsold inventory is below the long-term average, it has inched up...

Total number of unsold private residential units from projects with planning approvals

Source: URA

Chart 3.21 ...as the government ramped up GLS supply in 2022/23

GLS confirmed list supply

Source: URA
3.5 Outlook

Households are in a healthy position but should manage debt prudently in view of heightened uncertainties ahead

Households have managed the transition to higher interest rates well thus far, cushioned by income growth and accumulated savings. Income growth was underpinned by strong labour market conditions.

Looking ahead, while the labour market is expected to remain supported, nominal wage gains are expected to moderate amid slower growth and global macroeconomic uncertainties. Borrowers should thus remain prudent and maintain their financial buffers where they can, to protect against potential shocks.
Box B
Assessing Mortgage Repayment Risk in a High Interest Rate Environment

This box takes stock of how households were impacted by rising mortgage rates over the past 18 months as they took on new housing loans or refinanced their existing loan contracts with FIs. It also assesses the impact on households who may need to refinance in the coming months under conservative assumptions of interest rate and income shocks.

A significant proportion of FIs’ stock of mortgages have already seen a pass-through of higher interest costs

As of Q3 2023, MAS estimates that more than 70% of FIs’ existing mortgages have already seen some pass-through of higher interest rate costs.

About 40% of FIs’ mortgages are floating rate loans which reference interbank interest rates, such as the 3M SORA. Debt instalments for households with such loans have increased in tandem with the broader rise in interbank interest rates as mortgage rates are repriced (typically on a quarterly basis) by the full extent of the change in the reference rates. SORA-based floating mortgage rates rose from around 1% in early-2022 to about 4.5% as of October 2023, mirroring the sharp increase in the 3M SORA over the same period (Chart B1).

About 30% of FIs’ mortgages are linked to board rates or fixed deposit rates (which track benchmark interest rates with some lag) and have seen a staggered pass-through of higher interest costs to debt instalments (Chart B2).

The remaining 30% of mortgages are on fixed rate packages. Of these, those which originated or were refinanced to their current fixed rate packages from H2 2022 would have seen pass-throughs of higher mortgage rates. That said, others would be shielded from the increase in interest rates if they had locked in their low rates for relatively longer periods before or around the start of the global monetary policy tightening cycle in H1 2022. Any such respite could be temporary as these households would face much higher mortgage rates when they refinance upon the end of their fixed rate lock-in period.

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26 FIs account for 85% of total mortgage value as of Q3 2023 (Source: DOS Household Sector Balance Sheet).
27 In Singapore, the lock-in period for mortgage rate packages ranges from one to five years.
28 For borrowers who do not refinance, they could still face higher mortgage rates as their fixed rate packages are typically converted to loan packages referencing interbank rates (e.g. 3M SORA) after the lock-in period.
The household sector has weathered the rise in mortgage rates well thus far

The monthly mortgage instalments of households taking on new mortgages have increased considerably since H2 2022 in line with higher mortgage rates and property prices (Chart B3). However, the impact on overall debt servicing ability of such households has remained manageable. Between 2022 and 2023 thus far, total monthly debt repayment as a share of income for households for new mortgages has been relatively stable, with the median at a healthy level of around 43%. Relative to 2021, there is also a smaller proportion of households in 2023 with larger total debt repayment as a share of their income (Chart B4). This outcome reflects conservative credit assessment practices at the point of mortgage origination, as part of macroprudential policies put in place. FIs are required to ensure total monthly debt repayments are capped at 55% of a borrower’s monthly income, while LTV limits and loan tenure caps also ensure households’ resilience in servicing their housing loans.

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29 When granting new property loans, FIs need to use the medium-term interest rate (MTR) to compute the borrower’s TDSR and MSR. The MTR is defined as the higher of a 4% per annum (p.a.) floor or the thereafter interest rate, which is the highest possible interest rate applicable during the tenure of a property loan, excluding introductory or promotional rates.

30 For example, a borrower with no existing housing loans is subjected to an LTV limit of 75%.
Among households with existing mortgages, most have also paid down a significant portion of their loans over time. Hence, any increment to the monthly instalment from higher mortgage rates is less pronounced given their relatively smaller outstanding loan amounts as compared to those for new borrowers. As of end-2022, more than half of existing mortgages extended by FIs have less than 20 years of residual loan tenure (Chart B5). Such households tend to have much lower outstanding mortgages (Chart B6) and possibly have stronger financial buffers built up from their savings over the years.

Households with existing mortgages also have lower LTV ratios given the declining loan balances and rise in property prices over the years. For households that refinanced in 2023 thus far, about 75% of households have LTV ratios below 60%. The low ratio provides a good buffer against any fall in property valuations, such as a distressed sale. From a systemic risk perspective, it means that property prices would have to fall very significantly for FIs to experience losses on their mortgage portfolios.

MAS caps the maximum loan tenure for mortgages at 30 years for HDB flats and 35 years for non-HDB properties. Empirically, the median tenure at mortgage origination has remained at about 26 years in recent years.
Loans that were originated or last refinanced in the low-rate environment in 2021—when prevailing rates were about 1.2%—have seen the largest step-up in monthly mortgage instalment. The impact is particularly pronounced for fixed rate loan packages that were refinanced at a higher average rate of 3.7% in January–August 2023, with such households facing an immediate rise in repayments, with the average increase in monthly mortgage instalment at SGD680, or about 6.7% of their monthly income in 2021. Nonetheless, strong income growth has mitigated the impact of recent higher mortgage rates on debt servicing ability, with the monthly income of these households increasing by about 15% on average since 2021.

Moreover, account-level mortgage data suggest that some households have made partial prepayments upon refinancing in 2023. Using the sample of households who originated (or refinanced) their mortgages in 2021 and most recently refinanced in 2023, residual loan amounts were computed assuming the scheduled monthly repayments set out in the 2021 loan contracts. It was observed that for some borrowers, their actual residual loan amount in 2023 was lower than their estimated loan amount, suggesting some extent of partial loan prepayment (Charts B7 and B8). In particular, despite the higher leverage associated with a larger residual loan amount, the paydown of mortgages was more prevalent for private housing than for public housing, likely reflecting the stronger financial capacity of households that borrowed for private properties.
In the year ahead, more households could face higher debt servicing cost, although the impact is still expected to remain manageable.

Given the risk of higher-for-longer global interest rates, more households could face elevated mortgage rates in the coming year. Of particular focus are existing fixed rate loan packages that could see an immediate step-up in monthly mortgage instalment upon refinancing in 2024 should mortgage rates remain higher than levels in 2021/22. This group of borrowers account for about one in 10 housing loans, out of FIs’ entire mortgage portfolio.

MAS conducted a simulation to assess the debt servicing ability of households that refinance and face a step-up in mortgage rates in 2024. This scenario assumed that such borrowers face a higher mortgage rate of 4.5% in 2024 upon refinancing from previous fixed rates. Such borrowers will face an immediate rise in repayments, with the average increase in monthly mortgage instalment at about SGD790, or about 7.5% of their monthly income. However, the monthly incomes of such borrowers have increased by 10% on average since 2021/22, which should cushion the higher incremental mortgage payment.

In a separate simulation of an adverse scenario, borrowers who are expected to refinance in 2024 were subjected to an immediate increase in mortgage rate to 5.5%, alongside a simultaneous income loss of 10%. The results show that such households would still be able to service their mortgages from FIs even under such stress, although a small segment of highly leveraged borrowers, with below-median household income could be more vulnerable to repayment risk. Such borrowers account for less than 5% of total mortgage loans (by count) and comprise mostly private housing loans. Public housing owners who borrow from FIs are

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32 Based on reported income of borrowers who have originated their mortgages or refinanced in 2021 and 2022.
generally more resilient, given their lower mortgage servicing ratios (MSR) in the first instance. In general, borrowers could also have other sources of funds such as cash and CPF-OA funds which could be used for debt servicing.

On the whole, MAS’ stress test of mortgage accounts is conservative. First, MAS assumed an income decline of 10%, although the labour market is expected to remain supported in the coming year with continued wage growth. Second, while the stress test pencilled in a further 100 bps rise in interest rates, the market consensus is that the global inflation and interest rate cycles are at their latter stages.

Sum-up

The degree of stress arising from potentially higher-for-longer mortgage rates varies according to loan profile and borrowers’ characteristics. While relatively newer mortgage loan accounts could face greater debt servicing stress arising from larger outstanding loan amounts and higher property prices, the risk of default remains low, in part reflecting the macroprudential measures MAS had put in place over the years. Existing mortgage loan accounts originated or refinanced in the low-rate environment have seen large step-ups in monthly mortgage instalment. In the coming year, floating mortgage rates could yet reprice higher, while expiring fixed rate packages could see a sharp increase in monthly debt instalments when refinancing. However, such loans should generally be serviceable as borrowers have experienced strong income growth in recent years and paid down their mortgages. Indeed, MAS’ stress tests suggest that most households’ debt servicing ratios would remain manageable even under rather severe scenarios.

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33 The MSR is capped at 30% of a borrower’s gross monthly income. It applies only to housing loans for the purchase of an HDB flat, or an executive condominium (EC) where the minimum occupation period of the EC has not expired.
4 Singapore Financial Sector

Singapore’s financial sector has maintained its strong balance sheet position through multiple shocks over the past year. However, risks to the sector from tighter financial conditions remain elevated. Globally, higher interest rates and slowing growth will continue to put pressure on the debt servicing capabilities of borrowers, potentially raising credit costs for banks and weakening their profitability. Concurrently, tight financial conditions could raise funding costs for both banks and NBFIs, resulting in liquidity strains. Should market expectations of policy rates change markedly, a disorderly repricing of assets may lead to liquidity stresses in many NBFIs. Against this backdrop, banks should maintain adequate provisioning buffers and continue to manage credit risk prudently. Banks and NBFIs should also closely monitor potential liquidity risk and strengthen their liquidity profiles, where needed.

4.1 Banking sector

Banks in Singapore have remained resilient over the past year, with strong capital and liquidity positions supported by healthy profits. Nonetheless, banks could face higher credit costs as debt repayment capabilities of borrowers could weaken amid persistently high interest rates.

Banks in Singapore are well-positioned to deal with these risks. Asset quality is good, and banks have increased provisioning coverage in anticipation of a potential rise in credit cost. The IWST 2023 exercise affirmed that banks have adequate capital and liquidity buffers to weather potential downside risks arising from severe macrofinancial stresses.

<table>
<thead>
<tr>
<th>Banking sector FVI (y-o-y changes)</th>
<th>Q3 2022</th>
<th>Q3 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall banking FVI</td>
<td>↗</td>
<td>↘</td>
</tr>
<tr>
<td>Resident leverage risk</td>
<td>↗</td>
<td>↘</td>
</tr>
<tr>
<td>Non-resident leverage risk</td>
<td>↗</td>
<td>↘</td>
</tr>
<tr>
<td>Liquidity risk</td>
<td>↗</td>
<td>↗</td>
</tr>
<tr>
<td>Maturity risk</td>
<td>→</td>
<td>↘</td>
</tr>
</tbody>
</table>

The overall banking FVI has improved over the past year, supported by an easing of banking vulnerabilities. Liquidity and maturity risks have remained low, as banks maintained strong liquidity buffers and healthy loan-to-deposit (LTD) ratios. A decline in credit growth was reflective of deleveraging by corporates and households in response to rising interest costs, which has led to falling leverage vulnerabilities.
Leverage risk has subsided as tight monetary policy globally has dampened credit demand

The credit cycle has turned with overall credit declining in tandem with the rise in interest rates over the past year and a half (see Chart Panel 4A “Banking Sector: Credit Growth Trends”). Non-bank lending fell by 6.2% y-o-y in September 2023. Excess cash accumulated during the pandemic enabled corporates to actively deleverage to reduce interest expenses. The rise in nominal USD interest rates (concurrent with USD strength) (see Chapter 1, Chart 1.14) has also curtailed demand for USD-denominated loans in favour of local currency loans from banks located elsewhere in EM Asia, impacting corporate loan demand for USD-denominated loans in Singapore (Chart 4.1).

Non-resident loans contracted by 6.4% y-o-y in September 2023, as dollar lending to EM Asia declined. Lending to EM Asia was also weighed down by the ongoing weakness in the global manufacturing sector. On the liability side of the balance sheet, banks in Singapore continued to see strong growth in both resident and non-resident non-bank deposits. The higher deposits have led to increased cross-border interbank lending positions and higher government debt holdings (Chart 4.2) (see Chart Panel 4B “Banking Sector: Cross-border Lending Trends”).

The resident non-bank loan decline bottomed out in August 2023 before moderating slightly to −6.1% y-o-y in September 2023. Loans to the trade-related corporate sector were the largest contributor to the continued decline amid the contraction in non-oil domestic exports and non-oil re-exports. There are however incipient signs of a turnaround as resident non-bank lending picked up on a sequential basis, increasing 0.4% m-o-m in September 2023.

Accordingly, a survey of banks indicated that while loan demand from corporates had fallen over the past year (Chart 4.3), banks expect corporate loan demand to bottom out and remain relatively flat going into 2024.

Indeed, MAS’ econometric work shows that the current weakness in credit is in line with the slowdown in economic activity and higher interest rates. MAS estimated an error correction model (ECM) of resident credit against GDP and interest rates for the period Q4 2004 to Q3 2023. The model residuals remained within one standard error over the most recent periods, suggesting that the explanatory variables (GDP and interest rates) are consistent with current credit dynamics, with no signs of additional credit tightening beyond these macroeconomic fundamentals.

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34 For more details, see Chapter 2 “Singapore Corporate Sector”.
35 MAS conducted a survey of banks in September 2023 to seek industry views on realised credit conditions over the past six months and expectations in Q4 2023 and Q1 2024.
36 A decline in credit that is not well explained by prevailing macroeconomic conditions and interest rates might be indicative of a credit crunch.
Chart 4.1 The contraction in USD loans reflected the impact from Fed Funds rate hikes

Y-o-y growth of non-bank loans vs Fed Funds Rate

Source: Board of Governors of the Federal Reserve System (US), MAS

Chart 4.2 Higher non-bank deposits have led to larger cross-border interbank lending positions

Banking system balance sheet (September 2023)

Source: MAS

Chart 4.3 Loan demand has fallen over the past year, and expected to remain flat

Demand for loans by large corporates

Source: MAS survey

Note: "Net percentage balances" is a market-share weighted aggregate indicator of lenders’ views on demand for loans. Positive values indicate that lenders have responded that demand has increased. Net percentage balances are scaled to lie between ±100. "Expected" values are changes anticipated by banks.

While credit standards have tightened moderately, banks have not increased risk premiums charged on loans significantly

The current tightening of credit standards is moderate by historical standards. A net percentage balance\(^{37}\) of banks (17%) have reported some tightening in credit standards (Chart 4.4). Banks cited the challenging operating environment and sustained high debt servicing costs as warranting continued prudence in banks’ underwriting standards.

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\(^{37}\) "Net percentage" refers to the market-share weighted fraction of banks that reported having tightened minus the market-share weighted fraction of banks that reported having eased.
However, the tighter lending standards have not contributed to a significant rise in interest rates for corporates. Credit risk premiums, as proxied by the spreads of unsecured SME lending rates over the estimated cost of funds remained below historical peaks (Chart 4.5), and banks have continued to provide credit to SME borrowers (see Chapter 2.1).

**Chart 4.4** Credit standards have started tightening moderately

<table>
<thead>
<tr>
<th>Lending terms and conditions for large corporates</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Graph showing net percentage balances for lending terms and conditions" /></td>
</tr>
</tbody>
</table>

Source: MAS survey

Note: "Net percentage balances" is a market-share weighted aggregate indicator of lenders’ views on lending terms and conditions. Positive values indicate that lenders have responded that lending terms have loosened. Net percentage balances are scaled to lie between ±100. “Expected” values are changes anticipated by banks.

**Chart 4.5** SME credit spreads remained below historical peaks

<table>
<thead>
<tr>
<th>Estimated risk premium of new unsecured loans</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Graph showing risk premiums" /></td>
</tr>
</tbody>
</table>

Source: MAS survey

Note: The spread for each unique loan facility extended by the reporting banks to SMEs was estimated by calculating the difference between the interest rate charged at inception for the facility and the 3-month compounded SORA on the date the facility was granted.

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**Banks could face higher credit costs if interest rates are higher-for-longer**

Higher interest rates have had limited impact on asset quality so far, as evidenced by persistently low NPL ratios. Compared to a year ago, most sectors registered either unchanged or better asset quality. NPL ratios for the construction, transport and storage, and electricity, gas & water sectors have improved although they remain relatively high at 6.4%, 5.2% and 4.5%, respectively (Chart 4.6).

However, there are early signs of potential asset quality deterioration. The special mention ratio has ticked up slightly to 3.3% in Q3 2023, largely driven by corporate loans (Chart 4.7). Additionally, the share of loans that are less than 90 days past due, which serves as an advanced indicator of impaired loans, has risen since Q1 2023, although it remains very low at 0.6% in Q3 2023 (Chart 4.8). Looking ahead, still elevated inflation and persistent high interest rates could weigh on corporate profitability and debt repayment ability, placing pressure on banks’ asset quality.

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Credit facilities that exhibit potential weaknesses but are not yet classified as NPLs.
To manage this risk, banks continue to maintain adequate provisioning against a potential decline in credit quality. Banks have steadily increased provisioning coverage since Q3 2022 as a pre-emptive response to the potential rise in credit cost, bringing total provisioning coverage39 to 111.2% in Q3 2023 (see Chart Panel 4C “Banking Sector: Asset Quality and Liquidity Indicators”).

Provisioning coverage among local banking groups was particularly high, rising to 229% in Q3 2023 even as NPL ratios remain low, aided by strengthening profitability over 2023 (see Chart Panel 4D “Banking Sector: Local Banking Groups”). Rising net profits also underpin local banks’ strong capital positions, as aggregate CET1 CARs are well above regulatory requirements, at 14.0% as at Q3 2023. Strong capital buffers, supplemented by ample provisions, will ensure that local banking groups are well placed to withstand increases in

39 The banking system’s total provisioning coverage is the sum of general and specific provisions as a share of unsecured non-performing assets (NPA).
credit losses due to the high interest rate environment. The results of the IWST 2023 exercise also indicate that banks in Singapore have adequate capital buffers to weather potential downside risks (see Box C “Industry-Wide Stress Test of D-SIBs”).

Nevertheless, as interest rates are likely to stay high for some time, rising credit costs coupled with the levelling off in net interest margins could adversely impact banks’ profitability and capital positions. Against these challenges, banks should continue to manage credit risk prudently and maintain adequate provisioning buffers.

**Increased liquidity supervision and stress tests have affirmed the strength of Singapore banking sector’s liquidity buffers**

While global banking stresses in early 2023 raised concerns about the liquidity risks faced by banks worldwide, Singapore banks were well supported by their strong liquidity positions. The liquidity buffers of domestic systemically important banks (D-SIBs) are well above all-currency and SGD minimum regulatory Liquidity Coverage Ratio (LCR) requirements (see Chart Panel 4E “Banking Sector: Domestic Systemically Important Banks”). Their liquidity buffers are also above the weighted average LCR of internationally active banks. The liquidity stress test included in the 2023 IWST underscored that banks have sufficient liquidity buffers to withstand severe market-wide and idiosyncratic liquidity stresses—these include high asset haircuts, significant non-bank deposit withdrawals and constrained access to funding markets.

The banking system’s funding structure has remained healthy, as non-bank deposits constitute more than 80% of the system’s total funding (Chart 4.9). Following the surge in deposits during the pandemic, banks continued to see strong deposit growth. This was largely driven by individuals who took up higher-yielding fixed rate deposits (Chart 4.10).

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The weighted average LCR for the Group 1 banks reporting data for the December 2022 reporting date decreased by 6.2 percentage points from June 2022 to 132.0%. Group 1 banks are those that have Tier 1 capital of more than EUR3 billion and are internationally active, and the sample covers 26 countries.
Banks’ capacity to support credit to the economy has been underpinned by the ample supply of deposits, with the banking system’s SGD and foreign currency LTD ratios improving to 69.7% and 66.8%, respectively in September 2023 (see Chart Panel 4C “Banking Sector: Asset Quality and Liquidity Indicators”). Specifically, USD LTD ratios across all bank types have remained below 100% (Chart 4.11), implying that USD deposits are more than sufficient to fund USD loans.

Looking ahead, tight financial conditions could impact banks’ funding costs, leading to liquidity strains. As such, banks should closely monitor potential liquidity risk and strengthen their funding profiles to guard against these risks. MAS will also continue to engage banks to strengthen their liquidity risk management practices, drawing on lessons learnt from the global banking stresses that occurred in early 2023.
4.2 Non-bank sector

Financial assets of investment funds fell amid a period of high volatility in asset markets, persistent inflation and aggressive interest rate hikes over the past year. Nevertheless, fund managers in Singapore have been able to meet redemptions in an orderly manner.

Insurers in general also faced a difficult investment environment due to volatility in equity and credit spread markets. Despite these challenges, insurers continued to maintain healthy capital buffers and sound liquidity positions.

More details on these NBFI sectors can be found in the in-depth study of the potential vulnerabilities that key NBFI sectors face and their potential linkages to the rest of the financial system (see Special Feature 2 “Analysing Vulnerabilities of Non-bank Financial Institutions in Singapore”). The study adopts a two-part monitoring approach, examining key NBFI sectors (“entity-based monitoring”) and their key activities (“activity-based monitoring”) that could pose risks to the stability of the financial system in Singapore.
Box C
Industry-Wide Stress Test of D-SIBs

D-SIBs in Singapore have remained well-capitalised. In an adverse scenario of lower-than-expected global growth and a global banking crisis, D-SIBs would be able to maintain capital buffers that are well above regulatory minimums.

D-SIBs have maintained strong capital positions, with their aggregate CET1 CAR remaining well above the regulatory minimum in Q3 2023 (Chart C1). To bolster their resilience, D-SIBs have also been conducting regular stress tests against interest rate and liquidity risks, and have allocated adequate provisioning buffers to cushion against potential credit losses that could arise amid uncertainty in the global economic environment (Chart C2).

**Chart C1** D-SIBs’ capital positions have remained well above regulatory requirements

**Chart C2** D-SIBs have continued to set aside adequate provisions to cushion against credit losses

<table>
<thead>
<tr>
<th>Year</th>
<th>CET1 CAR</th>
<th>CET1 Regulatory Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 Q4</td>
<td>14.1</td>
<td>6.5</td>
</tr>
<tr>
<td>2019 Q4</td>
<td>14.4</td>
<td>6.5</td>
</tr>
<tr>
<td>2020 Q4</td>
<td>14.5</td>
<td>6.5</td>
</tr>
<tr>
<td>2021 Q4</td>
<td>14.7</td>
<td>6.5</td>
</tr>
<tr>
<td>2022 Q4</td>
<td>14.5</td>
<td>6.5</td>
</tr>
<tr>
<td>2023 Q3</td>
<td>14.1</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Source: MAS

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Provisioning Coverage Ratio*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 Q4</td>
<td>180</td>
</tr>
<tr>
<td>2019 Q4</td>
<td>188</td>
</tr>
<tr>
<td>2020 Q4</td>
<td>214</td>
</tr>
<tr>
<td>2021 Q4</td>
<td>207</td>
</tr>
<tr>
<td>2022 Q4</td>
<td>220</td>
</tr>
<tr>
<td>2023 Q3</td>
<td>205</td>
</tr>
</tbody>
</table>

Source: MAS

*Total provisions/total unsecured NPAs

MAS’ IWST 2023 exercise assessed D-SIBs’ resilience to severe financial sector stresses and a protracted global recession amid the high interest rates environment

The IWST 2023 exercise required D-SIBs to assess the resilience of their balance sheets and capital positions under two macroeconomic scenarios (central and adverse) over a three-year horizon.

The central scenario assumes that the AE central banks pause rate hikes or gradually lower rates, as inflation is brought under control and global economic growth proceeds at a healthy pace. The Singapore economy continues to grow at the projected pace, as the
electronics cycle turns up and China provides a modest boost to the continued recovery in the travel-related and consumer-facing services sectors.

By contrast, under the adverse scenario, AE central banks tighten monetary policy in response to renewed supply-side shocks (e.g. commodity price shocks) that de-anchor inflationary expectations and exacerbate price pressures. Higher interest rates trigger a global banking crisis, and credit conditions tighten considerably as banks cut lending to shore up their buffers, dampening investment and consumption spending. There are large spillovers to the EMES, including China. The Chinese economy slows sharply due to softening global demand conditions and increased stresses in its domestic real estate sector. Regional economies are also impacted extensively given their close trade ties with China.

In this adverse scenario, the contraction in economic activity in key trading partners leads to a sharp downturn in Singapore, particularly in its external-facing sectors (Charts C3 and C4). Elevated interest rates and rising unemployment put pressure on corporate and household debt servicing abilities, causing banks to incur increased credit losses as defaults rise. At the same time, Singapore FIs face elevated market and funding liquidity risks due to dysfunction in key USD funding markets and FIs’ own weakened capital positions. Compared to IWST 2022, this year’s adverse scenario features a more protracted recession, with the Singapore economy experiencing two consecutive years of negative growth (Chart C3).
D-SIBs’ aggregate CET1 CAR is projected to remain well above minimum regulatory requirements under the adverse scenario

Under the adverse scenario, D-SIBs’ projections indicate that their aggregate CET1 CAR\(^{41}\) would reach a trough of 9.7% in Year 2, remaining above MAS’ minimum CET1 regulatory requirement of 6.5%, and the combined CET1 and capital conservation buffer (CCB) threshold of 9.0% (Chart C5). Overall, the results of the IWST 2023 exercise show that D-SIBs would have adequate capital buffers to withstand severe macrofinancial shocks featured under the adverse scenario.

**Chart C5** D-SIBs’ aggregate CET1 CAR would remain above minimum regulatory requirements, even under the IWST adverse scenario

Projected D-SIBs’ aggregate CET1 CAR

![Graph showing projected CET1 CAR for D-SIBs](image)

Source: D-SIBs’ submissions, MAS estimates

The decline in the aggregate CET1 CAR is driven primarily by the rise in credit risk-weighted assets (RWA)\(^{42}\) (4.6 percentage points) and credit impairments (2.3 percentage points), reflecting significant deterioration in the asset quality of D-SIBs’ corporate and household credit portfolios (Chart C6). That said, D-SIBs’ aggregate capital positions would benefit from an increase in gross revenues. While D-SIBs’ profitability would be affected by declining non-interest and net trading incomes due to weak macroeconomic and financial market conditions, this would be more than compensated by an increase in net interest incomes due to widening NIMs in the high interest rate environment, with lending rates rising faster than deposit rates.

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\(^{41}\) While the results for individual D-SIBs are not shown in this box item, each individual D-SIB’s CET1 CAR is also projected to remain well above minimum regulatory requirements under the adverse scenario.

\(^{42}\) A deterioration in the financial health of banks’ counterparties would increase the probabilities of default associated with these exposures. This results in their reclassification to lower-quality credit grades that warrant higher risk weights, in line with Basel bank capital rules.
MAS augmented its stress testing approach by assessing second-order solvency-liquidity feedback effects...

Beyond the direct first-order impact from macrofinancial stresses, second-order solvency-liquidity feedback effects could result in further deterioration of banks’ capital positions. A negative shock to banks’ capital ratios could reduce their creditworthiness and increase wholesale funding costs, which in turn would erode profits and impede banks’ ability to replenish their capital buffers under stress.

To model these solvency-liquidity dynamics, MAS estimated the relationship between bank funding costs (proxied by market-implied credit default swap (CDS) spreads) and banks’ CET1 capital ratios, other bank fundamentals and macrofinancial variables using the generalised method of moments (GMM) (Arnould et al., 2020 and Aymanns et al., 2016). This procedure made use of an unbalanced panel dataset of 168 banks from Q1 2011 to Q4 2022. Results show that solvency-liquidity feedback effects are relatively significant,43 with a one percentage point decline in CET1 CAR resulting in a 12 basis points increase in funding costs on average (Table C1). This result is broadly in line with the range of estimates reported by other empirical studies.44

The coefficient estimates from the model and D-SIBs’ projected stressed CET1 CARs were used to project the funding cost increases, which were then applied on D-SIBs’ wholesale

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43 The estimated model passes the standard statistical tests for instrument validity and second-order serial correlation. The GMM procedure makes use of instrumental variables to account for endogeneity, including those arising from time-invariant fixed effects such as different bank nationalities and bank business models (e.g. commercial banks, wholesale banks).

44 Most estimates range from about 2–26 bps increase in funding costs for a percentage point decline in capital ratios (Arnould et al., 2020; Aymanns et al., 2016; Babihuga and Spaltro, 2014; Gamborta and Shin, 2018). Differences in estimates could arise due to variations in factors, such as bank sample and the empirical approaches adopted.
liabilities. The subsequent increase in interest expenses would further weaken D-SIBs’ capital positions. The additional impact due to higher funding costs would amount to an additional 0.4–0.6 percentage points decline in CET1 CAR each year under the adverse scenario (Chart C7).

Table C1 Second-order solvency-liquidity feedback effects are significant and can amplify initial shocks

Estimated relationships for key variables

<table>
<thead>
<tr>
<th>Dependent variable: Market-Implied CDS Spreads</th>
<th>Variable</th>
<th>Estimated Relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank-specific variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market-Implied CDS Spreads (Lagged)</td>
<td></td>
<td>+**</td>
</tr>
<tr>
<td>CET1 Capital Ratio (Capital)^</td>
<td></td>
<td>−*</td>
</tr>
<tr>
<td>(\frac{\text{Loan Loss Reserves}}{\text{Total Loans}}) (Asset Quality)</td>
<td></td>
<td>+*</td>
</tr>
<tr>
<td>(\frac{\text{Net Income}}{\text{Shareholder Equity}}) (Earnings)</td>
<td></td>
<td>−**</td>
</tr>
<tr>
<td>(\frac{\text{Non-Bank Loans}}{\text{Total Assets}}) (Liquidity)</td>
<td></td>
<td>+**</td>
</tr>
<tr>
<td>Macrofinancial variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 10-year Treasury Bill Rate</td>
<td></td>
<td>+**</td>
</tr>
<tr>
<td>GDP Growth Rate</td>
<td></td>
<td>−**</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Haver, MAS estimates

Note: ** and * represent statistical significance at the 1%, 5% levels respectively.

^A natural logarithmic transformation is applied on the Capital variable to capture non-linear effects.

...and potential mark-to-market losses from banks’ held-to-maturity assets

Global banking sector developments in H1 2023 highlighted how unrealised losses on banks’ held-to-maturity (HTM) debt securities portfolios could be an important driver of bank
stresses. While HTM securities are not marked to market (MTM), banks will need to recognise any MTM losses on their balance sheets if they are forced to sell these securities to meet liquidity needs under stress. Translating these annual MTM losses into impact on capital positions, D-SIBs’ aggregate CET1 CAR would decline by an additional 0.6–0.7 percentage points each year from their projected stressed capital projections under the adverse scenario (Chart C7).

Overall, these results show that D-SIBs’ capital levels would still remain above the regulatory minimum of 6.5% under the adverse scenario even after absorbing the impact from higher funding costs and MTM losses on HTM assets (Chart C7).

**Chart C7**  D-SIBs have sufficient capital buffers to cushion the impact from higher funding costs and MTM losses on their HTM assets under the adverse scenario

Solvency impact of higher funding costs and MTM losses for HTM assets

<table>
<thead>
<tr>
<th>Year</th>
<th>Adverse Scenario (With overall effects)</th>
<th>CET1 Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 0</td>
<td>14.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Year 1</td>
<td>10.9</td>
<td>11.2</td>
</tr>
<tr>
<td>Year 2</td>
<td>8.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Year 3</td>
<td>0.6</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Source: D-SIBs’ submissions, MAS estimates

**Sum-up**

D-SIBs have maintained strong capital positions amid the current uncertain environment. Results from the IWST 2023 exercise show that D-SIBs would have adequate capital buffers to weather potential downside risks arising from severe financial sector stresses, a global recession and a further tightening in financial conditions, with their aggregate CET1 CAR remaining well above MAS’ minimum regulatory requirements.

Beyond assessing direct macrofinancial impacts, MAS also augmented its stress testing approach by incorporating the assessment of second-order solvency-liquidity feedback effects and potential MTM losses on banks’ HTM assets. The modelled results show that banks have adequate capital buffers to cushion the additional impact arising from these transmission channels under the adverse scenario. MAS will continue to refine and augment its capabilities

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Based on current accounting and capital rules, banks do not need to factor any mark-to-market gains/losses on their HTM assets into their net profits and regulatory capital computations, and these gains/losses are considered to be unrealised.
to ensure that its stress tests remain useful and relevant as a tool for risk assessment and management.

References


Overall loan growth declined by 3.8% y-o-y as of September 2023 as both non-bank and interbank loans fell. The fall in non-bank loans was broad-based by residency.

Resident non-bank credit growth was weighed down by declines in lending to trade-related sectors, in line with the softening in external demand.

The credit-to-GDP gap for Singapore has remained negative at −26.0% as of Q3 2023.

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46 Consumer and Travel-related refers to Retail Trade and Accommodation and Food Services Activities. Property-related refers to Construction and Property and Development of Land. Trade-related refers to Manufacturing, Wholesale Trade, and Transport and Storage.
Chart Panel 4B   Banking Sector: Cross-border Lending Trends

While non-bank loans to EM Asia have declined, they remain the largest share of cross-border non-bank loans.

**Chart 4B1** Cross-border non-bank loans by region

- EM Asia
- Developed Asia
- Europe
- Americas
- Others

**Chart 4B2** Cross-border interbank loans by region

- EM Asia
- Developed Asia
- Europe
- Americas
- Others

Banks in Singapore have been net providers of credit to Developed Asia, Europe and Americas in recent months. Local and Japanese banks continued lending to EM Asia.

**Chart 4B3** Net lending positions by region

- EM Asia
- Developed Asia
- Europe
- Americas
- Others

**Chart 4B4** Net lending positions to EM Asia by bank nationality

- Others
- Singapore
- Japan
- Europe
- EM Asia
- Developed Asia (excl. Japan)
- Americas

Under the new MAS Notice 610/1003 reporting requirements implemented in July 2021, some data are not comparable with historical periods (pre-July 2021) due to a change in data definitions. Please refer to the Data Annex in MAS’ 2021 Financial Stability Review for more details.
The overall NPL ratio improved slightly to 1.7% as of Q3 2023. Total provisioning coverage increased to 111.2% as of Q3 2023.

Banks’ liquidity positions have continued to be strong. Resident deposits are more than sufficient to fund resident loans. All LTD ratios remained below 100% as of September 2023.
Chart Panel 4D  Banking Sector: Local Banking Groups

Local banking groups’ net profits increased as of Q3 2023, driven primarily by growth in net interest income. NIMs have stabilised at 2.18% as of September 2023.

Chart 4D1 Local banking groups’ profit components

Source: Local banking groups’ financial statements, MAS

Asset quality remained stable, with a slight improvement in NPL ratio to 1.2% as of Q3 2023. Local banking groups maintained a healthy total provisioning coverage of 229% as of Q3 2023.

Chart 4D3 Local banking groups’ NPLs

Source: Local banking groups’ financial statements, MAS

Chart 4D2 Local banking groups’ NIMs

Source: Local banking groups’ financial statements, MAS

Chart 4D4 Local banking groups’ provisioning coverage

Source: Local banking groups’ financial statements, MAS
Chart Panel 4E  Banking Sector: Domestic Systemically Important Banks

_D-SIBs maintain robust capital positions, with aggregate CARs well above regulatory requirements._

_Choice 4E1 D-SIBs’ CARs_

_D-SIBs maintain strong liquidity positions that are well above regulatory requirements._

_Choice 4E2 Local banking groups’ all-currency LCRs (Q3 2023)_

_Choice 4E3 Other D-SIBs’ all-currency LCRs (Q3 2023)_

_D-SIBs’ available amount of stable funding is more than sufficient to meet stable funding needs._

_Choice 4E4 D-SIBs’ NSFRs_

Source: D-SIBs’ financial statements, MAS

Source: Local banking groups’ financial statements, MAS

Source: Other D-SIBs’ financial statements, MAS

Source: D-SIBs’ financial statements, MAS
Insurance industry in Singapore remains well-capitalised. The average CAR for direct life and general insurance industry remain well above regulatory requirements.\(^{48}\)

**Chart 4F1** CARs of direct life and direct general insurers

Source: MAS estimates

*New business premiums of the direct life insurance industry fell, driven by reduced sales of participating products. The industry reported net income due to net premiums and unrealised investment gains.*

**Chart 4F2** Direct life insurers: New business premiums

Source: MAS estimates

**New business premiums of the direct general insurance industry increased, with growth noted in SIF and OIF business. The industry also reported positive underwriting and unrealised investment gains.**

**Chart 4F3** Direct life insurers’ net income by source

Source: MAS estimates

**Chart 4F4** Direct general insurers: Gross premiums

Source: MAS estimates

**Chart 4F5** Direct general insurers: Operating results

Source: MAS estimates

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\(^{48}\) With effect from Q1 2020, the valuation and capital framework for insurers in Singapore has been enhanced (revised Risk Based Capital framework, RBC 2). While the RBC 2 is not a major overhaul of the RBC, there are nonetheless some fundamental differences which make the CAR of the two regimes less directly comparable.
Singapore’s OTC derivatives market saw a sizeable increase in CO transactions, majority of which were intragroup transactions by corporates. Foreign banks and dealers remained key participants in the market.

**Chart 4G1** OTC derivatives market in Singapore by asset class and notional outstanding (end-Sep 2023)

- Interest Rate (IR) 51%
- Foreign Exchange (FX) 33%
- Credit (CR) 1%
- Commodity (CO) 1%

Source: Depository Trust & Clearing Corporation Data Repository (Singapore) Pte Ltd (DDRS), MAS estimates

**Chart 4G2** Cross-sectoral breakdown of notional outstanding (end-Sep 2023) – All asset classes

<table>
<thead>
<tr>
<th></th>
<th>LCL BK</th>
<th>FGN B/D</th>
<th>NBR</th>
<th>C/O</th>
<th>CCP</th>
<th>INDIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCL BK</td>
<td>0.4</td>
<td>2.9</td>
<td>0.3</td>
<td>0.2</td>
<td>2.5</td>
<td>0.4</td>
</tr>
<tr>
<td>FGN B/D</td>
<td>31.8</td>
<td>16.4</td>
<td>1.3</td>
<td>26.1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>NBR</td>
<td>0.8</td>
<td>0.1</td>
<td>1.3</td>
<td>0.1</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>C/O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.0</td>
<td>&lt;0.1</td>
</tr>
</tbody>
</table>

Source: DDRS, MAS estimates

Note: LCL BK = Locally incorporated bank; FGN B/D = Foreign bank or dealer; C/O = corporate or other non-bank entity

*FX derivatives transactions in the Singapore market comprised mainly of forwards and swaps, with the majority being conducted in developed market currencies.*

**Chart 4G3** FX derivatives by product: Monthly new trades

- Forwards & swaps
- Options
- NDF
- Spot
- Total Count (RHS)

Source: DDRS, MAS estimates

*IR derivatives transactions in the Singapore market were mostly denominated in Asia-Pacific currencies, with the majority being IR swaps.*

**Chart 4G4** FX derivatives by currency: Monthly new trades

- USDJPY
- USDEUR
- USDSGD
- USDAUD
- USDCNY
- USDGBP
- USDHKD
- USDKRW
- USDINR
- USDTWD
- Others

Source: DDRS, MAS estimates

**Chart 4G5** IR derivatives by product: Monthly new trades

- Others
- Options
- Cross Currency Swap
- FRA
- Interest Rate Swap
- Trade Count (RHS)

Source: DDRS, MAS estimates

**Chart 4G6** IR derivatives by currency: Monthly new trades (excluding cross-currency swaps)

- AUD
- JPY
- USD
- SGD
- KRW
- INR
- THB
- HKD
- NZD
- MYR
- Others

Source: DDRS, MAS estimates
Average degree per counterparty has generally remained stable over the past year. Concentration amongst counterparties fell slightly for CR, while EQ saw a small uptick.

The OTC derivatives network in Singapore is centralised among relatively few influential counterparties, as reflected by high centralisation values.
Special Features on Financial Stability
Special Feature 1

Assessing the Impact of Climate Transition Risk on the Financial System

**Introduction**

To limit global warming to 1.5 degrees Celsius, the global economy will have to undergo a rapid and systemwide transformation towards decarbonisation and achieve net zero carbon emissions by around 2050. Global Greenhouse Gas (GHG) emissions would need to peak before 2025, and decline at least 43% by 2030 relative to 2019 levels to reach this crucial target (IPCC, 2023). Overshooting 1.5 degrees Celsius will likely lead to far more severe and, at times, irreversible impacts on natural ecosystems and the economy. Against this backdrop of intensifying climate physical and transition risks, many central banks and financial regulators, with the participation of FIs, have conducted climate scenario analyses to better understand the implications of climate change on financial stability. Similarly, MAS conducted a climate scenario analysis exercise in 2022 for key banks and insurers and published its findings in the 2022 FSR (MAS, 2022).

Complementing IWST 2022’s long-term (30-year) climate scenarios, MAS seeks to assess the financial impact of transition risk on banks and insurers under two scenarios over the period 2023 to 2030—an early and orderly transition (Smooth Transition) versus a late and disorderly transition (Abrupt Transition). Given that many countries, corporates and FIs with Net Zero ambitions have set 2030 intermediate targets, it is crucial to understand the macrofinancial impact of different transition pathways over this period. MAS thus collaborated with Climate Finance Alpha (CLIMAFIN) to conduct a top-down analysis of the impact of transition risk on banks and insurers.

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49 This Special Feature was prepared in collaboration with Professor Stefano Battiston (University of Zurich and University of Venice), Professor Irene Monasterolo (Utrecht University) and Professor Antoine Mandel (Paris School of Economics).

50 Singapore’s 2030 Nationally Determined Contribution commits to “reduce emissions to around 60 million tonnes of carbon dioxide equivalent in 2030, after peaking emissions earlier”.

51 CLIMAFIN is a climate financial risk consultancy co-founded by Professor Stefano Battiston (University of Zurich and University of Venice), Professor Irene Monasterolo (Utrecht University) and Professor Antoine Mandel (Paris School of Economics).
Methodology of the top-down analysis

MAS estimated the financial impact of transition risk on banks’ and insurers’ Climate Policy Relevant Sector portfolios...

For the top-down analysis, MAS used the Climate Policy Relevant Sectors (CPRS)-2 framework (Battiston et al., 2022) which classifies economic activities at a granular level into 27 sectors based on four criteria: GHG emissions, business model (input substitutability), energy technology and climate policy relevance. This is an improvement over the CPRS-Main framework used in the IWST 2022 climate scenario analysis exercise, as the six CPRS-Main sectors\(^{52}\) have now been more finely disaggregated to better account for the more granular energy technology profiles of firms’ revenues. For example, the “Fossil Fuels” sector in CPRS-Main has been further segmented into sub-sectors such as Gas, Oil and Coal (see Table S1.2 in Annex below). Intuitively, firms from carbon-intensive sectors are expected to face greater transition risk. As the economy transits to cleaner sources of energy, less favourable business outcomes for the fossil fuels sector would increase the market and credit risks associated with FIs’ exposures to the sector.

... under two distinct scenarios—Smooth Transition and Abrupt Transition

In this Feature, MAS assessed the impact of two scenarios (Smooth Transition and Abrupt Transition) on Singapore’s financial system over an eight-year scenario horizon from 2023 to 2030. These scenarios, which are adapted from the NGFS Phase III Scenarios, sketch out decarbonisation pathways that are compatible with the (i) remaining carbon budget consistent with the temperature target, (ii) the trajectory of carbon prices, (iii) the extent of mitigation measures adopted by policymakers and (iv) low-carbon alternatives that are technologically feasible.\(^{53}\)

- The Smooth Transition scenario assumes the transition towards a low-carbon future begins in 2023, with decisive policy action taken by governments to reduce GHG emissions. As natural hazards become more frequent and severe in nature, the urgency of addressing climate change and shifting towards a low-carbon economy becomes more entrenched in the public’s awareness. Consequently, policymakers are spurred to respond in a coordinated manner. Further, the adoption of green industrial policies by some large economies catalyses a “race to green” as other jurisdictions also commit significant fiscal resources (e.g. subsidies) to secure international economic competitiveness in their green sectors. The result is a speed-up in the global decarbonisation process. Climate policies are implemented in an early, orderly, and

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\(^{52}\) The six sectors are “Fossil Fuels”, “Utilities”, “Energy-intensive Manufacturing”, “Building & Construction”, “Transport” and “Agriculture”.

\(^{53}\) Given the delayed implementation of necessary climate policies and the limited progress made in decarbonisation, it is increasingly likely that the green transition would be more disorderly than originally envisaged. Consequently, MAS adapted the NGFS Phase III Delayed Transition scenario to construct the scenarios featured in this top-down analysis. This approach is similar to the one taken by the ECB (see Emambakhsh, et al. (2023)). For the Smooth Transition, it is assumed that jurisdictions start the low-carbon transition immediately in 2023 and achieve their intermediate decarbonisation targets by 2030. Under the Abrupt Transition, the transition starts only in 2026, and policymakers have to implement climate policies at a faster pace to achieve similar levels of decarbonisation as under the Smooth Transition by 2030.
credible manner, and economic and financial adjustments materialise in a more gradual manner.

- The Abrupt Transition scenario features concerted climate policy action beginning only in 2026. Continued inertia results in a delayed climate policy response, as policymakers are preoccupied with addressing persistent inflation, elevated energy prices and the slowing global economy. For this scenario, it is assumed that the 2030 target remains unchanged from the Smooth Transition scenario. However, because the transition begins later, carbon prices increase at a faster pace to reach the target. This leads to higher transition risk as abrupt structural shifts occur in the global economy with policymakers trying to achieve similar levels of decarbonisation in a shorter period. Economic and financial adjustments are sudden and disruptive (e.g. mass divestment of fossil fuel assets), with effects concentrated in climate-relevant sectors.

To estimate climate credit and market losses, the CLIMAFIN methodology considers the revaluation of financial assets from a shift in market expectations

The CLIMAFIN methodology (Battiston et al., 2023) considers the possibility that market participants and firms suddenly revise their expectations of climate policy in the future, with corresponding adjustments in valuations. Here, a key assumption is that market participants now expect the climate transition to occur (i.e. either the Smooth Transition scenario or Abrupt Transition scenario), rather than a business-as-usual scenario (BAU). The change in investors’ expectations can be triggered by new information about energy technologies, climate science or climate policy. With a change in expectations, investors revise their projections of firms’ future investment, production and cashflow trajectories, in line with the expected future climate mitigation policies and the resultant sectoral output trajectories under the transition scenarios. Accordingly, market participants would adjust their computations of credit risk metrics and financial valuations of corporate and sovereign bonds and equities, depending on the economic sector and geography of the firm.

In CLIMAFIN’s model, firms finance capital investments through debt and retained earnings, and the revenues, profits and required investments are determined by the sectoral output trajectories under each scenario. Firms’ Probability of Default (PDs) and Loss Given Default (LGDs) are impacted through the following risk channels:

- Trajectories of economic output: Under a transition scenario, high-carbon activities (e.g. fossil fuels) would experience a sharp decline in output. The lower profit trajectory under the transition scenario would reduce firms’ debt servicing ability. The larger the fall in sectoral output from the BAU scenario relative to the transition scenario, the greater the increase in credit risk.

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54 The NGFS Phase III Current Policies scenario is used to proxy for the BAU scenario, as no new climate policies are introduced beyond those implemented by end-2022.

55 Sectoral economic pathways are derived from the NGFS Scenarios Integrated Assessment Model (IAM) variables. These IAMs jointly model, in an internally consistent manner, the macroeconomic, energy, land-use and climate systems to generate cost-effective transition pathways. In modelling the emissions-intensive energy- and land-use systems, IAMs also include detailed projections of the end-use sectors (e.g. energy demand for the buildings, transport and heavy industry sectors) within each of these systems.
• **The degree of asset stranding:** From a balance sheet perspective, under both scenarios, firms will have overinvested in capital equipment for high-carbon activities, resulting in unanticipated asset devaluations. The greater the output adjustment, the larger the decline in the economic value of these assets. Firms would also have to continue paying interest costs on debt liabilities that were previously incurred to finance these investments. In addition, firms may not be able to immediately adjust production (e.g. to cease fossil-fuel-based production) due to frictions, leading to delays in adjusting their investment plans under the transition scenario.\(^{56}\) Overall, firms’ PDs will increase due to the reduction of asset values relative to liabilities and LGDs will increase as the fall in asset values would reduce the amounts recoverable by lenders upon default.

To obtain credit cost and credit loss estimates for banks, the PD and LGD adjustments induced by the shift in expectations from a BAU to a transition scenario are applied to the banks’ credit exposures by sector and geography (e.g. the air transportation sector in Singapore) to estimate banks’ expected credit losses (ECL), in line with IFRS 9 accounting standards. For corporate bonds, the derived PDs and LGDs are used to adjust their values under different scenarios.\(^{57}\) For equities, the revaluation is conducted by computing the discounted present value of adjusted dividend payments, conditional on the firm not defaulting.\(^{58}\) These bond and equity valuation adjustments are then applied to banks’ and insurers’ market portfolios by sector and geography to derive market losses.

**Assessing the potential impact of transition risk on key banks and insurers**

This top-down analysis covered only key banks and insurers, with a focus on credit and market risk. The banks that are covered represent over 70% of total domestic lending in Singapore, while participating insurers represent over 90% of total assets (for direct life and composite insurers) and over 80% of gross weighted premiums (for direct general insurers and reinsurers). As part of joint efforts to enhance data availability and granularity, MAS worked with FIs to segment their end-2022 credit and market exposure by CPRS-2 sector and geography.

An analysis of the banks’ credit portfolio reveals that 27.6% of their total credit exposures as of end-2022 are to counterparties in CPRS (Chart S1.1). For the banks’ market portfolio, 5.1% of bond exposures and 54.1% of equity exposures are to CPRS. When sized relative to only non-financial corporate exposures, 59.9% of credit exposures and 28.0% of bond exposures are to CPRS.\(^{59}\) More than half of these credit exposures and more than a third of

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\(^{56}\) For example, the shift of expectations towards the realisation of a transition scenario might occur midway through the construction of a coal-fired power plant, but firms are forced to incur more debt to facilitate continued investment in the project due to business contracts that are already in place.

\(^{57}\) Specifically, the bond value is a probability weighted sum of the discounted present value of the par value of the zero-coupon bond conditional on no default occurring, and the discounted recoverable portion (i.e. the recovery rate of the bond, which is also equal to \((1 – \text{LGD})\)) of the bond value assuming the firm defaults.

\(^{58}\) The dividend payments are in turn adjusted based on the output and profit trajectories conditioned to the different scenarios.

\(^{59}\) These figures exclude indirect exposures to CPRS, for example from financial counterparties with exposures to CPRS.
these market exposures are to the Building and Construction sector,\textsuperscript{60} which is projected to experience relatively mild credit deterioration\textsuperscript{61} (Chart S1.7). As banks’ CPRS market (bond and equity) exposures are relatively small, amounting to 2.8% of banks’ CPRS credit exposures, a more granular breakdown of only the credit exposures by CPRS-2 sectors has been provided in Chart S1.2 for some of the larger (e.g. Energy-intensive Manufacturing | Electrical, Utilities | Fossil Fuels) and/or more transition vulnerable (e.g. Fossil Fuels | Coal, Energy-intensive Manufacturing | Cement) CPRS-2 sub-sectors.

For insurers’ investment portfolios, 29.3\% of their total bond exposures are to CPRS, which amount to 67.3\% of their non-financial corporate bond exposures, while 26.6\% of their total equity exposures are to CPRS (Chart S1.1). To obtain a more granular view of their exposures, a further breakdown by CPRS-2 sectors has been provided in Chart S1.3 for some of the larger (e.g. Energy-intensive Manufacturing | Other, Energy-intensive Manufacturing | Electrical) and/or more transition vulnerable (e.g. Fossil Fuels | Coal) CPRS-2 sub-secto rs.

\begin{center}
\textbf{Chart S1.1} MAS’ top-down analysis focused on banks’ and insurers’ credit and market exposures to CPRS counterparties
\end{center}

\begin{center}
\begin{tabular}{ccc}
<table>
<thead>
<tr>
<th>Sector</th>
<th>Credit</th>
<th>Bond</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bldg &amp; Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy-int Mfg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fossil Fuel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
\end{tabular}
\end{center}

Source: Banks’ submissions, MAS estimates

* The “Others” category includes banks’ and insurers’ exposures to non-CPRS corporates, sovereign and retail counterparties (where relevant).

\textsuperscript{60} This sector primarily consists of firms that engage in the construction of buildings and relevant adjacent activities such as installation activities (e.g. electricity installation), as well as real estate activities (e.g. real estate development).

\textsuperscript{61} The more favourable outcome for the sector reflects potential upsides arising from greater investment in climate adaptation measures for infrastructure and green retrofitting to improve building energy efficiency. For example, Singapore is accelerating efforts to green 80\% of its existing and new buildings by 2030 as part of the Singapore Green Building Masterplan.

\textsuperscript{62} This Special Feature follows the convention “CPRS Main sector | CPRS-2 sub-sector” when referring to specific sectors. For example, the coal sub-sector would be written as “Fossil Fuels | Coal”.

\textsuperscript{63} This sector includes firms that engage in the manufacturing of a wide range of products, such as petrochemicals, chemical products, and machinery.
Banks and insurers will incur significantly higher financial losses under the Abrupt Transition scenario than under the Smooth Transition scenario

For banks, credit losses as a proportion of CPRS exposures (i.e. credit costs) are projected to increase across both the Abrupt Transition and the Smooth Transition scenarios. However, the aggregate credit costs (2.43%) incurred under the Abrupt Transition scenario are 50% higher than that under the Smooth Transition scenario (Chart S1.4). When annualised, these credit costs amount to approximately 14.2% and 6.0% of banks’ FY2022 net profits under the Abrupt and Smooth Transition scenarios, respectively. In terms of market exposures, banks would also incur larger aggregate market losses of 3.1% of their market portfolios under the Abrupt Transition scenario, compared to 2.2% under the Smooth Transition scenario (Chart S1.5). However, given that banks’ market exposures are small relative to their credit exposures, these losses are correspondingly of a smaller magnitude, amounting to 2.6% and 1.9% of FY2022 net profits. For insurers, the Abrupt Transition scenario would also result in greater market losses of 4.5% compared to 2.9% under the Smooth Transition scenario (Chart S1.6). Overall, these findings are consistent with assessments conducted by other jurisdictions, where larger economic and financial losses are incurred under a disorderly transition scenario compared to an orderly transition scenario.

These results show the more severe impacts of a disorderly transition, as abrupt structural shifts can leave firms with little time to adjust their business models and decisions. An abrupt

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64 The analysis in this Special Feature took a more conservative approach by focusing primarily on the risks that could arise from a low-carbon transition. A more comprehensive analysis would take into account both the mitigating factors (e.g. firms’ climate mitigation plans), as well as opportunities and benefits that could accrue to selected sectors (e.g. electric vehicle manufacturers).

65 Market adjustments are assumed to take place instantaneously, resulting in an immediate hit to FIs’ market portfolios. Market losses are also assumed to be unhedged.

66 A global survey of climate scenario analysis exercises highlighted that most jurisdictions found more significant GDP and financial losses under disorderly transition scenarios as compared with an orderly transition scenario (FSB and NGFS, 2022).
transition could introduce shocks that hit firms’ cashflows and profits more severely, while an orderly and credible transition process would result in lower credit and market losses for FIs.

In addition, to complement the analysis at the aggregate level, a deep dive was conducted on individual FIs’ portfolios to better understand the distribution of risks across the banking and insurance sectors. The analysis suggests that there is considerable heterogeneity in transition risk profiles across FIs. For banks, credit cost estimates range from 0.37% to 4.6% (Chart S1.4). Similarly, there is heterogeneity in market loss estimates across banks, ranging from 0.02% to 3.6% (Chart S1.5), and across insurers, ranging from 0.31% to 8.4% (Chart S1.6). Depending on the sectoral composition of their portfolios, the impact of transition risk on individual FIs can differ significantly. Further analysis revealed that banks and insurers with the largest increase in credit costs and market losses are relatively more exposed to transition-vulnerable sectors such as Fossil Fuels, in particular the Coal and Oil & Gas sub-sectors. This heterogeneity in FIs’ transition risk profiles is examined in the following subsections, with a focus on the sectoral composition of banks’ credit portfolios and insurers’ market portfolios.
Credit deterioration was particularly pronounced for a subset of the banks’ CPRS portfolios.

Projections of credit costs for banks were disaggregated at the sectoral level for both transition scenarios to assess the extent of credit deterioration at the more granular CPRS-2 level. Chart S1.7 shows that the impact of transition risk is concentrated in a few CPRS-2 sectors, with the extent of credit deterioration (credit costs) being most pronounced in the four CPRS-2 sectors highlighted in Table S1.1 below.

Under a transition scenario, firms operating in these sectors could face material financial risks as policymakers ramp up the shift to alternative, cleaner sources of energy and reduce dependence on fossil fuels. Similarly, sectors that rely heavily on carbon-intensive production...
processes would face increased production costs and reduced profits as policymakers hike carbon taxes significantly to cut emissions.

Table S1.1 Overview of CPRS-2 sectors with the most pronounced credit deterioration

<table>
<thead>
<tr>
<th>Sector</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuels</td>
<td>Coal</td>
<td>Mining and quarrying, and manufacture of coke oven products</td>
</tr>
<tr>
<td>Utilities</td>
<td>Fossil Fuels</td>
<td>Power plants that generate electricity using fossil fuels</td>
</tr>
<tr>
<td>Energy-intensive Manufacturing</td>
<td>Cement&lt;sup&gt;67&lt;/sup&gt;</td>
<td>Manufacture of cement, concrete and plaster; Production of pre-cast components</td>
</tr>
<tr>
<td>Energy-intensive Manufacturing</td>
<td>Iron &amp; Steel&lt;sup&gt;68&lt;/sup&gt;</td>
<td>Manufacture and casting of iron and steel</td>
</tr>
</tbody>
</table>

Banks’ sectoral credit losses were obtained by multiplying sectoral credit costs by the banks’ corresponding CPRS-2 exposure amounts. Chart S1.8 presents the amount of credit losses by sector. The top three sectors that contribute most to the projected increases in credit losses are the Utilities | Fossil Fuels, Fossil Fuels | Coal and Building and Construction sectors. Even though the Utilities | Fossil Fuels and Fossil Fuels | Coal sectors constitute a relatively small proportion of banks’ CPRS credit exposures (2.2% and 0.8% respectively, see Chart S1.2), the pronounced credit deterioration in these sectors (Chart S1.7) results in sizeable credit losses for banks. Compared to the fossil fuel sectors, the Cement and Iron & Steel sub-sectors (under Energy-intensive Manufacturing) experience relatively less credit deterioration (Chart

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<sup>67</sup> To manufacture cement, limestone has to undergo a calcination process which emits carbon dioxide. Carbon dioxide is also emitted from fuels that are burnt to produce the heat required in the manufacturing process.

<sup>68</sup> To manufacture iron, coal is used to fuel blast furnaces to reduce iron ores to metallic iron, which produces carbon dioxide and iron as a byproduct. Molten iron is also usually refined into steel in a coal-fired furnace.
and banks’ credit exposures to these two sub-sectors are also smaller at only 0.29% and 0.52% of CPRS exposures, respectively (Chart S1.2). Hence, these two sectors do not contribute materially to the projected increases in credit losses. Finally, the Building and Construction sector turns out to be the single largest contributor to projected increases in credit losses due to banks’ large exposures to the sector (55.3% of banks’ CPRS exposures), even though credit deterioration was projected to be mild under both transition scenarios (Chart S1.7).

**Chart S1.7** Credit deterioration is particularly pronounced for a few CPRS-2 sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Abrupt Transition</th>
<th>Smooth Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy-intensive Manufacturing</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Utilities</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Fossil Fuels</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Coal</td>
<td>4%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*Source: Banks’ submissions, MAS estimates*

**Chart S1.8** The Building and Construction sector is the single largest contributor to banks’ projected credit losses

<table>
<thead>
<tr>
<th>Sector</th>
<th>Abrupt Transition</th>
<th>Smooth Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building &amp; Construction</td>
<td>16%</td>
<td>8%</td>
</tr>
<tr>
<td>Iron &amp; Steel</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Cement</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Fossil Fuels</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Coal</td>
<td>4%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*Source: Banks’ submissions, MAS estimates*

**Insurers incurred significant market losses from selected CPRS-2 sectors**

Insurers’ market exposures to the Fossil Fuels and the Energy-intensive Manufacturing sectors would experience a sharp fall in market value (Chart S1.9) in both scenarios. After accounting for exposure size, the three sectors experiencing the largest market losses are the Energy-intensive Manufacturing | Other, Fossil Fuels | Oil & Gas, and Building & Construction sectors (Chart S1.10). Due to insurers’ relatively large market exposure to the Building & Construction sector (32.4% of insurers’ CPRS market exposures), a relatively mild valuation shock (Chart S1.9) would result in large market losses. For the Fossil Fuels | Oil & Gas and Energy-intensive Manufacturing | Other sectors, the combination of relatively large valuation shocks and exposure sizes (see Chart S1.3) would result in large market losses. In contrast, Singapore insurers incur relatively limited losses on their Fossil Fuels | Coal exposures despite the large valuation shocks (Chart S1.9) as exposures to the sector are small at only 0.03% of CPRS exposures. Major insurers have deliberately kept their investment exposures to the coal sector low as part of their investment strategies.
Conclusion and next steps

This top-down analytical exercise forms part of MAS’ continued efforts to gain a better understanding of the potential impact of various transition pathways on Singapore’s financial system, including its key FIs. The analysis in this Special Feature showed that a disorderly transition could be potentially destabilising and disruptive for the financial system and could result in significant financial losses for FIs. The results also suggest an urgent need for FIs to engage their corporate clients to develop and execute credible transition plans to enable an early and orderly transition. MAS has sought to support FIs in this process by setting clear supervisory expectations on transition planning, and has recently issued a set of consultation papers proposing relevant guidelines for banks, insurers and asset managers.69 Importantly, the uneven distribution of risks and impact across the financial sector warrants close monitoring, and MAS will continue to assess the financial stability implications of climate transition risks.

Going forward, MAS will step up its efforts to improve internal and industry capabilities in climate risk assessments. Internally, MAS intends to incorporate more granular forward-looking information (e.g. corporate transition plans and net zero targets) in its transition risk assessments and build up its physical risk modelling capabilities. For the industry, MAS will continue to encourage FIs to enhance their climate risk assessment capabilities, including by actively engaging FIs on their progress and plans to address data and methodological gaps that were identified during the IWST 2022 climate scenario analysis exercise. This will enable FIs to better factor the implications of climate change and the climate transition into their internal risk management practices and business decisions.

69 For more details, please see “Consultation Paper on Guidelines on Transition Planning for Banks”, “Consultation Paper on Guidelines on Transition Planning for Insurers” and “Consultation Paper on Guidelines on Transition Planning for Asset Managers”.

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**Chart S1.9** The Fossil Fuels and Energy-intensive Manufacturing sectors experienced larger valuation shocks

Market losses (%) of insurers

Source: Insurers’ submissions, MAS estimates

**Chart S1.10** After accounting for exposure size, the Energy-intensive Manufacturing | Other sector contributed the most to market losses

Market losses of insurers

Source: Insurers’ submissions, MAS estimates
References


Fennell, Driver, Bataille, Davis (2022), “Cement and steel—nine steps to net zero”.

Network of Central Banks and Supervisors for Greening the Financial System (2022), “NGFS scenarios for central banks and supervisors”.


Birol, F (2023), “Peak fossil fuel demand will happen this decade”, Financial Times, September 11.

Leaton, J (2011), “Unburnable carbon—Are the world’s financial markets carrying a carbon bubble?”
### Table S1.2 CPRS-Main and corresponding CPRS-2 sectors

<table>
<thead>
<tr>
<th>CPRS-Main</th>
<th>CPRS-2</th>
<th>Brief description of sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuels</td>
<td>Coal</td>
<td>Mining and quarrying; Manufacture of coke oven products</td>
</tr>
<tr>
<td></td>
<td>Gas</td>
<td>Manufacture and distribution of gas; Retail sale of liquefied petroleum gas</td>
</tr>
<tr>
<td></td>
<td>Oil</td>
<td>Manufacture of refined petroleum products and biofuels</td>
</tr>
<tr>
<td></td>
<td>Oil &amp; Gas</td>
<td>Crude petroleum and natural gas production</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Wholesale of fuel and petrochemical products; Sale of automotive fuel; Service activities incidental to oil and gas extraction</td>
</tr>
<tr>
<td>Energy-intensive Manufacturing</td>
<td>Cement</td>
<td>Manufacture of cement, concrete and plaster; Production of pre-cast components</td>
</tr>
<tr>
<td></td>
<td>Electrical</td>
<td>Manufacture of electronic components and boards, computers, and communications equipment</td>
</tr>
<tr>
<td></td>
<td>Iron &amp; Steel</td>
<td>Manufacture and casting of iron and steel</td>
</tr>
<tr>
<td></td>
<td>Rubber &amp; Plastics</td>
<td>Manufacture of rubber and plastic products; Manufacture and repair of plastic processing machinery</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Manufacturing of a wide range of products, such as petrochemicals, chemical products, and machinery.</td>
</tr>
<tr>
<td>Utilities</td>
<td>Electricity</td>
<td>Generation of electricity by other sources (e.g. solar power, biofuels etc.)</td>
</tr>
<tr>
<td></td>
<td>Electricity</td>
<td>Generation of electricity by fossil fuels</td>
</tr>
<tr>
<td></td>
<td>Electricity</td>
<td>Transmission, distribution and sale of electricity</td>
</tr>
<tr>
<td></td>
<td>Electricity</td>
<td>Other related services (e.g. electricity brokers, meter reading)</td>
</tr>
<tr>
<td></td>
<td>Waste</td>
<td>Waste collection, treatment and disposal activities</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Water &amp; Sewerage</td>
<td>Water collection, treatment and supply; Sewerage; Dam, drainage, water and gas pipeline and sewer construction</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Supply of air or water for cooling or heating purposes</td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>Manufacture of air, spacecraft and related machinery; Wholesale of aircraft equipment, Air transport</td>
<td></td>
</tr>
<tr>
<td>Other Manufacturing</td>
<td>Manufacture of other transport equipment</td>
<td></td>
</tr>
<tr>
<td>Railways</td>
<td>Manufacture of railway locomotives and rolling stock; Wholesale of transport equipment except motor vehicles; Transport via railways</td>
<td></td>
</tr>
<tr>
<td>Roads</td>
<td>Manufacture of motor vehicles, motorcycles; Construction of roads; Wholesale and retail sale of motor vehicles and accessories; Passenger land transport; Renting and leasing of private cars</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>Wholesale of marine equipment and accessories; Water transport</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Supporting services to land, water and air transport; Cargo handling</td>
<td></td>
</tr>
<tr>
<td>Building &amp; Construction</td>
<td>Construction of buildings; Specialised construction activities</td>
<td></td>
</tr>
<tr>
<td>Fishing</td>
<td>Fishing, operation of fish hatcheries; Service activities incidental to fishing</td>
<td></td>
</tr>
<tr>
<td>Forestry</td>
<td>Forestry, logging and related service activities</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Agriculture and related service activities</td>
<td></td>
</tr>
</tbody>
</table>
Special Feature 2

Analysing Vulnerabilities of Non-bank Financial Institutions in Singapore

This Special Feature assesses the systemic vulnerabilities and risks of the non-bank financial institution (NBFI) sector in Singapore, focusing on its key transmission channels and linkages to the rest of the financial system. It adopts a two-part approach of (i) entity-based monitoring, focusing on investment funds and insurers, and (ii) activity-based surveillance, focusing on higher volume and riskier NBFI activities, such as over-the-counter (OTC) derivatives trading.

Rapid growth in the NBFI sector has raised the need for monitoring systemic vulnerabilities

Since the 2008 Global Financial Crisis, assets of NBFs worldwide have doubled to more than USD200 trillion—about twice global GDP (FSB, 2022). NBFs now play a key role in global financial intermediation and are important drivers of capital flows internationally, bringing benefits such as diversification, innovation and competition to the financial system. However, recent events—such as the collapse of Archegos in 2021 and the liquidity stresses faced by liability-driven investment (LDI) funds in the UK in 2022—serve as a reminder that NBFs can pose significant risks to financial stability.

In Singapore, the broader NBFI sector has grown to account for 20% of total financial system assets as of end-2022 (Chart S2.1). As a comparison, banks, which continue to dominate the domestic financial system, constituted 58% of total financial system assets in 2022.
Investment funds and insurers are key NBFI segments in Singapore

Within Singapore, insurers, investment funds and trust companies account for 96% of assets in the NBFI sector (Chart S2.2). Insurers, which make up about one-third of the sector, are subject to MAS’ prudential regulation, supervision and stress testing.

Investment funds are a key provider of market-based financial intermediation and make up 22% of domestic NBFI assets. Fund types include open-ended investment funds, offered for a range of asset classes. Such open-ended collective investment vehicles may be structurally susceptible to runs if they allow redemptions but invest in assets that are not always readily available for liquidation.

Licensed trust companies in Singapore do not engage in significant liquidity or maturity transformation, with limited credit intermediation (MAS, 2017). These entities administer trusts that are set up generally to serve individual high net worth clients for wealth preservation purposes, with investment activities being mainly outsourced to third-party investment managers or banks.

Most broker-dealers in Singapore, especially the major ones, are prudentially consolidated under banking groups and are hence subject to strict prudential regulations and banking supervision by MAS. The total assets of non-prudentially consolidated broker-dealers amounted to SGD18.1 billion (or 0.3% of total financial system assets) in 2022.
Potential vulnerabilities of NBFIs

NBFIs may pose systemic risk to the rest of the financial system via (1) interconnectedness, which transmits shocks from NBFIs to other entities, especially banks; (2) leverage that amplifies losses of NBFIs and accentuates liquidity shortfalls; and (3) liquidity mismatches, which are inherent features of NBFIs’ business models that could unravel under stress.

Interconnectedness

Shocks originating from NBFIs are typically transmitted to the wider financial system through two channels—the counterparty channel and the asset liquidation channel. A schematic overview of the potential linkages between the key NBFI sectors and the banking sector is presented in Figure S2.1.

Figure S2.1 Banks could be impacted by an NBFI’s default or through common holdings with NBFIs

Direct and indirect linkages between banks and key NBFIs

The counterparty channel consists of the direct linkages between entities, including the provision of credit, securities financing transactions (SFTs), ownership of fund shares and derivatives exposures. Even without a default, a broader tightening of financial conditions or a perceived increase in counterparty credit risk may result in liquidity challenges for these entities and their counterparties.

The asset liquidation channel takes in the indirect linkages between financial entities, such as shared portfolio holdings or exposures to similar markets. In times of stress, NBFIs may engage in fire sales of assets to meet sudden liquidity demands such as margin calls or redemption shocks. Such fire sales exacerbate price pressures amid poor market conditions, causing other entities with common exposures to be adversely impacted as valuations drop.
Direct linkages between NBFIs and banks are mainly via loans and deposits while indirect linkages are primarily via the bond market.

Singapore’s banking system asset exposures to the broader NBI segment are about 15% of total bank assets, and comprise mostly loans (Chart S2.3). The bulk of exposures are to “Other NBFIs”, a category that includes investment funds, financial leasing corporations and central counterparties. At the same time, NBFIs account for 19% of the Singapore banking system’s liabilities. Deposits make up more than 80% of these liabilities, while repos account for only 2.7%. The IWST 2023 exercise results show that banks have sufficient capital and liquidity buffers to cushion against shocks that could arise from their asset and liability linkages with NBFIs.

Chart S2.3: Banks’ asset exposures to NBFIs are largely in loans and bills, while banks’ liabilities to NBFIs are mainly in deposits.

<table>
<thead>
<tr>
<th>NBFIs’ share of banking system assets and liabilities as of September 2023</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
</tr>
<tr>
<td>Negotiable Certificates of Deposits</td>
</tr>
<tr>
<td>Cash and Balances</td>
</tr>
<tr>
<td>Equity Investments</td>
</tr>
<tr>
<td>Reverse Repos</td>
</tr>
<tr>
<td>Debt Securities</td>
</tr>
<tr>
<td>Loans and Bills</td>
</tr>
</tbody>
</table>

Source: MAS estimates

Note: Derivatives have been excluded from the calculations to focus on credit exposures.

Indirect linkages are assessed through the common exposures of NBFIs and banks in Singapore’s debt and equity capital markets. In Singapore, banks and NBFIs account for a larger share of the bond market than of the equity market (Charts S2.4 and S2.5). Banks are the largest local investors in bond markets, accounting for 34.0% of total bonds outstanding. This is followed by investment funds (12.5%) and insurers (1.3%). More than 90% of banks’ domestic bond holdings are in sovereign bonds, due to capital and liquidity needs.

In contrast, there is limited common ownership in the local equity market. Bank investments comprise only 1.7% of the total market capitalisation of the SGX, while investment funds (5.5%) had slightly larger shares. Insurers (0.1%) have minimal exposures to the equity market.
Leverage

Globally, the past decade of low interest rates has led to an increase in NBFI leverage, potentially amplifying asset price losses in the event of a sell-off. Where leverage is backed by collateral, losses can increase liquidity demands to meet collateral or margin calls, triggering fire sales which lead to further price declines. Leverage can generally be categorised into financial leverage (use of debt, covered in the section on interconnectedness above) and synthetic leverage (use of derivatives).

The SFT market in Singapore, which consists largely of bond repos and securities lending, has grown significantly

To better understand the extent of financial leverage provided or undertaken by key NBFI sectors in Singapore, MAS conducted a survey\(^{70}\) of banks, broker-dealers, and hedge fund managers to size the SFT market\(^{71}\) in Singapore. Domestic insurers were excluded from the survey as regulatory returns indicated that their exposures were less than 1% of the SFT market.

Domestically, the SFT market has grown significantly, expanding from SGD106.4 billion in March 2017 (MAS, 2018) to SGD287.2 billion in June 2023 or 4.9% of national financial system assets.\(^ {72}\) Domestic SFT activity (Table S2.1)—which includes only transactions

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\(^{70}\) Regulatory data was used to identify entities with significant dealings in SFTs. The surveyed entities account for more than 90% of the SFT market as of December 2022.

\(^{71}\) SFTs include repurchase and reverse repurchase agreements (repos and reverse repos), securities borrowing and lending, and margin lending.

\(^{72}\) The size of the SFT market is determined by the sum of the total outstanding amount of financing provided and received from repos, gross market value of instruments borrowed and lent, as well as the outstanding margin loans extended by the surveyed entities. For the purpose of this study, repos conducted with central banks have been excluded. All figures provided hereafter are in terms of value according to the total outstanding amount.
conducted between two Singapore-based entities—constitutes a relatively small share of SFT activity in Singapore, at about 13.5% of the total SFT market (up from 11% in 2017). Most domestic activity is conducted between banks. Cross-border SFTs (i.e. transactions with foreign counterparties), make up 86% of SFTs involving a Singapore-based entity. As with domestic SFTs, domestic banks account for more than two-thirds of these transactions, normally with foreign banks as a counterparty.

Domestic hedge funds, which transact mainly with foreign banks and dealers, account for the bulk of the remaining transactions (Table S2.1). There are hence limited direct linkages between domestic NBFIs and the local financial sector via the SFT market.

### Table S2.1 Domestic transactions are mostly done between banks, with hedge funds reporting their SFT activity mostly with foreign banks

<table>
<thead>
<tr>
<th>Reporting Entity Type</th>
<th>Counterparty Jurisdiction: Singapore (%)</th>
<th>Counterparty Type</th>
<th>Bank</th>
<th>Investment Funds</th>
<th>Broker-dealers</th>
<th>Insurers</th>
<th>Other NBFIs</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank</td>
<td></td>
<td></td>
<td>10.5</td>
<td>0.9</td>
<td>0.2</td>
<td>1.0</td>
<td>0.1</td>
<td>0.3</td>
<td><strong>12.9</strong></td>
</tr>
<tr>
<td>Hedge Funds</td>
<td></td>
<td></td>
<td>0.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td><strong>0.1</strong></td>
</tr>
<tr>
<td>Broker-dealers</td>
<td></td>
<td></td>
<td>0.1</td>
<td>0.1</td>
<td>0.0</td>
<td>-</td>
<td>0.0</td>
<td>0.2</td>
<td><strong>0.5</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reporting Entity Type</th>
<th>Counterparty Jurisdiction: Outside Singapore (%)</th>
<th>Counterparty Type</th>
<th>Bank</th>
<th>Investment Funds</th>
<th>Broker-dealers</th>
<th>Insurers &amp; Pension Funds</th>
<th>Other NBFIs</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank</td>
<td></td>
<td></td>
<td>49.4</td>
<td>8.6</td>
<td>3.3</td>
<td>0.2</td>
<td>2.5</td>
<td>7.7</td>
<td><strong>71.6</strong></td>
</tr>
<tr>
<td>Hedge Funds</td>
<td></td>
<td></td>
<td>9.3</td>
<td>-</td>
<td>5.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td><strong>14.5</strong></td>
</tr>
<tr>
<td>Broker-dealers</td>
<td></td>
<td></td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td><strong>0.4</strong></td>
</tr>
</tbody>
</table>

Source: MAS survey

Note: Domestic transactions refer to SFTs conducted by only Singapore-based entities. Intragroup transactions have been excluded from the sizing of linkages to better reflect the relationship between banks and NBFIs. “Other NBFIs” refer to other NBI entities and single-family offices, while “Others” refer to other types of counterparties that are not FIs.

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The SFT market in 2017 included transactions entered by foreign-domiciled funds with foreign financial institutions. In sizing the local SFT market this year, such overseas-overseas transactions have been excluded to better reflect the channels involving domestically based entities.
The share of SFTs collateralised by government securities increased from 58% in 2017 to 66% in 2023, possibly reflecting cash lenders’ increased preference for relatively safer and more liquid instruments in view of heightened macrofinancial uncertainty.

**Liquidity**

The risk that NBFIs are unable to settle their obligations immediately is of increasing importance to the stability of the financial system as evidenced by recent episodes such as the UK gilts crisis. Facing a sudden surge in investor redemptions, NBFIs with insufficient liquidity will be forced into fire sales of assets to raise cash. Such fire sales can destabilise the financial system via the asset liquidation channel described above.

For open-ended collective investment vehicles, liquidity mismatches—where funds hold portfolios with less liquid assets and offer investors frequent redemptions from their funds—constitute a potential structural vulnerability. This year, MAS conducted its first liquidity stress simulation exercise for both funds domiciled in Singapore as well as funds managed out of Singapore. The exercise concluded that most investment funds would have sufficient liquidity to deal with increased redemptions in times of severe stress. More details can be found in Box D “Liquidity Stress Simulation of Investment Funds in Singapore”.

For insurers, a more rigorous liquidity stress scenario was incorporated into this year’s IWST to assess significant insurers’ liquidity positions under economic stress or a loss of confidence. Details are in the section below.

**Entity-based Monitoring**

**Investment funds**

Buoyed by strong economic growth in the Asia-Pacific over the last decade, Singapore’s position as a pan-Asian asset management hub has grown significantly, underpinned by a vibrant ecosystem of institutional investors and investment managers. Since 2013, the Singapore asset management sector grew at a compound annual growth rate of 10.4% to SGD4.9 trillion of assets under management (AUM) as of 2022 (MAS, 2023).

Assets managed in Singapore by fund management companies (FMCs) comprise collective investment schemes (CIS) and segregated mandates, with the majority of CIS domiciled outside of Singapore. Nevertheless, CIS managed by MAS-regulated FMCs should have effective liquidity risk management (LRM) frameworks and practices to ensure that redemption requests are met in an orderly manner and investors are treated fairly, as set out in the Guidelines on Liquidity Risk Management Practices for FMCs. FMCs must manage the liquidity risk of a CIS throughout its lifecycle, including ongoing monitoring of redemption patterns and regular assessments of the liquidity profile of the CIS’ liabilities and assets. Based on MAS’ thematic liquidity risk management inspections, FMCs have largely adhered to these

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74 The Bank of England provides a detailed account of the disruptions in the gilt market in 2022 (Pinter, 2023).
expectations, taking into consideration the size, scale and complexity of their businesses and the risk profiles of the CIS that they manage.\(^{76}\)

For the purposes of financial stability surveillance, the focus is on liquidity and leverage vulnerabilities of CIS domiciled in Singapore. For liquidity risk, the attention is on authorised and restricted CIS\(^{77}\) which comprise most of the open-ended CIS in Singapore. For leverage risk, S-REITs and hedge funds managed out of Singapore are examined.

In 2022, authorised CIS offered to retail investors in Singapore held a total of SGD62.3 billion in AUM. Based on the liquidity stress simulation survey (see Box D “Liquidity Stress Simulation of Investment Funds in Singapore”), almost all AUM were invested in traditional investment strategies and markets (i.e. equity and fixed income). Portfolio exposures of authorised CIS were mainly to Asia-Pacific ex-Singapore equities (24% of portfolio exposures) and fixed income (21% of portfolio exposures). Exposures to Singapore fixed income also formed a significant portion of portfolio exposures (20%) (Chart S2.6). The Code on Collective Investment Schemes (CIS Code) issued by MAS sets out the investment guidelines and limits applicable to authorised CIS, including on areas such as liquidity\(^{78}\) and leverage.\(^{79}\)

Restricted CIS are offered to accredited investors (or investors with a minimum transaction amount of SGD200,000). These funds held a total of SGD28.3 billion in assets as of 2022. Unlike authorised CIS, restricted CIS are not subject to the CIS Code. Restricted CIS engage in a broader spectrum of investments, with private equity and venture capital (PE/VC) funds constituting 15% of total AUM and hedge funds taking up 9%. However, FMCs in Singapore that manage restricted CIS are still subject to close supervision by MAS and supervisory expectations in relation to liquidity risk management, as set out above.

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\(^{76}\) This is set out in an information paper titled “Strengthening Liquidity Risk Management Practices for Fund Management Companies” and covers key findings from MAS’ thematic liquidity inspections and review of prospectuses, which focused on CIS offered to retail investors.

\(^{77}\) Authorised CIS refer to Singapore-constituted CIS that are authorised pursuant to Section 286 of the Securities and Futures Act 2001 (SFA) and offered to retail investors. Restricted CIS refer to CIS that have submitted a notification pursuant to Section 305 of the SFA to make offers to accredited investors (or investors with a minimum amount of SGD200,000 per transaction).

\(^{78}\) Under the CIS Code, authorised CIS (excluding hedge funds and property funds) must primarily invest in permissible liquid assets. Investments in alternative assets that are considered less liquid are capped at 10% of the fund’s net asset value (NAV).

\(^{79}\) Under the CIS Code, authorised CIS (excluding hedge funds and property funds) may borrow only on a temporary basis to meet redemptions and bridging requirements. The borrowing period may not exceed one month. Moreover, aggregate borrowing is capped at 10% of the scheme’s NAV.
S-REITs’ leverage is well-managed, with a median leverage ratio of 38.7%. Leverage ratios of most S-REITs are also within leverage limits set out by the CIS code as of June 2023.\(^{80}\) S-REITs have total assets amounting to SGD200 billion as of December 2022, or about 3% of total financial system assets. S-REITs do not present liquidity mismatch risk associated with open-ended investment funds as they are publicly traded on the SGX and non-redeemable.

Hedge funds managed out of Singapore take on leverage that is broadly in line with global peers, but they do participate in derivatives trading with Singapore-based counterparties. Leverage taken on by these hedge funds may thus have an impact on banks or dealers via the counterparty channel. In 2022, gross leverage for the sector was 6.89 times net asset value (NAV). Meanwhile, financial leverage, mostly consisting of securities borrowing, was lower at 0.5 times NAV.\(^{81}\)

**Insurers**

MAS’ adoption of a framework for designating insurers as domestic systemically important insurers (D-SIIs) reflects insurers’ importance to Singapore’s financial system and economy (MAS, 2023). The framework uses four indicators: size, interconnectedness, substitutability and complexity. Insurers designated as D-SIIs are subject to additional supervisory measures including higher capital requirements.

In the current macroeconomic environment, higher interest rates are generally favourable to life insurers as the duration of their insurance liabilities tends to exceed that of

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\(^{80}\) Under the CIS Code, aggregate leverage of property funds should not exceed 45% of the fund’s deposited property. The property fund may only exceed the threshold (up to 50%) if it has a minimum adjusted interest rate coverage ratio of 2.5 times.

\(^{81}\) Leverage ratios, derivatives and borrowing exposures has been estimated based on funds with NAV greater than or equivalent to USD500 million. This is aligned with reporting thresholds used by the International Organization of Securities Commissions (IOSCO).
their assets. However, higher interest rates could limit new business and prompt more policy redemptions as a result of increased competition from investments offering higher returns. Volatility in equity and credit spread markets has also contributed to a challenging investment environment for insurers. Despite the challenging environment, the capital adequacy ratios of insurers in Singapore remains healthy (see Chart Panel 4F, Chart 4F1).

To assess insurers’ resilience to unanticipated shocks, MAS conducted an IWST featuring a base scenario and a stress scenario over a three-year horizon. In the stress scenario, which assumed sharp increases in interest rates, falling equity prices and widening credit spreads, insurers were impacted mainly by the lower valuation of assets arising from the financial shocks. However, in the case of life insurers, higher interest rates also decreased the value of long-term guaranteed liabilities, mitigating some of the negative impact. Insurers were able to continue meeting regulatory capital requirements, in certain cases after undertaking management actions such as reducing bonus allocations, reducing dividend transfers to shareholders and changing asset allocations.

The IWST also included a liquidity stress scenario to assess insurers’ liquidity positions in the face of sudden outflows. In this scenario, in addition to the economic stresses described above, mass lapses of insurance savings policies and significant reduction in new business premiums were also simulated. The liquidity stress test further included haircuts to assets that were higher than in previous IWSTs, for the scenario where liquidation was required to meet a projected cash flow deficiency. Despite the stresses, insurers were able to maintain sound liquidity positions, in certain cases after undertaking management actions such as interfund transfers.

Activity-based Monitoring

To complement entity-based monitoring efforts, activities that key domestic NBFI sectors engage in with the potential to cause financial stability risks were examined. Besides the SFT market discussed earlier, another key market is the OTC derivatives market. The 2022 FSR provided an overview of financial stability risks in the OTC derivatives market and examined the interconnectedness of market participants.

The OTC derivatives market in Singapore had a total gross notional stock of derivatives outstanding of SGD61.9 trillion as of September 2023. The market has been increasing in size over the last few years, particularly in the interest rate (IR) asset class, which has grown by 38% since October 2021. IR and FX OTC derivatives account for the bulk of transactions booked and traded in Singapore, constituting 51% and 33% of the total outstanding notional amount, respectively (see Chart Panel 4G, Chart 4G1). Foreign banks and dealers are the most prominent counterparties in the market, with 80% of outstanding transactions facing a foreign bank or dealer (see Chart Panel 4G, Chart 4G2). The OTC derivatives market is centralised among relatively few influential counterparties.
Synthetic leverage in the OTC derivatives market has fallen, although NBFIs’ derivatives exposures have increased

Synthetic leverage undertaken by NBFIs in the form of OTC derivatives transactions has decreased. Gross notional exposure has fallen from 13.2 times of gross market value in September 2022 to 5.9 times of gross market value a year later (Chart S2.7). However, NBFIs’ gross notional exposure to OTC derivatives appears to have increased, indicating that, while individual FIs and NBFIs appear to be managing their derivatives-related risk effectively, there remains some residual risk associated with OTC derivatives trading.

Chart S2.7 NBFIs’ notional exposures have increased but leverage has decreased

Source: DDRS, MAS estimates

Conclusion

Overall, the domestic NBFI sector continues to pose limited systemic risk to Singapore’s financial system, based on MAS’ surveillance and ongoing analysis. The expansion of the NBFI sector in Singapore over the last decade has developed the financial sector into a more diverse and vibrant ecosystem. At the same time, the growing presence of NBFIIs requires increased attention to the potential risks posed to financial stability. MAS will continue to closely monitor the evolving risks posed by NBFIIs, collect additional data if needed, and assess whether policy recalibrations are required to mitigate the risks posed.

Besides introducing a framework to analyse the vulnerabilities of key NBFI sectors in Singapore, this Special Feature also provides a structure for the surveillance and analysis on NBFIIs in future FSRs. Going forward, the NBFI section will continue to be organised by entity-based and activity-based monitoring to provide a holistic overview of the NBFI sector, with thematic studies to cover new risks posed by the evolving landscape.

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82 Synthetic leverage is proxied by the ratio of the gross notional amount to gross market value of NBFIIs’ OTC derivatives positions, in line with the FSB (2023).
Box D
Liquidity Stress Simulation of Investment Funds in Singapore

Motivation and approach for the stress simulation

Open-ended investment funds may invest in a broad range of assets with varying levels of liquidity and yet offer short-term redemptions to investors. This subjects funds to structural liquidity mismatches, especially those invested in less liquid assets such as high-yield (HY) or emerging market (EM) bonds. In the event of significant liquidity demands from large redemptions, such funds may be forced to sell assets immediately, often at a discount, to raise cash. The collective sales of assets by many funds could depress asset valuations, result in one-sided markets and transmit stress to other FIs and investors holding these assets.

MAS conducted a liquidity stress simulation for CIS in Singapore, concentrating on funds with a focus on fixed income and equities. Beyond authorised and restricted CIS constituted in Singapore, the exercise also examined recognised and restricted foreign CIS offered to Singapore investors and managed out of Singapore.83

The exercise follows similar exercises conducted by other regulators such as the European Securities and Markets Authority (ESMA), as well as the IMF in its financial sector assessment programs (FSAP) stress tests, which assess open-ended investment funds’ resilience to a redemption shock. The stress simulation works by applying a significant redemption shock on funds and then determining whether the funds have sufficient liquidity in their portfolios to meet the redemptions. The exercise further examines the aggregate impact of funds’ asset sales on asset prices and the resulting impact on funds’ portfolios from asset valuation losses.

Redemption shock: The redemption shock is calibrated based on the distribution of historical net fund flows (subscriptions minus redemptions) via an expected shortfall (ES)84 approach. For instance, the ES at the 10% level takes reference from the historical worst 10% of net outflow episodes. Net flows are examined both at the individual fund level and at an aggregate level by fund type. A redemption shock is applied to each level as it allows for an appropriate calibration of shocks including for funds that have not experienced significant outflows in the past (e.g. those with a short fund history). Redemption shocks based on the ES at the 1% level are used for the stress simulation.

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83 Authorised CIS refer to Singapore-constituted CIS that are authorised pursuant to Section 286 of the Securities and Futures Act 2001 (SFA) and offered to retail investors. Recognised CIS refer to foreign-constituted CIS that are recognised pursuant to Section 287 of the SFA and offered to retail investors. Restricted CIS refer to CIS that have submitted a notification pursuant to Section 305 of the SFA to make offers to accredited investors (or investors with a minimum amount of SGD200,000 per transaction).

84 Expected shortfall, also known as conditional value-at-risk (CVaR), measures the average of all values in a loss distribution that are worse than the value-at-risk (VaR) at a given confidence level. The ES measure is sensitive to the shape of the tail of the loss distribution unlike VaR.
**Liquidity of portfolio:** The liquidity of funds’ asset holdings is measured using a tiered approach which assigns liquidity weights based on asset type and credit rating (**Table D1**). The specific weights adopted are those used by the IMF and other regulators in their stress simulation exercises, which are in turn derived from the Basel III framework for the calculation of high-quality liquid assets (HQLA) for banks.

HQLA for each fund is calculated as:

\[ HQLA = \sum_{k=1}^{n} \omega_k s_k \]

where \( \omega_k \) is the liquidity weight for security \( k \) and \( s_k \) is the value of security \( k \). The HQLA can be expressed as a percentage of the fund’s total net assets (TNA).

**Table D1** Liquidity weights are derived from the Basel III framework for HQLA

<table>
<thead>
<tr>
<th>Asset class</th>
<th>AAA to AA-</th>
<th>A+ to A-</th>
<th>BBB+ to BBB-</th>
<th>Below BBB-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Sovereign bonds</td>
<td>100</td>
<td>85</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Corporate bonds</td>
<td>85</td>
<td>50</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Securitised products</td>
<td>75</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Equities</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: BCBS, IMF, ESMA

**Resilience of funds:** The redemption coverage ratio, which measures the ratio of HQLA to net outflows, can be used to assess the funds’ resilience to a redemption shock. A redemption coverage ratio \( > 1 \) indicates that the fund has sufficient HQLA to cover the net outflows from the redemption shock. For funds with a redemption coverage ratio \( < 1 \), the liquidity shortfall is measured by the difference between the net outflows and the amount of HQLA available.

**Liquidation strategy:** Fund managers would liquidate a part of their portfolios to meet redemption needs. In practice, fund managers generally liquidate assets in a pro-rata manner, to the extent possible. Under this approach, all securities are sold according to their proportion in the portfolio so that its composition remains aligned with the fund’s overall

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**Notes:**


investment strategy. This maintains the fund’s overall liquidity profile and safeguards the interests of the remaining investors following redemptions.

**Price impact of asset sales on markets:** The sale of assets in aggregate across funds in the face of the redemption shock could impact market prices, affecting the holders as well as the issuers of these assets.

The price impact is assumed to depend largely on the market depth of the securities, and to increase in proportion to the securities sold. Market depth reflects the available market liquidity and the ability of the market to absorb asset sales without a significant price impact. Intuitively, a market is considered more liquid if the underlying securities are traded more frequently with lower volatility.

Following the methodology used by Cont and Schaanning (2017), which was also referenced by ESMA and the IMF, the market depth of a security $k$ (over a liquidation horizon of $\tau$ days) is defined as the ratio between the average daily trading volume of the security $ADV_k$ (in dollar terms) and its daily volatility $\sigma_k$ (in %), scaled by a factor of $c$ associated with the trading cost, and the square root of the liquidation horizon $\tau$.

$$\text{Market depth } h_k(\tau) = c \frac{ADV_k}{\sigma_k} \sqrt{\tau}$$

The liquidation horizon refers to the number of days over which the fund sells the security. Liquidating the same amount of assets over a longer time horizon would have a smaller price impact.

The corresponding price impact of a sale of security $k$ of $q$ (in dollar terms) is:

$$\text{Price impact}_k(q) = \frac{q}{\text{Market depth}_k}$$

The price impact of asset sales is estimated under the assumption that assets would need to be liquidated within a tighter horizon of five days as compared to the redemption shock which is applied at a monthly frequency in this stress simulation (Table D2).

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Table D2 Price impact of asset sales depends on market depth relative to the assets sold
Price impact from a sale of SGD1 billion of securities over a five-day liquidation horizon

<table>
<thead>
<tr>
<th>Asset class</th>
<th>Price impact (bps)</th>
<th>SGD billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE sovereign bonds(^{(a)})</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>EM sovereign bonds(^{(a)})</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Equities(^{(b)})</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>IG corporate bonds(^{(c)})</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>HY corporate bonds(^{(c)})</td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>Securitised products(^{(d)})</td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>Other funds(^{(d)})</td>
<td>22.0</td>
<td></td>
</tr>
</tbody>
</table>

\(^{(a)}\) The price impact for AE and EM sovereign bonds is a weighted average of the price impacts derived for the top five AE and EM sovereign bond markets respectively based on the value of funds’ sovereign bond holdings. Data on average daily trading volumes are obtained from the various central banks and regulatory authorities. Daily volatility is estimated using the daily returns of S&P government bond indices.

\(^{(b)}\) The price impact for equities is a weighted average of the price impacts derived for the top five equity markets based on the value of funds’ equity holdings. Data on average daily trading volumes are obtained from the various stock exchanges. Daily volatility is estimated using the daily returns of S&P market indices. The price impact for some equities could be lower than the estimated impact as their actual market depth may be higher due to listings in foreign stock exchanges or secondary listings.

\(^{(c)}\) As market data on the trading volumes of corporate bonds is sparse, ESMA (2019)’s price estimates are used to scale the price impact for corporate bonds relative to the simple average of the price impacts for AE and EM sovereign bonds.

\(^{(d)}\) The price impact of other asset classes is assumed to follow the price impact for HY corporate bonds as a conservative estimate.

Source: MAS estimates
Note: 2022 data was used to calculate the price impact. Funds here refer to the sample of funds covered in this stress simulation exercise. \(c\) is set to 0.4, similar to Cont and Schaanning (2017).
Overview of funds managed in Singapore

Data on portfolio holdings, historical monthly fund flows (subscriptions and redemptions) and net asset values were collected from licensed FMCs for the funds that they manage out of Singapore. The data collection covered open-ended investment funds with AUMs of at least SGD500 million each as of June 2023. Collectively, these funds constituted a total AUM size of SGD216 billion as of June 2023 (Table D3), which represented 90% of total assets of such CIS with similar investment profile. The sample period covered was from July 2013 to June 2023. Funds in scope were categorised by the following fund types: Asia equity, EM equity, global equity, Asia fixed income, EM fixed income, HY fixed income, global fixed income and balanced funds.

Table D3 Equities comprise more than half of the AUM of funds in the sample
AUM of funds in the sample, as of June 2023

<table>
<thead>
<tr>
<th>Fund category</th>
<th>AUM (SGD billion)</th>
<th>Cash</th>
<th>Equity</th>
<th>Fixed income</th>
<th>Other funds</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Equity</td>
<td>53.3</td>
<td>1.9</td>
<td>84.6</td>
<td>-</td>
<td>12.4</td>
<td>1.2</td>
</tr>
<tr>
<td>EM Equity</td>
<td>62.1</td>
<td>1.9</td>
<td>93.6</td>
<td>&lt;0.1</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Global Equity</td>
<td>17.4</td>
<td>0.6</td>
<td>91.7</td>
<td>&lt;0.1</td>
<td>7.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Asia Fixed Income</td>
<td>8.6</td>
<td>1.2</td>
<td>-</td>
<td>98.5</td>
<td>0.8</td>
<td>~0.6</td>
</tr>
<tr>
<td>EM Fixed Income</td>
<td>33.5</td>
<td>8.2</td>
<td>-</td>
<td>89.4</td>
<td>2.4</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>HY Fixed Income</td>
<td>9.8</td>
<td>0.3</td>
<td>&lt;0.1</td>
<td>92.6</td>
<td>5.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Global Fixed Income</td>
<td>11.9</td>
<td>9.1</td>
<td>0.8</td>
<td>88.7</td>
<td>0.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Balanced</td>
<td>19.2</td>
<td>3.3</td>
<td>29.1</td>
<td>36.7</td>
<td>30.8</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>215.8</strong></td>
<td><strong>3.0</strong></td>
<td><strong>59.5</strong></td>
<td><strong>28.4</strong></td>
<td><strong>8.0</strong></td>
<td><strong>1.1</strong></td>
</tr>
</tbody>
</table>

Source: MAS survey
Note: “Others” may include securitised products, investments in alternative assets, derivatives, margin and collateral, payables and receivables.
In terms of the liquidity of asset holdings, most fund types have HQLA levels of around 50% of TNA. An exception is HY fixed income funds, which have less than 10% of assets that are HQLA (Chart D1). In particular, these funds also have a very low level of cash holdings (0.3% of AUM), compared to the average of 3% across all funds (Table D3).

**Chart D1** HY fixed income funds have much lower levels of HQLA
Median HQLA as a % of TNA (as of June 2023)

On average, funds have faced monthly redemption shocks ranging from 1.5% (balanced funds) to 15.3% (HY fixed income funds) of TNA, when shocks are calibrated on their individual historical fund flows (Chart D2). In contrast, redemption shocks at the aggregate level appear to be less severe, suggesting that larger outflows could be concentrated in some of the smaller funds.

**Stress simulation on funds managed in Singapore**

For the stress simulation, more severe redemption shocks corresponding to the 90th percentile of individual fund level shocks are considered, which range from 14.0% (global fixed income funds) to 38.5% (EM fixed income funds) of TNA (Chart D2).

Under these extreme scenarios, funds across most fund types would still have enough liquid assets to meet redemption needs. However, funds investing in HY and EM bonds would be less resilient, with nine funds (six HY, three EM) facing a redemption coverage ratio of less than one. Most of these funds would have a liquidity shortfall of more than 10% of TNA (Chart D3). These funds amount to 5.2% of TNA of the funds in the sample.

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88 This is measured by the median of individual fund-level shocks, where shocks are based on the ES at the 1% level.
In practice, fund managers can employ a range of liquidity management tools (LMTs) to mitigate the impact of redemptions. Almost all of the surveyed funds have indicated at least one type of LMT available for use.89

**Chart D3** A number of HY and EM fixed income funds would face a liquidity shortfall under the adverse redemption shock

Redemption coverage ratio and liquidity shortfall

[Graph showing the redemption coverage ratio and liquidity shortfall for HY and EM fixed income funds]

Source: MAS estimates

The price impact of asset sales on funds’ portfolios is modest

The impact of the redemption shock on asset markets and the value of funds’ remaining assets would depend on the total amount of assets sold relative to the market depth, as well as the liquidation strategy adopted by fund managers. A total of SGD49.2 billion of assets would need to be liquidated to meet the redemption shock, corresponding to 23% of the funds’ TNA.

The estimated price impact of the redemption shock on various asset classes ranges from 0.2 to 193 bps, with the largest impact observed for equity markets (Chart D4). Larger amounts of equities are sold in order to meet the stressed redemption needs, given a higher proportion of equity funds in the sample (Table D3). Nonetheless, the price impact remains moderate compared to equity price movements observed during stress periods.90

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89 The availability of tools were as follows: redemption fees (24% of surveyed funds), swing pricing (72%), redemption gates (82%), suspensions (88%), notice periods (21%), side pockets (4%). Some funds have other mitigating measures such as paying redemptions in specie (instead of cash).

90 Global equity markets experienced large daily price declines during the COVID-19 market turmoil (−9.5%) and the Global Financial Crisis (−7.4%), based on global stock market indices.
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The fall in asset prices from funds’ sales leads to a further decline in funds’ TNA although the impact appears to be modest compared to the initial redemption shock (Chart D5). However, there could be instances where the estimated impact would be understated, as in the case of a lower probability but higher impact broader risk-off event which simultaneously affects funds across different markets.

**Chart D4** The price impact from the shock on asset markets is relatively moderate

**Chart D5** Most of the decline in funds’ TNA stems from the initial shock

The results of the stress simulation show that on the whole, most funds would have enough liquid assets to meet redemption needs arising from monthly redemption shocks ranging from 14% to 38% of TNA. HY and EM fixed income funds remain vulnerable with lower levels of cash and other HQLA. These funds would experience liquidity shortfalls as a result of such a shock and may be forced to sell less liquid assets to cover the redemptions.

Going forward, MAS will explore conducting these stress simulation exercises on a regular basis to assess the resilience of investment funds to liquidity risk. MAS will also continue to refine the exercise. Potential enhancements could include examining the impact of shocks from adverse macroeconomic scenarios; sizing the second-round impact on fund withdrawals due to negative fund returns; and assessing contagion risks arising from the interlinkages between investment funds and other FIs.
References


Special Feature 3

Impact of COVID-19 Credit Easing Measures on Bank Lending to SMEs

Introduction

In 2020, with COVID-19 disruptions causing Singapore’s GDP to incur its largest recorded quarterly decline in Q2, the government introduced two sets of measures to ease credit conditions for SMEs. Enterprise SG (ESG) rolled out the Temporary Bridging Loan Programme (TBLP) and the Enhanced Enterprise Financing Scheme—SME Working Capital Loan (EFS-eWCL) (henceforth “ESG Loan Schemes”), that provided government guarantees of up to 90% of the loan amount under the schemes. Meanwhile, to ensure the availability of low-cost credit to SMEs facing acute liquidity constraints amid the pandemic, MAS introduced the MAS SGD Facility for ESG loans (henceforth “the Facility”), which significantly reduced the cost of funding to banks for loans extended to businesses.

This Special Feature highlights research by MAS-EPG and Professor Sumit Agarwal of the National University of Singapore Business School, that estimates the joint impact of the two schemes on bank lending to SMEs and on the broader economy. To explain the separate channels through which the two schemes affected the SME lending market, a simple framework taking into account both credit demand and credit supply, is used. The ESG Loan Schemes increased credit supply to SMEs via the risk channel, by reducing the private credit risk borne by lenders, while the Facility increased banks’ net interest margin on loans to SMEs, leading to higher SME lending via the interest rate channel.

The study finds that the combined policy impact on credit to SMEs has been positive and large. Notably, amid heightened uncertainty, participating lenders passed on lower funding costs from the credit easing schemes to SME borrowers, helping to keep SME financing costs low. In addition, the schemes helped to improve the broader financial and economic outcomes for borrowing firms, although the magnitude of effects was relatively small. Further, both schemes helped to reduce SME loan credit spreads, with the Facility contributing about 45% of the total impact, and the ESG Loan Schemes the remaining 55%. This reflects a theoretical implication of the paper’s model: higher risk guarantees and lower central bank funding costs alleviate retrenchment of credit arising from distinct financial frictions, and a combination of both policies should be more effective than each individual policy measure in isolation.

Background

After rising steadily from January 2019 to March 2020, total bank lending to non-bank entities began a marked decline from April 2020, when COVID-19 cases rose sharply in Singapore and strict distancing restrictions were imposed (Chart S3.1). The fall in the stock of
non-bank loans was broad-based across sectors, with consumer, corporate, and NBFI loans all declining through Q2 2020.

Against this rapid drop in bank lending and economic activity, in April 2020, MAS and ESG launched two sets of policy measures to ease lending conditions faced by SMEs. ESG implemented two schemes that offered government risk sharing for loans to SMEs by eligible FIs, namely the TBLP and EFS-eWCL schemes. The government’s share of risk sharing was initially set at 90%, and later reduced to 50–70% from April 2021 onwards.91 As eligibility requirements were broadly similar across loan schemes up to March 2021, mainly stipulating that borrowing firms have a significant presence in Singapore, the two ESG schemes are effectively treated as substitutes for the purposes of this empirical study.92

At the same time, the MAS SGD Facility for ESG loans offered Singapore dollar funding for eligible banks at an annual rate of interest of 0.1%, conditional on the use of the funds for loans to SMEs under the ESG Loan Schemes. As the Facility’s lending was at a two-year tenor, it effectively reduced the funding rate for banks from the 2-year wholesale swap offer rate (SOR) Interest Rate Swap rate, which was 0.65% in April 2020; this would have represented a material decline in funding costs amid a period of significant liquidity stress.93

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**Chart S3.1** Bank lending fell during the pandemic, from April to end-2020

Total non-bank lending by banks (Q1 2019–Q1 2021)

1.1 1.2 1.3 1.4 1.5
2019 2020 2021

Source: MAS

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91 Before April 2020, risk sharing under the EFS-WCL was 50%, while loans to SMEs under five years from establishment and fulfilling certain requirements could qualify for 70% risk sharing.

92 The TBLP offered a larger maximum loan amount of SGD5 million, and imposed an interest rate cap of 5% per annum. The Enhanced EFS schemes were reserved for firms with annual turnover not exceeding SGD500 million, and had a maximum loan amount of SGD1 million under the Working Capital Loan.

93 The Facility also represented a significant reduction in funding costs from the MAS Standing Facility, which allows eligible counterparties to borrow Singapore dollars from MAS on an overnight and collateralised basis (equivalent to the Federal Reserve’s discount window). In April 2020, the month of the Facility’s launch, the overnight borrowing rate under the MAS Standing Facility averaged 0.8%.
Following the introduction of the ESG Loan Schemes and the Facility, the stock of non-bank loans outstanding continued to decline until November 2020 before resuming positive growth. Consumer loans recovered more quickly than corporate and NBFI loans increasing from around June 2020. Overall, loans to all sectors ceased declining by the end of 2020.

The stock of loans to SMEs similarly saw a dip in April 2020, but reversed the decline entirely by June 2020. At the same time, the value of ESG loans rose steadily from April 2020 to March 2021. In March 2020, before the sharp COVID-19 impact and government financing policies, ESG-SME loans comprised less than 1% of all SME loans. By March 2021, the share of ESG-SME loans in all SME loans had increased to around 8%.

Table S3.1 shows summary statistics for the stock of ESG loans for which lenders drew on the Facility and where the loans were assigned to MAS as collateral, covering the period April 2020 to March 2021. Some 15,285 unique firms took up loans in this period, at an average interest rate of 2.5%. About twice as many firms took up loans under the TBLP, which had a higher maximum loan limit than the Enhanced EFS-eWCL scheme. The vast majority of borrowing firms were SMEs, with average revenues in 2019 of SGD21 million under the TBLP, and SGD13 million under the EFS-eWCL scheme. Cumulatively, about SGD11 billion worth of TBLP and EFS-eWCL loans were made in this period.

### Table S3.1
In the first year after roll-out, about SGD11.7 billion in SME loans supported by both schemes was approved

<table>
<thead>
<tr>
<th></th>
<th>EFS-eWCL</th>
<th>TBLP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Lenders</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Number of Borrowers</td>
<td>5,165</td>
<td>11,462</td>
<td>15,285</td>
</tr>
<tr>
<td>Total Loans (SGD billion)</td>
<td>Approved 1.6</td>
<td>10.2</td>
<td>11.7</td>
</tr>
<tr>
<td></td>
<td>Disbursed 1.6</td>
<td>9.8</td>
<td>11.3</td>
</tr>
<tr>
<td>Average Interest Rate (%)</td>
<td>2.4</td>
<td>2.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Source: MAS survey

Note: Based on MAS loan-level data on ESG loans for which participating FIs drew on the Facility, only loans assigned to MAS as collateral were included.
Framework and empirical strategy

Description of the model

A simple model of bank lending is used to articulate the effects of central bank funding under the Facility and increased risk sharing by the government under the ESG Loan Schemes. Figure S3.1 is a simplified schematic showing key mechanisms of the model.

**Figure S3.1** Credit easing schemes should help to support credit supply to SMEs

<table>
<thead>
<tr>
<th>Banks</th>
<th>Interest rate (endogenous)</th>
<th>SMEs</th>
<th>Sectoral shocks increase probability of firm default</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maximise profits by taking deposits, making loans</td>
<td>Incomplete information about probability of default</td>
<td>• Take on bank debt to cover costs and invest in projects</td>
<td>• Government guarantees on bank loans reduce loan-loss risk</td>
</tr>
<tr>
<td>• Risk-averse</td>
<td></td>
<td>• Borrowers have positive probability of default $\rho_i$</td>
<td></td>
</tr>
<tr>
<td>• Access funding from central bank at exogenous interest rate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risk-averse banks maximise profits by making loans to SMEs, which cover operating costs and invest in new projects. SMEs default on their loans with positive probability. In equilibrium, banks fund illiquid and risky loan assets by taking on short-term liabilities in the form of deposits and have access to central bank funding, giving rise to credit and term risk premia in loan rates. Importantly, banks have incomplete information on borrowers’ firm-specific probability of default $\rho_i$, with $i$ denoting individual firms. Borrowers’ probability of default is costly for lenders to verify, a market failure that leads to credit rationing in SME lending markets, where credit is not supplied to some creditworthy borrowers or projects. Intuitively, lenders have to impose an additional premium to cover the costs of verifying default risk, which reduces lending below its efficient, perfect information, level.\(^\text{94}\)

A graphical representation of the effects of the COVID-19 shock and the credit easing measures is provided in Figure S3.2. Line $D_1$ is the demand schedule for loans from SMEs, which is downward sloping—as the interest rate falls, more SMEs demand loans. Line $S'$ represents the supply curve under perfect information, which rises with the interest rate, as more lenders are willing to take on higher risk projects if loan yields rise, relative to the lender’s cost of funding. In the perfect information equilibrium, firms up to default probability $\rho'$ will be funded. Under imperfect information, however, the slope of the supply schedule is steeper, as represented by line $S'_1$. The risk premium increases along with borrowers’ default risk, as

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\(^{94}\) As Townsend (1979) shows, this is also because imperfect information leads to adverse selection. Lenders are aware that risky borrowers have a larger incentive to take up loans at prevailing rates than safe borrowers, making due diligence and verification costs necessary.
verification costs rise. As such, only firms with default probability less than $\rho_1$ will be granted loans, and credit rationing ensues.\footnote{The distribution of the random variable $\rho$ determines the shape of the supply schedule for SME loans. In this case, the linear supply schedule in Figure S3.2 is consistent with the assumption of a uniform distribution for $\rho$.}

**Figure S3.2** ESG Loan Schemes and the SGD Facility affected credit supply via different channels

Interest rate and risk channels of bank lending

The COVID-19 shock had two distinct effects on the market for SME lending, represented by the blue line in **Figure S3.2a**.\footnote{For illustrative purposes, we assume that the demand curve for SME loans is unchanged. In practice, effects on SME credit demand are ambiguous in direction. It may rise as liquidity constraints become more binding, or fall as investment opportunities decline due to a negative aggregate demand shock.} First, a drop in bank profits and increase in demand for market liquidity raises banks’ cost of funding. This increases financing costs for even low-risk borrowers, leading to a leftward shift of the credit supply curve. Second, greater uncertainty about the prospects of individual borrowers intensifies the problem of imperfect information, leading to higher verification costs for lenders. This raises the risk premium for firms with higher default risk, causing an upward rotation of the credit supply curve, increasing its slope. The combination of the above two effects shifts the equilibrium level of lending from Point $a$ to Point $b$—fewer loans at higher interest rates relative to the efficient equilibrium.

Lowering the cost of funding and expanding guarantees on loans can alleviate the effects of the COVID-19 shock on credit supply and restore the constrained efficient equilibrium represented by Point $a$, via different channels. Lowering the cost of funding shifts the credit supply curve rightward, as banks can mitigate the potential losses associated with higher default probability, increasing credit supply via the interest rate channel. Government guarantees flatten the credit supply curve, as they reduce the need for banks to verify the actual probability of default on potential loans, raising credit supply via the risk channel.

It can be shown theoretically that the combination of both measures, rather than the use of one or the other, is the optimal policy response to the COVID-19 shock on the SME lending
market. The intuition for this result is shown in Figure S3.2b—each policy instrument is a direct response to distinct shocks in the SME lending market.

Empirical strategy

A two-step approach is used to identify the impacts of the Facility and ESG Loan Schemes on SME bank lending and economic outcomes for borrowing firms.

In the first step, a differences-in-differences (DiD) estimation procedure is used to assess differential outcomes for firms that participated in the two credit easing schemes relative to those that did not. To help identify the causal connection between the schemes and outcomes, the DiD approach considers other SME credit variables, including volumes, applications, approvals and interest rates of SME loans. Economic effects of the credit easing schemes in alleviating liquidity shortages and credit dysfunction, as well as the direct impact on borrowers are estimated, using indicators of financial distress and employment/wage outcomes at the firm level.

The second step of the empirical strategy distinguishes the effects of the ESG Loan Schemes from those of the Facility. Lenders continue to face some credit risk, even for loans under the ESG Loan Schemes, as government guarantees cover less than the full value of the loan. As such, the credit spread between the firm-specific loan rate and the funding rate under the Facility should continue to reflect credit risk from individual firms. Further, under imperfect information, credit risk increases with the size of the loan. Controlling for other determinants of credit spreads, the effects of the relationship between loan size and the credit spread are estimated, which are then used to calculate the size of the risk channel effect.

Results

The combined effects of the Facility and the ESG Loan Schemes on SME lending outcomes are reported in Table S3.2. The DiD coefficients estimates of the policy impact on several SME lending outcomes—the stock of loans outstanding, loan applications and loan approvals—are all correctly signed (positive) and statistically significant. The regression estimates imply that over the April 2020 to March 2021 period, the combined policies led to a SGD588 million (2.1%) increase in the stock of SME loans per participating bank, a SGD111 million (10.4%) increase in the value of monthly loan applications and SGD99 million (17.4%) increase in the value of monthly loan approvals. The combined policies had a significant impact (−0.6 percentage point) in reducing interest rates for SME loans.

97 There were nine participating banks in the ESG Loan Schemes.
### Table S3.2

In combination, the two schemes increased lending to SMEs, while reducing loan interest rates.

Combined policy impact on bank lending to SMEs

<table>
<thead>
<tr>
<th></th>
<th>Stock of Loans Outstanding (SGD, million)</th>
<th>Loan Applications (SGD, million)</th>
<th>Monthly Loan Approvals (SGD, million)</th>
<th>Interest Rates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controlling for Credit Demand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector Emp Change</td>
<td>2.7</td>
<td>1.3*</td>
<td>1.3</td>
<td>0.9***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>COVID-19</td>
<td>−256***</td>
<td>−79***</td>
<td>−35</td>
<td>−49***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.6*</td>
</tr>
<tr>
<td>Combined Policy Effect</td>
<td>588***</td>
<td>111***</td>
<td>99***</td>
<td>−73***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>−0.6**</td>
</tr>
</tbody>
</table>

Note: “Sector Emp Change” is y-o-y total employment change in the sector of the borrowing firm, and “COVID-19” is a time fixed effect for the April 2020 to March 2021 period. Other explanatory variables included in the regression are bank fixed effects, sector fixed effects, y-o-y sector VA growth lender capital-to-asset ratios and borrowing firms’ average 2019 employment level. Data is sourced from a combination of the MAS Annual and Monthly SME Lending Surveys, MAS 610 data, and administrative employment data from MOM and CPF.

The result that the schemes had a greater impact on loan applications than on loan approvals (column 2 versus 3 in **Table S3.2**) indicates that the response of credit demand from SMEs exceeded that of credit supply from banks. This offers some assurance that banks remained cognisant of the private credit risk they took on, likely helping to reduce lending to zombie firms. At the same time, these results validate the model assumptions that some credit rationing remained even under the credit easing schemes’ generous parameters, and that SME lending during the COVID-19 crisis was constrained by credit supply rather than demand. Controlling for the increase in credit demand from SMEs (using loan applications as a proxy), the combined policies led to a pure credit supply impact of SGD73 million (12.8%) in new SME loan approvals per month.

### Decomposing risk and interest rate effects

The combined policy effects are decomposed into two channels—the interest rate channel, due to the MAS SGD Facility, and the risk channel, due to the ESG Loan Schemes. This is accomplished using a loan-level instrumental variable regression. Regression results suggest that firms with weaker pre-COVID financials tended to receive modestly smaller loans and face slightly higher interest rates, after controlling for firm size (based on 2019 net asset holdings). In particular, a one percentile difference in the borrowing firm’s 2019 revenue distribution was associated with a SGD4,000 increase in loan size and a −0.004 percentage point reduction in interest rate. A decomposition of the combined policy impact is shown in **Table S3.3**.

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88 The instrumental variable approach estimates the effect of lending undertaken by banks on loan-level credit spreads. The dependent variable is the credit spread on each loan. The key instrumental variable is the quantum of the loan not subject to guarantees by the ESG risk-sharing schemes. The “unguaranteed loan size” instrument represents the amount of risk still borne by the lender excluding guarantees, and facilitates the calculation of what interest rates would be in the absence of government loan guarantees. This in turn allows for the estimation of ESG’s risk-sharing schemes on interest rates. Also included in the regression estimation are other control variables including the pre-COVID financial health of the firm and the loan tenor.

89 As interest rates charged under the ESG Loan Schemes were capped, lenders were likely to have reduced their loan exposure to riskier borrowers by reducing loan sizes, further helping to explaining why loan size was correlated with borrowers’ risk profiles.
**Table S3.3** Both sets of schemes contributed significantly to supporting credit supply to SMEs

Decomposition of ESG Loan Scheme and MAS SGD Facility impact

<table>
<thead>
<tr>
<th></th>
<th>Stock of Loans Outstanding (SGD, million)</th>
<th>SME Monthly Loan Approvals (SGD, million)</th>
<th>SME Loan Interest Rates (% point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESG Loan Schemes</td>
<td>2498</td>
<td>311</td>
<td>−0.32</td>
</tr>
<tr>
<td>MAS SGD Facility</td>
<td>2205</td>
<td>274</td>
<td>−0.28</td>
</tr>
<tr>
<td>Combined</td>
<td>4703</td>
<td>585</td>
<td>−0.6</td>
</tr>
</tbody>
</table>

Note: Depending on model specification, the contribution of the ESG Loan Schemes vary somewhat, from 40–55%. Reported results are from a model that accounts for significant non-linearities in the empirical relationship between unguaranteed loans and credit spread, which may be regarded as more realistic.

Between the two policies, the ESG Loan Schemes accounted for a larger share of around 55% of the total policy impact on credit spreads, while the Facility contributed about 45%, implying that the ESG Loan Schemes led to a 0.32 percentage point decline in credit spreads, while the Facility prompted a 0.28 percentage point decline in spreads. From the perspective of the theoretical model, the substantial effect of both policies suggests that there was scope for both interest rate and risk channels combined in alleviating the credit supply conditions during COVID-19.

**Discussion**

The results suggest three broad policy implications. First, credit supply to SMEs shrank by more than credit demand during COVID-19, as shown by aggregate liquidity shortages for SME borrowers. As hypothesised in the model, greater financial frictions likely reflected increased difficulties in verifying credit risk in the SME lending market during COVID-19. Under these conditions, credit easing policies for SMEs have positive externalities and can help maintain efficient credit flows.

Second, moral hazard did not appear to be a major issue. Even under cheap central bank funding and high government risk sharing, SME lending continued to reflect sound fundamentals, with firms with healthier pre-COVID finances likely to receive larger loans at lower interest rates. In separate regressions that are not reported in this Special Feature, indicators of the borrowing firm’s financial health, including pre-COVID revenue and profit levels, were found to be statistically significant in reducing the interest rate and increasing the loan quantum. Further, firms that took up loans under credit easing policies experienced better employment and wage outcomes, suggesting that credit easing measures did not significantly prop up financially weak firms.

Third, greater uncertainty around borrower credit risk during COVID-19 implies that reducing funding costs for lenders will likely be insufficient for resolving dysfunction in SME lending markets during severe crises. Even with lower funding costs, lenders are unlikely to extend loans if they face large uncertainty over borrowers’ credit risk. At the same time, risk guarantees are unlikely to be effective on their own, as resolving financial frictions stemming from information incompleteness cannot deal with aggregate liquidity shortages from a sudden increase in macroeconomic uncertainty. As such, both risk and interest rate channels
are important for increasing SME credit, and a combination of risk guarantees and lower interest rates for lenders during a crisis will likely be more effective in boosting credit supply than each individual policy in isolation.

**Sum-up**

This empirical study finds that the combined impact of policies to support lending to SMEs during the pandemic was positive and relatively large. Effects on credit were substantially larger than effects on observable economic outcomes for individual firms. This is likely because the credit easing schemes were introduced alongside aggressive fiscal support for jobs and businesses, helping to support economic outcomes for the vast majority of firms that did not take out new loans under the credit easing schemes. While the research may not be able to completely separate the real economic effects of the credit easing schemes from broader COVID-19 policy response, the success of the policies at increasing credit supply is encouraging. The results provide evidence that using unconventional interest rate policies could be effective for supporting bank lending and avoiding a credit (supply) crunch in Singapore, during times of crisis when risk aversion is elevated.

**References**

Agarwal S and Ng, D X. (2022), “Interest and risk effects of COVID-19 credit easing policies in Singapore”, manuscript.

