Financial Stability Review
December 2021

ISSN 1793-3463

Published in December 2021

Macroprudential Surveillance Department
Economic Policy Group
Monetary Authority of Singapore

https://www.mas.gov.sg

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanised, photocopying, recording or otherwise, without the prior written permission of the copyright owner except in accordance with the provisions of the Copyright Act (Cap. 63). Applications for the copyright owner’s written permission to reproduce any part of this publication should be addressed to:

Macroprudential Surveillance Department
Economic Policy Group
Monetary Authority of Singapore
10 Shenton Way
MAS Building
Singapore 079117
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>vi</td>
</tr>
<tr>
<td>Overview</td>
<td>1</td>
</tr>
<tr>
<td>1. Global Financial and Economic Environment</td>
<td></td>
</tr>
<tr>
<td>Risks in the External Environment</td>
<td>4</td>
</tr>
<tr>
<td>2. Singapore Corporate Sector</td>
<td></td>
</tr>
<tr>
<td>Risks in the Corporate Sector</td>
<td>18</td>
</tr>
<tr>
<td>Chart Panel 2A: Small and Medium-sized Enterprise Financing Conditions</td>
<td>29</td>
</tr>
<tr>
<td>3. Singapore Household Sector</td>
<td></td>
</tr>
<tr>
<td>Risks in the Household Sector</td>
<td>30</td>
</tr>
<tr>
<td>4. Singapore Financial Sector</td>
<td></td>
</tr>
<tr>
<td>Risks in the Banking Sector</td>
<td>42</td>
</tr>
<tr>
<td>Risks in the Non-banking Sector</td>
<td>47</td>
</tr>
<tr>
<td>Box A: Industry-wide Stress Test of D-SIBs</td>
<td>50</td>
</tr>
<tr>
<td>Box B: Enhancements to Supervisory Stress Testing of Central Counterparties</td>
<td>56</td>
</tr>
<tr>
<td>Chart Panel 4A: Banking Sector: Credit Growth Trends</td>
<td>60</td>
</tr>
<tr>
<td>Chart Panel 4B: Banking Sector: Cross-border Lending Trends</td>
<td>61</td>
</tr>
<tr>
<td>Chart Panel 4C: Banking Sector: Asset Quality and Liquidity Indicators</td>
<td>62</td>
</tr>
<tr>
<td>Chart Panel 4D: Banking Sector: Local Banking Groups</td>
<td>63</td>
</tr>
<tr>
<td>Chart Panel 4E: Insurance Sector</td>
<td>64</td>
</tr>
<tr>
<td>Chart Panel 4F: Over-the-counter Derivatives</td>
<td>65</td>
</tr>
<tr>
<td>5. Special Features on Financial Stability</td>
<td></td>
</tr>
<tr>
<td>Special Feature 1: Integrated Macro Policy Frameworks: An Assessment of the Ongoing Research</td>
<td>67</td>
</tr>
<tr>
<td>Special Feature 2: Climate Transition Risk Exposure of Singapore’s Banking and Insurance Sectors</td>
<td>82</td>
</tr>
<tr>
<td>Special Feature 3: Enhancing Corporate Surveillance with Probability of Default Model</td>
<td>88</td>
</tr>
<tr>
<td>Special Feature 4: An Empirical Analysis of the Determinants of Domestic Interest Rates and Net Interest Margin</td>
<td>99</td>
</tr>
<tr>
<td>Data Annex</td>
<td></td>
</tr>
<tr>
<td>Impact of Recent Regulatory Revisions on Banking Sector’s Indicators</td>
<td>116</td>
</tr>
</tbody>
</table>
Statistical appendix may be accessed from:

Disclaimer: MAS is not liable for any damage or loss of any kind, howsoever caused as a result (direct or indirect) of the use of any information or data contained in this publication, including but not limited to any damage or loss suffered as a result of reliance on the information or data contained in or available in this publication. You are reminded to observe the terms of use of the MAS website, on which this publication is made available.
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-4” comprises Indonesia, Malaysia, Philippines and Thailand.
- “Emerging Asia” comprises Asian economies such as China, Hong Kong, India, Indonesia, South Korea, Malaysia and Thailand.
- “EMEA” refers to Europe, Middle East and Africa.
- “Euro zone” comprises Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain.
- “LATAM” refers to Latin America.

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:

- ABS: Association of Banks in Singapore
- ACU: Asian Currency Unit
- AE: Advanced Economy
- AFC: Asian Financial Crisis
- AR: Accuracy Ratio
- BIS: Bank of International Settlements
- CAPE: Cyclically Adjusted Price-to-earnings Ratio
- CAR: Capital Adequacy Ratio
- CBS: Credit Bureau Singapore
- CCB: Capital Conservation Buffer
- CCP: Central Counterparties
- CCR: Core Central Region
- CCyB: Countercyclical Capital Buffer
- CET1: Common Equity Tier 1
- CFM: Capital Flows Management
- CIS: Collective Investment Schemes
- COVID-19: Coronavirus Disease 2019
- CPRS: Climate Policy Relevant Sectors
- DBU: Domestic Banking Unit
- DCP: Dominant Currency Pricing
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDRS</td>
<td>Depository Trust &amp; Clearing Corporation Data Repository (Singapore) Pte Ltd</td>
</tr>
<tr>
<td>DOS</td>
<td>Department of Statistics</td>
</tr>
<tr>
<td>DSGE</td>
<td>Dynamic Stochastic General Equilibrium</td>
</tr>
<tr>
<td>D-SIB</td>
<td>Domestic Systemically Important Banks</td>
</tr>
<tr>
<td>EBITDA</td>
<td>Earnings Before Interest, Tax, Depreciation and Amortisation</td>
</tr>
<tr>
<td>ECB</td>
<td>European Central Bank</td>
</tr>
<tr>
<td>EDB</td>
<td>Economic Development Board</td>
</tr>
<tr>
<td>EM</td>
<td>Emerging Markets</td>
</tr>
<tr>
<td>EME</td>
<td>Emerging Market Economy</td>
</tr>
<tr>
<td>EML</td>
<td>Emissions per SGD Million of Loan</td>
</tr>
<tr>
<td>EPG</td>
<td>Economic Policy Group</td>
</tr>
<tr>
<td>ESG</td>
<td>Enterprise Singapore</td>
</tr>
<tr>
<td>ESS-S</td>
<td>Extended Support Scheme – Standardised</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FCI</td>
<td>Financial Conditions Index</td>
</tr>
<tr>
<td>FDI</td>
<td>Foreign Direct Investment</td>
</tr>
<tr>
<td>Fi</td>
<td>Financial Institution</td>
</tr>
<tr>
<td>FRED</td>
<td>Federal Reserve Economic Data</td>
</tr>
<tr>
<td>FSR</td>
<td>Financial Stability Review</td>
</tr>
<tr>
<td>FVI</td>
<td>Financial Vulnerability Indices</td>
</tr>
<tr>
<td>FX</td>
<td>Foreign Exchange</td>
</tr>
<tr>
<td>FXI</td>
<td>Foreign Exchange Intervention</td>
</tr>
<tr>
<td>FY</td>
<td>Fiscal Year</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GFC</td>
<td>Global Financial Crisis</td>
</tr>
<tr>
<td>GICS</td>
<td>General Industry Classification Standard</td>
</tr>
<tr>
<td>GLS</td>
<td>Government Land Sales</td>
</tr>
<tr>
<td>HDB</td>
<td>Housing Development Board</td>
</tr>
<tr>
<td>HQLA</td>
<td>High-quality Liquid Assets</td>
</tr>
<tr>
<td>HY</td>
<td>High Yield</td>
</tr>
<tr>
<td>ICR</td>
<td>Interest Coverage Ratio</td>
</tr>
<tr>
<td>IEA</td>
<td>International Energy Agency</td>
</tr>
<tr>
<td>IG</td>
<td>Investment Grade</td>
</tr>
<tr>
<td>iMaPP</td>
<td>Integrated Macropudential Policy</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>IMPF</td>
<td>Integrated Macro Policy Frameworks</td>
</tr>
<tr>
<td>IPF</td>
<td>Integrated Policy Framework</td>
</tr>
<tr>
<td>IWST</td>
<td>Industry-wide Stress Test</td>
</tr>
<tr>
<td>LCR</td>
<td>Liquidity Coverage Ratio</td>
</tr>
<tr>
<td>LTD</td>
<td>Loan-to-deposit Ratio</td>
</tr>
<tr>
<td>LTV</td>
<td>Loan-to-value Ratio</td>
</tr>
<tr>
<td>MAS</td>
<td>Monetary Authority of Singapore</td>
</tr>
<tr>
<td>MFSF</td>
<td>Macro-financial Stability Framework</td>
</tr>
<tr>
<td>m-o-m</td>
<td>Month-on-month</td>
</tr>
<tr>
<td>MPM</td>
<td>Macroprudential Measures</td>
</tr>
<tr>
<td>MSD</td>
<td>Macroprudential Surveillance Department</td>
</tr>
<tr>
<td>MSR</td>
<td>Mortgage Servicing Ratio</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>NBFI</td>
<td>Non-bank Financial Institution</td>
</tr>
<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>
</tr>
<tr>
<td>NPL</td>
<td>Non-performing Loan</td>
</tr>
<tr>
<td>NUS</td>
<td>National University of Singapore</td>
</tr>
<tr>
<td>NUS-CRI</td>
<td>National University of Singapore Credit Research Initiative</td>
</tr>
<tr>
<td>OCR</td>
<td>Outside of Central Region</td>
</tr>
<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>OLS</td>
<td>Ordinary Least Squares</td>
</tr>
<tr>
<td>OTC</td>
<td>Over-the-counter</td>
</tr>
<tr>
<td>PD</td>
<td>Probability of Default</td>
</tr>
<tr>
<td>PFMI</td>
<td>Principles for Market Infrastructures</td>
</tr>
<tr>
<td>PSTASSA</td>
<td>Professional, Scientific, Technical, Administrative, Support Service Activities</td>
</tr>
<tr>
<td>q-o-q</td>
<td>Quarter-on-quarter</td>
</tr>
<tr>
<td>RCR</td>
<td>Rest of Central Region</td>
</tr>
<tr>
<td>REIT</td>
<td>Real Estate Investment Fund</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>
</tr>
<tr>
<td>SAAR</td>
<td>Seasonally Adjusted Annual Rate</td>
</tr>
<tr>
<td>SGS</td>
<td>Singapore Government Securities</td>
</tr>
<tr>
<td>SGX</td>
<td>Singapore Exchange</td>
</tr>
<tr>
<td>SIBOR</td>
<td>Singapore Interbank Offered Rate</td>
</tr>
<tr>
<td>SIF</td>
<td>Singapore Insurance Fund</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium-sized Enterprise</td>
</tr>
<tr>
<td>SOR</td>
<td>Swap Offer Rate</td>
</tr>
<tr>
<td>SORA</td>
<td>Singapore Overnight Rate Average</td>
</tr>
<tr>
<td>SSIC</td>
<td>Singapore Standard Industrial Classification</td>
</tr>
<tr>
<td>STI</td>
<td>Straits Times Index</td>
</tr>
<tr>
<td>TDSR</td>
<td>Total Debt Servicing Ratio</td>
</tr>
<tr>
<td>URA</td>
<td>Urban Redevelopment Authority</td>
</tr>
<tr>
<td>y-o-y</td>
<td>Year-on-year</td>
</tr>
</tbody>
</table>
Preface

The Monetary Authority of Singapore (MAS) conducts regular assessments of Singapore’s financial system, which identify potential risks and vulnerabilities, and reviews the capacity of the financial system to withstand potential shocks. The analyses and results are published in the annual Financial Stability Review (FSR). The FSR 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 in-depth analyses on various topics in financial stability.

The production of the FSR is coordinated by the Macroprudential Surveillance Department (MSD) team of the Economic Policy Group (EPG) that comprises Lily Chan, Evelyn Chen, Fan Jia Rong, Cheryl Ho, Koh Zhi Xing, Khoo Ye-Min, Eugene Lee, Wendy Lee, Leou Jie Dong, Aloysius Lim, Kalena Lim, Low Yen Ling, Ng Heng Tiong, Desmond Ong, Alex Phua, Celine Sia, Edward Robinson, Tan Siang Meng, Tan Yee Ling, Teoh Shi-Ying and Wong Siang Leng. The FSR includes contributions from other members of EPG, Irineu de Carvalho Filho, Vincent Low and Ng Ding Xuan, as well as colleagues from Banking Departments I & II, Enterprise Knowledge Department, Economic Analysis Department, Economic Surveillance & Forecasting Department, Insurance Department, Markets Policy & Infrastructure Department and Monetary & Domestic Markets Management Department. Adjunct Professor Choy Keen Meng of Singapore Management University assisted in editing parts of the Special Feature section. The FSR reflects the views of the staff of MSD, EPG and other contributors.

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

Overview

The global financial system has remained resilient this year, but medium-term vulnerabilities are building up

The COVID-19 pandemic has continued to shape global macro-financial developments and government policy responses in 2021. The progress in national inoculation programmes and ongoing accommodative macroeconomic policies have facilitated in lifting global GDP from its trough in Q2 2020, though renewed outbreaks of the virus have delayed economic recovery in some economies. More recently, there has been a pick-up in cost and price pressures induced in part by COVID-19-related disruptions. Through the undulating course of the COVID-19 pandemic, global financial conditions have remained conducive, supporting the general resilience of the international monetary and financial system over the past year.

However, medium-term vulnerabilities of the global financial system have grown, reflecting the build-up of non-financial corporate and sovereign debt, as well as elevated property prices and stretched equity valuations. These vulnerabilities could interact with potential shocks from the evolving macro-financial environment and pose a risk to financial stability. The possibility of a sharper-than-expected tightening of monetary policy in response to persistent above-target inflation could trigger a disorderly repricing of assets. The ensuing tightening of financial conditions could adversely affect economic recovery among more vulnerable emerging market economies (EMEs). Even as economies have adapted towards living with COVID-19, the trajectory of the pandemic remains a key risk. Renewed outbreaks—arising from new virus strains that are more virulent and transmissible—could disrupt economic activity and financial stability anew. For example, the Omicron variant was declared a “variant of concern” in late November 2021, though the scientific assessment of its virulence is still being established. These risks are especially relevant in EMEs with lower rates of vaccinations as well as reduced fiscal and monetary space.

In Singapore, indicators of vulnerability for the corporate, household and financial sectors have improved through the COVID-19 pandemic

Corporates, households and banks in Singapore have remained resilient through the pandemic. At the height of the crisis, existing buffers that had been built up earlier, together with the rollout of exceptional COVID-19 measures, provided critical support. The subsequent economic recovery and accommodative domestic financial conditions helped to shore up overall financial resilience. The Financial Vulnerability Indices (FVI) for the corporate and banking sectors have declined on a year-ago basis, while that for households has remained steady (see table below).
The FVI is calibrated according to deviations from its historical distribution and divided into five coloured bands, which reflect varying degrees of y-o-y change. An increase/decrease in the FVI indicates that vulnerability has risen/fallen over the previous year.

<table>
<thead>
<tr>
<th>Sector</th>
<th>y-o-y change as of</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Corporate FVI</td>
<td>Q2</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Overall Household FVI</td>
<td>Q3</td>
<td>↑</td>
<td>→</td>
</tr>
<tr>
<td>Overall Banking FVI</td>
<td>Q3</td>
<td>→</td>
<td>→</td>
</tr>
</tbody>
</table>

The FVI is calibrated according to deviations from its historical distribution and divided into five coloured bands, which reflect varying degrees of y-o-y change. An increase/decrease in the FVI indicates that vulnerability has risen/fallen over the previous year.

The vulnerability of corporates in Singapore has come down with the improvement in earnings, albeit from elevated levels a year ago. Leverage risk has remained broadly stable, as credit extended to the corporate sector as a share of GDP moderated in Q2 2021 alongside improved profitability. Liquidity and maturity risks have also generally eased over this period, as firms built up cash buffers on the back of the earnings recovery, resulting in improving maturity profiles and debt servicing ability. Foreign currency mismatch risk remains stable as Singapore firms continued to avoid excessive reliance on foreign currency borrowings.

Household vulnerability was broadly unchanged over the past year, though it remains slightly higher than the pre-pandemic period. Maturity risk has declined, as households took on less short-term debt, proxied by credit card borrowings, given the pullback in discretionary spending amid mobility restrictions and the uncertain economic environment. However, leverage risk remains elevated, reflecting an increase in debt relative to the pre-pandemic period. A key driver of higher household indebtedness has been the growth of new housing loans on the back of a resilient property market since end-2019.

Singapore’s financial sector has remained resilient to the economic and financial impact of COVID-19. The banking sector has maintained healthy asset quality alongside strong capital and liquidity buffers, while continuing to support the economy’s demand for credit. Similarly, the non-bank sector has weathered the stresses from COVID-19 well; insurers remain well-capitalised and investment funds have been able to meet redemptions.

The economy’s overall resident credit-to-GDP ratio has declined from its peak of 192% in Q1 2021 to 183% in Q3 2021, driven primarily by an increase in GDP levels as the macroeconomic outlook improves. At the same time, resident credit growth has been firm alongside the recovery in economic activity. Accordingly, the resident credit-to-GDP gap has narrowed from a peak of 10.6% in Q1 2021 to 0.1% in Q3 2021. Hence, MAS will maintain the Countercyclical Capital Buffer (CCyB) at 0% for 2022.

---

1 Based on latest available data.
Singapore corporates, households and the financial sector should remain vigilant and prudent, as the pandemic continues to be a source of considerable uncertainty

While the economy is expected to expand by a creditable 3–5% next year, the pandemic will continue to be a source of considerable uncertainty. Renewed global outbreaks which lead to a reimposition of mobility restrictions could disrupt economic activity anew, resulting in renewed job losses and concerns about the viability of corporates. The consequent increase in global risk aversion could cause a tightening in domestic financial conditions, reducing the flow of credit to the economy. These stresses to the financial channel could be exacerbated if global financial conditions were to also tighten significantly in response to persistently higher inflation. Continued vigilance and prudence therefore remain warranted.

The domestic corporate sector will likely have to contend with some growth unevenness across the economy. Sectors less affected by the pandemic, especially manufacturing, will gain further traction, while the more pandemic-sensitive sectors could be subject to sporadic mobility restrictions depending on the evolution of the virus. Against this backdrop, targeted government support for viable firms temporarily affected by the resurgence in infections may still be needed, even as broad-based assistance programmes are withdrawn to guard against debt sustainability risk in the medium to longer term.

The macroeconomic environment is expected to be supportive for households, as labour market conditions improve. However, the financial positions of households—particularly the more vulnerable segments—could come under pressure in the event that shocks materialise in a scenario of financial stress. The prevailing buffers and macroprudential measures to discourage overleveraging have built up resilience against these shocks. Nevertheless, households should exercise caution in taking on large new commitments, paying due regard to their ability to service long-term mortgage obligations, especially as interest rates are expected to gradually rise. Highly leveraged households should refrain from taking on more debt and try to build up financial buffers where possible, to cushion against stresses emanating from a weakening in macroeconomic conditions. Most households on mortgage relief have been able to resume payments, while bespoke arrangements continue to be available for those with ongoing difficulties.

While credit risk has subsided recently amid improvements in the economic outlook, credit quality could deteriorate if renewed disruptions to economic activity trigger a rise in business insolvencies and unemployment. Nevertheless, the results of the Industry-wide Stress Test (IWST) 2021 exercise show that banks would remain resilient if a resurgence in infections due to more virulent mutated virus strains causes the global recovery to stall. Banks would be able to meet the credit needs of businesses and households in the adverse scenario, even as they continue to adhere to prudent provisioning practices.

Macroprudential Surveillance Department, Economic Policy Group
Monetary Authority of Singapore
6 December 2021
1 Global Financial and Economic Environment

The COVID-19 pandemic has continued to shape global macro-financial developments and governments’ policy responses in 2021. The progress in national inoculation programmes, ongoing fiscal support and easy monetary policy have enabled a recovery in global output, though renewed outbreaks of the virus have delayed economic recovery in some economies. Financial conditions have remained conducive despite persistent market expectations of tighter monetary policy in the face of a pick-up in cost and price pressures this year. Consequently, financial stability risks have remained largely contained this past year.

However, financial system vulnerabilities over the medium term have grown as a result of the accommodative policy mix that has facilitated the global economic recovery. Accommodative financial conditions have led to a build-up of non-financial corporate debt, elevated property prices and stretched equity valuations. The expansion of fiscal support has also induced an increase in sovereign debt, raising fiscal sustainability concerns.

These vulnerabilities could interact with potential shocks from the evolving macro-financial environment to disrupt financial stability. Foremost among the array of possible shocks is the possibility of a sharper-than-expected tightening of monetary policy in response to persistent above-target inflation. Against the backdrop of elevated asset prices and leverage, a disorderly repricing of assets could occur. The ensuing tightening of financial conditions could adversely affect economic recovery among more vulnerable EMEs where recovery remains incomplete. Such a scenario will further widen economic divergence between advanced economies (AEs) and EMEs, amplifying global and regional financial stability risks induced by capital flow volatility. Even as economies have adapted towards living with COVID-19, renewed outbreaks—arising from falling vaccine efficacy or more virulent strains—could disrupt financial stability. These risks are especially relevant in EMEs with lower vaccination rates as well as reduced fiscal and monetary space.

Beyond these vulnerabilities, emerging sources of financial stability risks include a more pronounced manifestation of climate-related physical2 and transition3 risks, and the growing prominence of crypto-assets in financial activity. The strengthening of the surveillance mechanism to identify and analyse these risks is an ongoing task for central banks and regulators.

---

2 Physical risk refers to the economic costs and financial losses from the exposure of human and natural systems to climate-related events. These climate-related events include acute weather events (e.g. flash floods) and more gradual, long-term changes in climate patterns (e.g. gradual melting of polar ice sheets).

3 Transition risk refers to the economic and financial costs of the adjustment to a low-emissions economy, including those induced by policy changes, technological breakthroughs, and shifts in investor preferences and social norms.
1.1 Conjointural update

Global financial conditions have remained accommodative over the past year

Overall, financial conditions have eased since the height of the COVID-19 crisis in the first quarter of 2020. Over the past year, financial conditions in AEs have continued to loosen further and are, at present, slightly more accommodative than the pre-pandemic period. In contrast, conditions in EMEs have remained mostly unchanged over the same period (Chart 1.1). Expectations of further economic recovery from the pandemic—supported by fiscal measures, relatively easy monetary policy and the progress of vaccinations—have underpinned these accommodative financial conditions, albeit more so for AEs than EMEs. Growth prospects of AEs have improved considerably compared to EMEs over the course of 2021, reflecting their faster rollout of vaccinations that has allowed for the easing of mobility restrictions. Monetary policy in AEs has also remained broadly accommodative, supporting the ongoing recovery. In comparison, some emerging market (EM) central banks have started to tighten monetary policy in response to rising inflation.

In AEs, low interest rates—together with an improvement in earnings amid the economic recovery—have buoyed equity and bond valuations, ensuring continued conducive conditions for financing. Since the market trough in Q1 2020, AE equity prices have risen steadily and have significantly exceeded their pre-COVID levels (Chart 1.2). Risk sentiment in AE corporate debt markets has also been robust, with corporate yields, including high yield issuances, generally trending around pre-pandemic levels this year (Chart 1.3).

However, borrowing costs for AE corporates and households are expected to rise on the back of higher government bond yields going forward. For example, 10-year sovereign bond yields (Chart 1.4) have edged higher in recent months and are expected to rise gradually as monetary policy begins to normalise with output and employment recovering further. That said, markets are constantly assessing the ensuing pick-up in cost and price pressures, which has been exacerbated by supply bottlenecks. Should inflation prove to be more persistent and broad-based, a rapid repricing in market expectations of the pace of tapering and policy rates could lead to a disorderly tightening in global financial conditions, with its attendant impact on EMEs.

Overall sentiment surrounding EM assets has turned somewhat cautious given their weaker macroeconomic outlook; the path to a sustainable exit from the pandemic has yet to be firmly established in many countries amid sporadic outbreaks in infections. Conditions for equity and debt financing have also become more restrictive. Equity prices in EMEs have lost their upward momentum from last year. While borrowing costs for investment-grade EM corporates have remained generally stable, those for lower-rated corporates have seen a sharp rise in recent months. Borrowing costs for EM governments have similarly risen throughout 2021, in tandem with a tightening of monetary policy across much of EM ex-Asia this year, higher US Treasury yields as well as a stronger USD.

In the foreign exchange markets, EM currencies have weakened over the year (Chart 1.5), contributing to some tightening in financial conditions for EMEs dependent on external financing. Nonetheless, financial conditions in EMEs remain broadly accommodative at this
juncture compared to the pre-COVID period and at the height of the pandemic last year. EMEs have seen net portfolio investment inflows this year, led by steady foreign inflows into the bond market (Chart 1.6).

**Chart 1.1** Financial conditions have either eased or remain broadly unchanged over the past year

Financial Conditions Indices

![Financial Conditions Indices Chart](chart-1.1.png)

Source: International Monetary Fund (IMF)

Note: Other AEs include AEs in Europe outside of the EU, and those in the Asia-Pacific region. EME includes EMEs in Europe, EMEA, LATAM, and Emerging Asia excluding China.

**Chart 1.2** Equity prices have risen above pre-pandemic levels, especially for AEs

Equity Price and Volatility Indices

![Equity Price and Volatility Indices Chart](chart-1.2.png)

Source: Haver Analytics

**Chart 1.3** Corporate borrowing costs have ticked up in the high yield (HY) segment of EMEs

Corporate Bond Index Effective Yields

![Corporate Bond Index Effective Yields Chart](chart-1.3.png)

Source: ICE Data Indices, LLC, retrieved from Federal Reserve Economic Data (FRED), Federal Reserve Bank of St. Louis

Note: Data are effective yields of Intercontinental Exchange Bank of America (ICE BofA) indices for US and EM corporate debt; the EM index tracks only USD- and EUR-denominated corporate bonds issued in EMEs; IG=Investment Grade.

**Chart 1.4** Government bond yields are rising towards pre-pandemic levels

10-year Government Bond Yields, Actual and Forecasts

![10-year Government Bond Yields Chart](chart-1.4.png)

Source: MAS estimates, Bloomberg, Haver Analytics

Note: Regional values are the simple average of the following economies: AE=AU, CA, CH, FR, DE, ES, IT, JP, PT, UK, and US; EM=BR, CN, CO, IN, ID, MX, PH, PL, KR, TH, TR, and ZA; EM Asia=CN, IN, ID, PH, and TH. Dotted lines are averages calculated from analyst forecasts compiled by Bloomberg as of 9 November 2021.
1.2 Assessment of vulnerabilities

Unprecedented policy support has lifted economies out of the crisis, but has led to elevated debt and stretched asset valuations

A defining feature of the global macroeconomic and financial policy responses to the COVID-19 pandemic has been the unprecedented level of support extended to businesses and households. In the absence of these exceptional measures, the contraction in economic activity would have been sharper and more prolonged, while the initial market turmoil could have spiralled into significantly greater stresses for the global financial system. To support the recovery through repeated waves of infections and considerable uncertainty surrounding the evolution of the pandemic, these measures were put in place for an extended period; though some of these measures have since expired or been pared back with the normalisation in market conditions and the dissipation of downside risks to growth.

However, these measures have contributed to a build-up in corporate debt, further elevation of sovereign borrowings and a relentless climb in asset valuations to successive new highs. Businesses have taken on more debt over this period to sustain their operations amid falling revenues during the crisis, as authorities provided moratoriums on debt repayment and offered low cost funding. Fiscal injections by governments into the economy were mostly financed through more borrowings, as tax revenues fell in tandem with the initial pullback in economic activity. In asset markets, valuations have risen ahead of economic fundamentals, underpinned by accommodative global financial conditions. These developments have increased vulnerabilities in the global financial system, which could pose severe risks to financial stability in the event of unexpected shocks.
Corporate indebtedness has increased unevenly across regions and sectors

The disruption to cashflows and easing in global financial conditions have contributed to a further build-up in corporate debt globally since the onset of the pandemic, with the increase being more pronounced in certain regions and sectors. For example, economies that started off with higher corporate debt-to-GDP levels appear to have accumulated relatively more debt (Chart 1.7). Within the ASEAN-4 region, the pace of debt accumulation has been more pronounced in the industrials, telecommunications and consumer discretionary sectors (Chart 1.8).

**Chart 1.7 The rise in corporate debt levels has been uneven across regions...**
Change in Corporate Debt as % of GDP (Q4 2019 to Q1 2021)

Source: Bank for International Settlements (BIS)

**Chart 1.8 ...as well as across sectors within the ASEAN-4 region**
ASEAN-4 Corporate Debt Growth by Sector

Source: MAS estimates, Worldscope

Notwithstanding the accumulation of debt, overall corporate vulnerability in the region has fallen over the past year, as measured by MAS’ ASEAN-4 corporate sector FVI (Chart 1.9). The fall in the FVI has largely been driven by the decline in the leverage component, owing to improved profitability (relative to the peak stress period of COVID-19) and lower interest expenses. Loan repayment support measures have eased corporates’ cashflow pressures through the deferral of loan interest and principal repayments. However, with the planned withdrawal of loan moratoriums in tandem with the economic recovery, credit risk could rise on the back of increasing debt servicing costs and manifest as an increase in non-performing assets. This would be especially pronounced if the timing and pace of such withdrawals do not coincide with a sustained recovery in corporate earnings. Foreign currency mismatch risk in the corporate sector has also increased amid the rise in foreign currency denominated bonds and depreciation of ASEAN-4 currencies. In a risk-off environment, further depreciation pressures in EM currencies could weigh on corporates’ ability to service their foreign currency debt, especially if their liabilities are largely unhedged.
Continued rise in sovereign debt-to-GDP levels raise concerns about fiscal sustainability and, in turn, banking stability

Sovereign debt-to-GDP levels are projected to remain elevated over the medium term in the wake of the large fiscal support measures and reduction in tax revenues that followed the onset of the pandemic (Chart 1.10). Across both AEs and EMEs, estimates by the IMF show that gross government debt-to-GDP ratios will be around 20 percentage points higher over the next five years than before the pandemic. Some stabilisation of AE public debt-to-GDP levels is expected after 2021 as these countries experience a faster pace of growth that exceeds nominal interest rates. In comparison, EM debt ratios are expected to continue their upward trajectory as the lingering effects of the pandemic continue to weigh on economic growth.

At higher debt levels, sovereigns would be more vulnerable to a sharp rise in borrowing costs and refinancing risk. EMEs are likely to be more affected by higher interest rates as non-resident bond investors reduce their positions in the face of rising concerns about fiscal sustainability. In addition, in EMEs, higher sovereign debt levels have been partly financed by domestic banks through their increased holding of domestic sovereign bonds. Such linkages between sovereigns and domestic banks mean that financial strains facing sovereigns could directly affect banks’ financial health or limit their access to financing. In AEs, higher government debt levels were predominantly financed by central banks as part of their quantitative easing policy.
Asset valuations remain elevated amid accommodative global financial conditions

Continued accommodative measures have been a key driver of rising financial asset prices. However, asset valuations are increasingly stretched against fundamentals, with the rise in prices outpacing growth in earnings. Markets could be susceptible to a sharp and disorderly correction in the event of a shock.

The cyclically adjusted price-to-earnings (CAPE) ratios of major equity indices—a measure of overvaluation or undervaluation that compares the current market price to the inflation-adjusted historical earnings record—have mostly hit multi-year highs since the steep correction in March 2020 (Chart 1.12). Credit spreads have generally remained tight relative to historical levels, with the exception of EME high yield bonds (Chart 1.13). As a result of the correction in the high yield property segment in China, credit spreads of high yield EME bond indices have widened beyond pre-COVID levels. However, the sell-off has been contained to over-leveraged high yield property firms, with little spillover to the broader high yield complex in EMEs at this juncture. Financial risk-taking via the use of leverage has also increased alongside compressed risky asset volatility; margin debt held at brokerage accounts had risen to a new high in August 2021 before dipping slightly (Chart 1.14).
Property prices relative to income have also risen across most AEs and EMEs despite the pandemic (Chart 1.15). This has been driven by low interest rates, the massive fiscal and monetary stimulus, as well as the limited supply of new properties amid pandemic-related construction bottlenecks. An increase in housing prices that is not supported by fundamentals risks a sharp correction that could impair household wealth and bank loan portfolios (see Chapter 3 for an analysis of the domestic property market).
1.3 Identification and assessment of potential shocks

Shocks to the macro-financial environment could interact with the build-up of vulnerabilities and pose risks to financial stability. The shocks identified are not mutually exclusive and could materialise jointly.

The current global macroeconomic conjuncture is being shaped by a dynamic tussle between inflation and growth risks, driven by the uncertainty from the impact of COVID-19. On one hand, a sustained trend of higher inflation could trigger a sharper-than-expected tightening of global financial conditions. On the other hand, growth setbacks, including from a resurgence of the pandemic, could pose obstacles to a sustained global economic recovery. In the current environment, policy risk—such as misjudgements in the pace of withdrawing support measures or missteps in the normalisation of monetary policy—could exacerbate both growth and inflation risks.

Sharper-than-expected tightening of global financial conditions triggered by higher and persistent inflation

Inflation has picked up in many economies this year, owing to a recovery in demand, supply-side bottlenecks and low base effects. The baseline expectation is for elevated price pressures to abate, as pandemic-induced supply constraints ease and labour force participation rates recover. This baseline forecast is consistent with the market pricing of long-term inflation expectations in AEs, which remain generally within or below central banks’ targets of price stability (Chart 1.16).

However, there remains considerable uncertainty surrounding the path of macroeconomic variables. Importantly, if supply bottlenecks prove to be more persistent than currently anticipated, elevated inflation readings could feed into demand for higher nominal
wages. This would eventually unmoor inflation expectations and force central banks to normalise monetary policy in a more aggressive manner than what markets have currently priced in. The consequent tightening in global conditions could trigger a sharp repricing in financial assets and capital outflow from EMEs, as shifts in risk appetite elicit a rebalancing of investment portfolios.

**Chart 1.16 Inflation expectations remain within or below major AE central banks’ price stability targets for now**

**Breakeven Inflation Rates and Forward Swap Rates**

![Graph of Inflation Expectations](chart)

Source: Bloomberg

Note: US and JP are plotted using 10-year breakeven inflation rates, while EU is plotted using the 5-year forward 5-year inflation swap rate; data are month-end values; data for November 2021 is as of 19 November 2021.

**Growth setbacks, including from the pandemic**

Apart from potential inflation shocks, the pandemic also remains a source of considerable uncertainty. While higher vaccination coverage has seen the withdrawal of stringent restrictive measures that impede economic activity, the emergence of more virulent strains and the waning efficacy of vaccines are risks that could lead to renewed infection waves. In turn, any reimposition of mobility restrictions that disrupt economic activity anew will have attendant effects on both price and financial stability.

In China, regulations aimed at curbing the rise in leverage among highly-indebted property developers have increased refinancing risk. A sharper-than-expected slowdown in the property sector could cause a material drag in consumption spending and investments and substantially impact the broader economy. In the scenario of a more pronounced slowdown, perhaps in the context of renewed infection outbreaks, there would be negative spillovers to regional and global growth, especially for jurisdictions that have greater economic linkages to China, including commodity exporters. This could also affect broader risk sentiment, leading to a tightening in financial conditions.
Risk of policy missteps in the unwinding of pandemic support measures

As the global recovery takes hold, the wide range of extraordinary fiscal, monetary and prudential measures introduced to support output and financial stability over the course of the pandemic will need to be gradually withdrawn. However, uncertainty over the evolution of the pandemic as well as its impact on price stability and economic growth present significant challenges for the timing, pace and sequence of policy withdrawal. Policymakers will need to balance between jurisdiction-specific economic conditions and resource constraints, while taking into account the build-up of vulnerabilities that could arise from protracted extensions of pandemic support measures. There is a risk that the withdrawal of policy support, whether intended or forced by other policy considerations, could be premature if the economic recovery has not firmly taken hold. Similarly, the lack of coordination in the pace or sequence of policy withdrawal could leave unintended policy voids. In addition, there could be increased market volatility if miscommunication or lack of communication over the timing and pace of policy normalisation creates uncertainty among market participants.

1.4 The interaction between vulnerabilities and shocks could amplify financial stability risks

One common risk across the shocks set out in Section 1.3 is the potential for investors and lenders to indiscriminately pull back credit, triggering a sudden and disorderly repricing of financial assets, especially those with stretched valuations. Under such a scenario, market liquidity issues could compound the initial tightening of financial conditions amid the rush to exit from risky assets. In particular, non-bank financial institutions (NBFIs), such as open-ended mutual funds, could face a liquidity crunch from redemptions, given the inherent liquidity mismatch risk of such funds. Money-market funds could also face liquidity calls, as institutions tap on such funds to meet expenditure needs or to rebalance their portfolios.

The ensuing market dislocations could reinforce the initial sell-off, propagating shocks across markets and jurisdictions. Long-standing vulnerabilities as well as interlinkages could come under intense scrutiny, exacerbating risk aversion and setting forth destabilising dynamics. During periods of heightened volatility, such as the Global Financial Crisis (GFC), asset markets across geographies whose returns are not correlated during normal times may sometimes move together. The sovereign-bank nexus is one such example that may multiply and accelerate vulnerabilities in each sector, and lead to adverse feedback loops.

These developments could impact economies and markets more severely than in 2020, given the more limited fiscal and monetary policy capacity at the current juncture to respond to additional downside shocks. EMEs could be in a more vulnerable position with their relatively lower vaccination rates and output trajectory, as well as greater sensitivity to financing conditions amidst elevated debt levels. A further widening of the AE-EME growth divergence could exacerbate capital outflows from EMEs. EM central banks may be pressured

---

4 Sandoval Junior and De Paula Franca (2011) find that during times of crisis, markets tend to behave similarly during times of high volatility. Specifically, periods of high volatility seem to be preceded by a period of high correlation between stock markets of the world, based on crises such as the dot-com bubble in 2001 and the GFC in 2008.
to tighten monetary policy to reduce capital outflows at the expense of economic recovery, both of which would exacerbate financing difficulties for corporates and sovereigns.

Nevertheless, EMEs entered the pandemic with sound banking sectors, alongside firmer external balances and larger foreign reserves compared with previous crises. They have also taken an eclectic and pragmatic approach in safeguarding price and financial stability, deploying a broad set of tools as necessary to maintain market functioning, manage capital outflows and anchor inflation expectations (see Special Feature 1 “Integrated Macro Policy Framework: An Assessment of the Ongoing Research”).

More broadly, the global banking sector has generally remained resilient through this crisis, with sufficient capital buffers and provisioning to cushion against potential shocks. Moreover, in anticipation of potential shocks to the financial system, regulators have undertaken or are studying various measures to tackle rising property prices, mitigate liquidity mismatch risk of open-ended funds and enhance the resilience of funding markets.

1.5 Climate change and crypto-assets are emerging vulnerabilities

Climate change and the increased prominence of crypto-assets present emerging vulnerabilities\(^5\) for financial stability. While these risks may be less pronounced at this juncture, they warrant close monitoring and an active assessment of options due to their potential to rapidly develop and materialise into significant financial stability risks.

Vulnerabilities associated with climate change are increasing

Climate-related extreme events have been increasing in frequency with global warming.\(^6\) As the urgency to combat climate change comes to the fore, global efforts to transition to a low-carbon economy have also gained much traction. Accordingly, the manifestation of physical and transition risks is likely to become more pronounced over time.

At the same time, there has also been growing recognition of the effects that these climate risks could pose to financial stability. For example, increasing awareness could trigger an abrupt reassessment of physical and transition risks, leading to a sharp increase in risk premia across a wide range of assets that are perceived to be incompatible with a low-carbon economy. It is thus imperative for financial institutions (FIs) and authorities to build up capabilities to better assess, manage and mitigate the impact of these climate risks on their assets (see Special Feature 2 “Climate Transition Risk Exposure of Singapore’s Banking and Insurance Sectors”).

---

\(^5\) According to the Financial Stability Board (FSB)’s Financial Stability Surveillance Framework (2021), emerging vulnerabilities refer to those judged to not be material from a financial stability perspective over the next 3 years, but could become material over the next 3–5 years.

\(^6\) The Intergovernmental Panel on Climate Change Sixth Assessment Report (2021) states that climate change has brought about an increased incidence of weather-related events in Asia, including intensifying rainfall and associated flood patterns, rising sea levels and extreme heat events.
The increased prominence of crypto-assets warrants heightened surveillance

Crypto-assets have gained increasing prominence with the rapid rise in crypto-asset market capitalisations and trading volumes over the past two years (Charts 1.17 and 1.18). As an asset class, crypto-assets have also seen rising interest from investors. For example, in a recent survey by Fidelity Digital Assets, a cryptocurrency custody and trading firm, 52% of institutional investors surveyed globally had investments in financial digital assets, and 71% of institutional investors in the US and Europe were keen to purchase such assets, compared to 59% in 2020. The range of derivative products linked to crypto-assets on established international derivatives exchanges has also been growing.

Despite rapid growth, crypto-assets remain only a small proportion of overall financial system assets and have not been widely used in critical financial services. For example, the peak daily trading volume of crypto-assets against the SGD year-to-date has been less than 1% of the average daily turnover on the Singapore Exchange (SGX). However, the continued growth in activity and deepening of interconnections between FIs in such assets are likely to continue, with crypto-assets and their markets becoming systemically significant for financial stability considerations in the future. The wealth effect could also be more pronounced if crypto-assets account for a larger share of investor portfolios. In particular, consumption could be subject to considerable shocks arising from the inherent heightened volatility of such assets.

Stablecoins could be subject to a surge in redemptions that lead to liquidity stresses during market stress scenarios, similar to that of money-market funds, which could in turn propagate instability to the wider financial system. If widely used for payments, operational disruptions to stablecoin arrangements may disrupt financial system functioning and real economic activity. Stablecoins could also increase the likelihood of systemic bank runs in a banking crisis given the ease of bank deposit withdrawals if such tokens become widely accepted as a common store of value and as a digital substitute for bank money and cash.

Additionally, the growth of decentralised finance (DeFi) has the potential to create a shadow financial system without the regulatory safeguards designed to mitigate financial stability risks across the entire range of financial services. As such, close monitoring of the crypto-asset market will be increasingly important going forward.

---

8 Daily trading volume of crypto assets against SGD calculated by summing the total volume of direct trades of the top 10 most active crypto-SGD trading pairs.
9 Coins that seek to maintain a stable value relative to a specified asset or pool of assets.
10 This is a financing activity enabled by smart contracts built on distributed ledger technologies to facilitate peer-to-peer financial transactions.
Chart 1.17 Total crypto-asset market capitalisation has risen rapidly since 2020...

Crypto-asset Market Capitalisation
- ADA
- BNB
- USDT
- ETH
- Other
- BTC

Source: MAS estimates, Coinmarketcap
Note: ADA=Cardano, BNB=BinanceCoin, USDT=Tether, ETH=Ethereum, BTC=Bitcoin.

Chart 1.18 ...as have trading volumes

Crypto-asset Daily Trading Volumes, 20-day Moving Average
- XRP
- BUSD
- ETH
- BTC
- Other
- USDT

Source: MAS estimates, Coinmarketcap
Note: XRP=Ripple, BUSD=BinanceUSD, ETH=Ethereum, BTC=Bitcoin, USDT=Tether.
2 Singapore Corporate Sector

Aggregate economic activity in Singapore has recovered to pre-pandemic levels as of Q3 this year, with firms' earnings showing a similar trend of improvement, underpinned by the pick-up in external demand. Domestically, the less stringent containment measures relative to H2 2020, coupled with accommodative financial conditions, have supported business cashflows.

Nevertheless, there remain significant disparities in performance across industries, as prospects in some segments of the Singapore economy have been weighed down by new waves of infections and the reimposition of mobility restrictions.

Firms' vulnerability to shocks in Q2 2021—as measured by the corporate sector FVI—has eased, albeit from elevated levels a year ago. Leverage risk has remained broadly stable as credit extended to the corporate sector as a share of GDP moderated in Q2 2021, while profitability improved amid the recovery in the economy. Liquidity and maturity risks have also generally eased over this period. Firms have built up healthy cash buffers on the back of the earnings recovery, resulting in improved maturity profiles and debt servicing ability. Foreign currency mismatch risk has remained stable as Singapore firms continued to avoid excessive reliance on foreign currency borrowings.

Looking ahead, while the outlook for the corporate sector is expected to improve with the gradual reopening of the economy, the pandemic will continue to be a source of considerable uncertainty. The projected growth outcomes across sectors are also likely to remain uneven, given the differentiated impact of COVID-19 across sectors. Stress tests suggest that firms in general would have adequate buffers to mitigate the impact of shocks to earnings and cost of financing in the event adverse scenarios unfold.

<table>
<thead>
<tr>
<th>Corporate sector FVI (y-o-y changes)</th>
<th>Q2 2020</th>
<th>Q2 2021</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</td>
<td>→</td>
<td>→</td>
</tr>
</tbody>
</table>

*y-o-y changes in FVI

- decreased significantly
- broadly unchanged
- increased significantly

*The extent of risk is classified by band thresholds. While leverage risk remains within the same band in Q2 2021, the level of the indicator is lower compared to Q2 2020 as well as Q4 2019, before the onset of COVID-19.*
2.1 Financing conditions in Singapore

Domestic financing conditions have remained accommodative over the past year, supporting the flow of credit to businesses

Domestic financing conditions have remained accommodative over the past year amid continued near record-low global interest rates (Chart 2.1). SGD interest rates have been anchored at low levels by the exceptional monetary accommodation in AEs and expectations of some strengthening in the SGD exchange rate. In capital markets, the Straits Times Index (STI) has tracked higher alongside the global rally, while spreads of investment-grade corporate bonds issued by Singapore-based firms have narrowed since Q1 2020 (Table 2.1). Financing conditions have also remained accommodative for small and medium-sized enterprises (SMEs), amid the cautious and gradual approach towards unwinding of credit relief measures (see Section 2.3 below).

Against this backdrop, the corporate sector’s debt-to-GDP increased to a high of 172% in Q1 2021, before easing slightly to 164% in Q2 2021 (Chart 2.2). Compared to pre-COVID levels, Q2 2021 debt-to-GDP was higher by 12 percentage points, as corporate lending rose by 3.9% while nominal GDP fell by 3.7%.

---

### Chart 2.1 Domestic financing conditions have stayed accommodative since Q2 2020

**Domestic Financial Conditions Index (FCI)**

**Source:** MAS estimates, Bloomberg, Department of Statistics (DOS), Urban Redevelopment Authority (URA)

---

### Chart 2.2 Corporate debt-to-GDP moderated in Q2 2021 alongside the rebound in economic activity

**Singapore’s Corporate Debt as Percentage of GDP**

**Source:** MAS estimates, BIS, Dealogic
### Table 2.1 Indicators of domestic financing conditions

<table>
<thead>
<tr>
<th></th>
<th>Q4 2019</th>
<th>Q1 2020</th>
<th>Q4 2020</th>
<th>Q3 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic FCI (Standard deviation from mean)</td>
<td>−0.57</td>
<td>0.95</td>
<td>−0.43</td>
<td>−0.30</td>
</tr>
<tr>
<td>3-month compounded SORA</td>
<td>1.38</td>
<td>1.16</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>10-year Singapore Government Securities (SGS) yields</td>
<td>0.87</td>
<td>0.79</td>
<td>0.44</td>
<td>0.71</td>
</tr>
<tr>
<td>STI index</td>
<td>3189.88</td>
<td>3014.66</td>
<td>2690.67</td>
<td>3119.43</td>
</tr>
<tr>
<td>CEMBI Investment Grade+ SG Spread*</td>
<td>112.97</td>
<td>120.66</td>
<td>149.54</td>
<td>101.82</td>
</tr>
</tbody>
</table>

Source: MAS, Bloomberg, J.P. Morgan Markets

Note: Figures are quarterly averages.

*The spread is spread-to-worst computed by J.P. Morgan Markets. It is calculated as the spread of the yield-to-worst of USD corporate bond over the yield of the corresponding maturity US Treasury zero coupon bond.

### 2.2 Assessment of vulnerabilities

Leverage risk has eased marginally with the moderation in corporate debt growth and improved corporate profitability

There have been incipient signs of easing in leverage risk with the recent moderation in corporate debt growth and improvement in profitability amid the broader recovery in the economy (Chart 2.3). Corporate earnings of SGX-listed firms, measured by return on assets (ROA), improved across the board in H1 2021, with the median ROA rising from 0.3% in Q2 2020 to 1.0% in Q2 2021. The increase was more pronounced in the domestic-oriented cluster, which had also experienced the largest decline during the COVID-19 pandemic (Chart 2.4). For example, the median ROA of firms in the construction, hotels & restaurants and commerce segments saw significant improvements from the trough in Q2 2020—rising by 1.0, 0.8 and 1.1 percentage points respectively between Q2 2020 and Q2 2021—on the back of the recovery in domestic demand following the easing of containment measures (Chart 2.4).

Notwithstanding the overall progress, significant disparities in performance persist, given the differentiated COVID-19 restrictions across sectors. The median ROAs for firms in the property, construction and multi-industry sectors are still below pre-pandemic levels, with the latter two in the red, albeit with smaller losses as compared to Q2 2020. The construction sector continued to be affected by high material and wage costs due to supply-side disruptions. Within the multi-industry sector, border restrictions remain a key impediment to profitability for the hospitality segment, while the ROA in the marine and offshore engineering segment has been weighed down by weak global demand for offshore rigs.
Debt servicing ability of firms also improved in H1 2021, with most sectors having sufficient financial buffers

The improvement in earnings has also strengthened the debt servicing ability of firms in H1 2021, as shown by the increase in the interest coverage ratio (ICR), which measures the ratio of earnings to interest payments. Generally, a firm is considered to have difficulties in servicing its debt if the ICR is less than 1, in which case earnings are insufficient to cover interest expenses. The median ICR of all SGX-listed firms rose from 1.7 in Q2 2020 to 2.8 in Q2 2021, indicating that firms had comfortable buffers to service their annual interest payments (Chart 2.5).

However, the pace of recovery in earnings varied across sectors. The debt servicing ability of the construction sector remained weak, with a negative ICR, suggesting that the firms would have to draw on cash reserves to meet their interest cost commitments. At the other end, firms in the commerce, hotel & restaurant and multi-industry sectors saw the largest increases in their ICRs, with the median ICRs at 5.7, 3.9 and 2.1 respectively in Q2 2021, surpassing their pre-pandemic levels. The other sectors also had relatively healthy buffers, with median ICRs remaining above 1.5 in Q2 2021.
Liquidity and maturity risks have broadly eased, as firms have generally maintained healthy cash buffers and improved their maturity profiles

In H1 2021, firms generally held sufficient liquidity, with the median current ratio and median cash coverage ratio of SGX-listed firms remaining at 1.7 and 1.6 in Q2 2021 respectively (Charts 2.6 and 2.7). Firms’ healthy cash buffers can be attributed to improved earnings over this period. Firms had to access the short-term debt market to ease short-term cashflow constraints in the first half of last year at the onset of the pandemic, but subsequently were able to raise cash organically in H2 2020 and H1 2021. This in turn reduced the maturity risk for firms, with the maturity profile of debt—measured by the proportion of short-term debt to total debt—falling from 42% in Q2 2020 to 38% in Q2 2021 (Chart 2.8). Further, the bond maturity profile of Singapore firms also remains well termed out, with bonds due by 2022 making up about only 10% of outstanding bonds.

However, the liquidity profiles of firms varied significantly across sectors. For example, the manufacturing sector outperformed other sectors, with both liquidity indicators having risen to new highs. This could be attributed to the rapid expansion of output in the electronics and precision engineering industries, which boosted sales and revenues and in turn cash holdings. In comparison, the construction sector’s liquidity ratios fell in Q2 2021 due to weak profitability amid heightened cost pressures and activity disruptions.
Chart 2.6 Current ratios have remained healthy in 2021...

Median Current Ratios of SGX-listed Firms

Source: MAS estimates, Thomson Financial

Chart 2.7 ...as have cash coverage ratios

Median Cash Coverage Ratios of SGX-listed Firms

Source: MAS estimates, Thomson Financial

Chart 2.8 Short-term debt to total debt ratios have fallen in 2021

Median Short-term Debt to Total Debt Ratios of SGX-listed Firms

Source: MAS estimates, Thomson Financial
Foreign currency mismatch risk has remained stable

The outstanding foreign currency bond value as a proportion of total outstanding bond value in Singapore has remained at around 60% since 2018, indicating a stable risk profile. Further, foreign currency bond issuance was driven by external-oriented firms, which are naturally hedged for foreign currency exposure as a sizeable proportion of their revenues are also denominated in foreign currency. The foreign currency liabilities taken up by these firms would generally reflect the need to fund their operations in other countries or support transactions that are typically priced in major currencies. More broadly, corporates are able to rely on the deep and liquid FX market in Singapore to hedge their FX exposure. Based on the 2019 BIS Triennial Central Bank Survey, the daily average turnover of FX derivatives arising from corporate activities in Singapore was about USD12 billion or in annual terms, about USD3 trillion, which was about 2.5 times the value of total trade (export and import of goods and services).

The corporate non-performing loan ratio has fallen in 2021

The Singapore banking system’s corporate non-performing loan (NPL) ratio fell from 3.4% in Q1 2021 to 3.0% in Q3 2021. While overall asset quality remains healthy, several sectors registered relatively higher NPL ratios as they were more severely impacted by the pandemic. In particular, the transport & storage, wholesale trade and construction sectors recorded NPL ratios of 11.8%, 6.2% and 5.9% as of Q3 2021, reflecting continued weakness in the travel and tourism-related industries and unanticipated cost increases arising from supply chain disruptions. That said, banks are assessed to be well-placed to weather further downside risks, with strong capital buffers and adequate provisions (see Chapter 4 “Singapore Financial Sector”).

2.3 SME financial position and operating environment

Smaller firms in sectors more impacted by the pandemic remain vulnerable

MAS has updated its analysis of the financial position of unlisted firms, based on firm-level FY2019 financial data, and more timely and comprehensive data of SGX-listed firms. Similar to last year’s analysis, firms with low cash relative to ongoing operational costs (or low “cash buffers”) and with low cash to current liabilities (or low “cash cover”), were identified as relatively more vulnerable.11

SMEs continue to have weaker cash buffers than large firms. The proportion of vulnerable SMEs is estimated to be about 30 percentage points higher than that of vulnerable large firms, which is relatively unchanged from last year’s findings. After accounting for their projected revenue12 in 2021, sectors most affected by the pandemic—accommodation, food and beverage (F&B), construction and retail—continue to have a higher proportion of vulnerable firms with weaker cash buffers. Compared to the rest of the economy, these sectors have more

11 A firm is assessed to be vulnerable if both ratios are below EPG-MSD’s internal threshold. If the firm does not report any liquidity indicators, vulnerability will then be assessed based on debt servicing ability (profit before tax over liabilities).
12 Revenues in 2021 are projected using sectoral VA growth forecasts.
vulnerable firms by 10–19 percentage points, with their median cash to current liabilities ratio about 16 percentage points lower. Smaller firms in such sectors more severely hit by the pandemic are still expected to be under strain amid the uneven recovery, with their smaller balance sheet and limited access to capital markets leaving them less well-positioned to weather the pandemic’s lingering impact.

The decline in take-up of relief schemes suggests some normalisation of SMEs’ ability to resume loan repayments

Bank lending to SMEs has remained supportive, with lending having increased at a y-o-y growth rate of 2% as of Q2 2021, similar to the overall growth of credit to businesses (see Chart Panel 2A “Small and Medium-sized Enterprise Financing Conditions”). The extension of the MAS SGD Facility and Enterprise Singapore (ESG) schemes till March 2022 provides assurance that SME financing conditions will remain conducive, even as the credit relief support measures become more targeted to focus on sectors that are weaker.

Further, the declining trend of applications and take-up of relief schemes in 2021 suggests that most SMEs are recovering well alongside the improvement in economic activity and have resumed loan repayments. In the absence of the Extended Support Scheme-Standardised (ESS-S), borrowers can avail themselves of bilateral debt moratorium or restructuring packages with banks.

Overall SME credit quality has remained stable against the backdrop of the gradual tapering of credit relief support schemes.

2.4 Outlook

Business outlook has improved in 2021

The Singapore economy is expected to remain on an expansion path, with GDP growth registering a slower but still above-trend growth pace in 2022. Against this backdrop, the general outlook for the manufacturing and services sectors in 2021 has improved from the negative levels in 2020. In the Q4 2021 Business Expectation surveys by the Economic Development Board (EDB) and the Department of Statistics (DOS), a net weighted balance of 16% of manufacturers and 19% of firms in the services sector predicted a favourable business situation for October 2021 to March 2022 (Chart 2.9).

Within the manufacturing sector, the electronics cluster was the most optimistic, with a net weighted balance of 27% of firms expecting a better business situation, largely driven by the semiconductors segment which anticipates continued robust demand. However, some segments within the manufacturing sector have a less sanguine view of the horizon. A net

---

13 Take-up of the current extended ESS-S scheme in 2021 is lower compared to earlier relief schemes, including the Special Financial Relief Programme (SFRP), which similarly provided deferments on principal repayments up till end-2020, and the initial ESS-S for partial principal deferments up till 30 June 2021. The number of ESS-S applications under the extension was about 4% of the applications under the SFRP, and 16% of the applications under the initial ESS-S. Trends for approval rates are also similar to application rates, with ESS-S approvals under the extension lower than those under the SFRP and the initial ESS-S.
weighted balance of 3% of firms in the chemicals segment expect weaker business conditions in the same period, arising from higher raw material costs and global supply chain disruptions. Nonetheless, the manufacturing sector overall is expected to be one of the stronger sectors, with increases in output forecast across all segments.

Within the services sector, all segments expect business conditions to improve for the period October 2021 to March 2022. In particular, the transportation & storage segment has the highest net weighted balance of 35% of firms expecting a more favourable business outlook, as air transport firms turn optimistic arising from the opening up of Singapore’s aviation sector with Singapore’s Vaccinated Travel Lanes. More generally, the gradual reopening of the Singapore economy will support broad-based improvement in corporate performance.

Chart 2.9 Net positive outlook in business outlook for the six months till March 2022

General Business Outlook for Manufacturing & Services Sector (Net Weighted Balance*)

Source: DOS, EDB

Note: The latest data point (surveyed in Q4 2021) refers to the business outlook for October 2021 to March 2022.

* “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 be resilient against shocks

The corporate outlook will unsurprisingly be susceptible to potential global shocks described in Chapter 1, given Singapore’s small and open economy. Cost of financing for corporates in Singapore could rise sharply alongside the tightening of global financial conditions triggered by a sustained trend of higher inflation. Earnings setbacks could materialise should growth come under pressure from falling vaccine efficacy or more virulent virus strains, or if the risk of a more pronounced growth slowdown in China materialises.

The rebuilding of buffers over the past year, in the form of stronger liquidity positions and reduced maturity mismatches, will help firms to withstand shocks under these adverse
scenarios. MAS’ stress test on the balance sheets of SGX-listed firms suggest that most corporates would be resilient to interest rate and earnings shocks, with cash reserves providing additional buffers. Under a stress scenario of a 25% increase in interest costs and a 25% decline in earnings before interest, tax, depreciation and amortisation (EBITDA), the percentage of firms-at-risk (defined as a ratio of EBITDA to interest expense of less than two) increases from 30% to 37% of all corporates, and their share of debt-at-risk increases from 20% to 32% (Chart 2.10). However, after taking net cash reserves and hedging into consideration, the share of firms-at-risk and debt-at-risk would drop to 18% and 21% respectively.

**Chart 2.10 Most Singapore corporates would remain resilient in the face of combined interest rate and earnings shocks**

Share of Firms and Share of Corporate Debt Held by Firms with ICR below 2

![Chart 2.10](chart2.10.png)

Source: MAS estimates, Thomson Financial

However, sectoral disparities in corporate performance will persist, which requires timely and close surveillance of weaker firms.

Despite the improved outlook, the projected growth outcomes across sectors are expected to remain uneven given the continued effects of the pandemic. Growth in sectors less affected by the pandemic, especially manufacturing, will gain further traction, while the pandemic-sensitive sectors could be subject to renewed mobility restrictions depending on the evolution of the virus.

Even as broad-based measures are withdrawn to guard against debt sustainability risk in the medium to longer term, there may be a need to continue the current approach of providing targeted government support for viable firms temporarily derailed by the resurgence in infections. This underscores the importance of timely surveillance on non-financial corporates (NFCs) in order to assess their vulnerability, understand their contribution to financial stability risks as well as inform the design of appropriate policy support. To this end, MAS is looking to enhance the surveillance of corporates in Singapore with probability...
of default indicators to complement its existing corporate surveillance framework (see Special Feature 3 "Enhancing Corporate Surveillance with Probability of Default Model").
Lending to SMEs has increased over the past year, supported by the general improvement in business outlook and accommodative financial conditions.

The Property and Development of Land sector accounts for the majority of SME loans.

The share of outstanding SME loans secured by property has decreased.

The SME NPL ratio has remained stable even as credit relief support schemes were gradually unwound.
Household sector balance sheets in Singapore have been relatively resilient throughout the COVID-19 pandemic, despite the sharp fall in employment and wage incomes last year. Support from the government, MAS and the financial industry as well as accommodative financing conditions have kept the household credit risk profile stable. In addition, the strong buffers and the macroprudential policies put in place over the past decade had also ensured that household balance sheets were in a relatively healthy position prior to the crisis.

Household financial vulnerability—as measured by the FVI—was unchanged over the past year, but have remained slightly higher than pre-COVID levels, reflecting higher leverage risk. A key driver of higher household leverage has been the growth of new housing loans on the back of a resilient property market since end-2019.

Private residential property prices and transactions have gathered pace, even as uncertainties over the trajectory of the pandemic remain, especially with the emergence of new virus strains. Accordingly, households should continue to exercise prudence when taking on debt for property purchases to ensure resilience against shocks.

The other component of the FVI, maturity risk, has declined, as households take on less short-term debt, proxied by credit card borrowings, given a pullback in discretionary spending amid mobility restrictions and the uncertain economic environment.

Labour market conditions are expected to recover alongside the continued expansion of Singapore’s economy, with both wage and employment growth bolstering the balance sheets of households. In the event that the shocks identified in Chapter 1 materialise, households’ debt servicing abilities would be affected, although MAS’ assessment is that the aggregate balance sheet would remain resilient, given the prevailing buffers and measures to limit excessive leverage of households.

### Household sector FVI (y-o-y changes)  |  Q3 2020  |  Q3 2021
---|---|---
Overall Household FVI | | →
Leverage risk | ↗ | →*
Maturity risk | ↘ | ↘

*The extent of risk is classified by band thresholds. While leverage risk remains within the same band in Q3 2021, the level of the indicator is higher compared to Q3 2020 as well as Q4 2019, before the onset of COVID-19.
3.1 Assessment of leverage risk

Household debt has grown over the past year and is higher than pre-COVID levels

As a share of GDP, household sector debt has eased from its recent high of 72% in Q1 2021 to 70% in Q3 2021. However, compared to pre-COVID levels in Q4 2019, the ratio in Q3 2021 was higher by 3 percentage points, as household debt rose by 3.7% while nominal GDP fell by 0.6% over this period (Chart 3.1). In absolute terms, household debt grew by 6.8% over the past year (Chart 3.2). Accordingly, household leverage risk has effectively risen compared to pre-COVID levels.

Housing loans grew in tandem with property prices and transactions

The key driver of growth in household debt has been housing loans. It was the largest single contributor (2.4 percentage points increase) to the overall 3.7% growth of household debt since end-2019. In contrast, overall household debt fell in the period prior to the crisis, with housing loans contributing −0.3 percentage points to the decline of 0.8% (Chart 3.3). The strong growth in housing loans since end-2019 has been underpinned by the robust residential property market with rising property prices and higher transactions despite the pandemic (refer to next section for further details) (Chart 3.4).
Credit quality of housing loans has improved over the past year, and is broadly in line with its historical average

Credit quality of housing loans has improved over the past year and stayed healthy against the backdrop of the robust property market. While the housing NPL had risen in Q2 2020 after the onset of the crisis, it has since fallen to below pre-COVID levels. Housing NPL in Q3 2021 was broadly in line with its 10-year historical average (Chart 3.5).

However, in the event of a shock to the property market, the correction in property prices could impact domestic demand, given that residential properties and loans account for the bulk of the household balance sheet, representing about 40% of assets and 75% of liabilities. The consequent rise in NPLs would also affect the banking system, as housing loan exposure forms a significant share of the banking system’s overall non-bank loan portfolio at about 15%, possibly curtailing banks’ capacity to extend credit to other sectors. Nevertheless, direct spillovers would be mitigated by the strong capital buffers in the banking system. In addition, the average loan-to-value (LTV) ratio of outstanding housing loans has eased further to a low of 45.7% in Q3 2021 (Chart 3.6).

---

14 Estimated based on DOS Household Sector Balance Sheet data in Q3 2021.
Credit quality of housing loans has improved over the past year, and is broadly in line with its 10-year historical average.

Average LTV ratio has declined slightly over the past year.

### 3.2 Update on the private residential property market

Momentum in the property market has picked up since Q2 2020, despite the pandemic.

The private residential property market has stayed resilient throughout the COVID-19 crisis. Private residential property prices have been increasing for six consecutive quarters since Q2 2020, averaging out to a modest pace of about 0.6% in Q2–Q3 2020 on a q-o-q basis, before accelerating to an average of about 2% between Q4 2020 and Q3 2021 (Chart 3.7). This brought the cumulative price gain to 8.7% since the start of the COVID-19 pandemic in Q1 2020, outpacing the nominal GDP growth of 5.3%.

Price increases were fairly broad-based (Chart 3.8), with properties transacted in the Core Central Region (CCR), Rest of Central Region (RCR) and Outside of Central Region (OCR) showing cumulative price increases of 3.1%, 15% and 6.6% respectively since Q1 2020.
Transactions have increased, driven by both new sales and resales

The gains in private housing prices were underpinned by strong transaction demand. Despite the COVID-19 pandemic, the quarterly average volume of transactions since Q1 2020 was close to 20% higher than the pre-COVID quarterly average between 2017–19. The resurgence in demand was driven by both new sales and resales, with volumes in Q3 2021 at their highest quarterly levels since Q2 2013 and Q3 2009, respectively (Chart 3.9). This was despite the tightening of Safe Management Measures at developer sales galleries. In terms of residency, transaction activities were mainly driven by residents. Meanwhile, foreign demand, which has remained stable at 3% of overall purchases for the past year (Chart 3.10), has risen slightly to about 5% in October 2021. Transactions by non-residents could pick up further as travel restrictions gradually ease.

<table>
<thead>
<tr>
<th>Chart 3.9</th>
<th>Transaction activity has increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Private Residential Property Transactions</td>
<td></td>
</tr>
<tr>
<td>Source: URA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chart 3.10</th>
<th>Buyer profiles have remained relatively stable in the past few years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transactions by Residency</td>
<td></td>
</tr>
<tr>
<td>Source: URA</td>
<td></td>
</tr>
</tbody>
</table>

Vacancy rate has fallen, and further declines are likely to result in sharper rental increases

Vacancy rate for private residential properties has fallen from the recent high of 7.0% in Q4 2020 to 6.4% in Q3 2021 (Chart 3.11). As a result, rentals have increased significantly by 7.1% over the same period. Vacancy rates are close to their 10-year average, suggesting that supply is still adequate to meet occupation demand at this point. However, further declines in the vacancy rate could trigger a sharper increase in rentals. Rental increases were fairly consistent across the regions, with non-landed properties rising by 6.8%, 6.5% and 8.4% in the CCR, RCR and OCR respectively, from Q4 2020 to Q3 2021 (Chart 3.12).
Chart 3.11 Vacancies have fallen on strong rental demand to levels near the long-run average

Vacancy Rate for Private Residential Property

Chart 3.12 Recent rental prices have displayed an uptick

Private Property Rental Price Indices by Region

Inventory of unsold units has declined, driving interest in land sales activity

The number of unsold units in the supply pipeline has been on a steady decline since Q3 2019 as the resurgence in developer sales outpaced additions to the supply pipeline. As of 30 September 2021, there were about 17,100 unsold units, 35% lower than the unsold pipeline inventory a year ago (Chart 3.13) and close to the historical low of about 15,100 units in 2017.

The falling unsold inventories has driven interest in land sales activity. Bidding interest in the Government Land Sales (GLS) market increased, with a median of 10 bids for projects awarded in 2021 (till September), higher than the median of 5 and 7 bids per site in 2019 and 2020, respectively. There has also been a pick-up in collective sales, with more sites sold to date in 2021, compared to the whole of 2019 and 2020.

Chart 3.13 Pipeline supply has been edging lower

Total Number of Unsold Private Residential Units from Projects with Planning Approvals

Source: URA
A confluence of factors, including early macroprudential measures, contributed to the resilient property market through the crisis

The resilience of the private residential property market could be attributed to a few factors. The strong upturn in external demand, low SGD interest rates on the back of accommodative global monetary conditions, and more generally, the broader recovery from the COVID-19 pandemic, have provided an overall conducive backdrop for the property market. At the same time, domestic macroeconomic and financial sector policies, in the form of government transfers, MAS’ measures and the financial industry’s provision of liquidity support to households, have mitigated the downside risks in the property market. Further, macroprudential measures put in place earlier have encouraged prudence in household borrowing and prevented excessive leverage, providing some buffers to cushion against the broader income shocks. The confluence of these factors has supported sentiments in the property market, underpinning the recent gains in prices and transaction activity that appear to be characterised by a firm underlying momentum.

As the Singapore economy proceeds on its recovery path, the uncertain trajectory of the pandemic remains a key risk as new virus strains emerge. Against this backdrop, the government closely monitors developments with the continuing objective of promoting a stable and sustainable property market.

3.3 Assessment of maturity risk

Maturity risk has eased, as households take on less short-term debt

The trend of declining household short-term debt, as proxied by credit card borrowings, has generally continued through the COVID-19 pandemic. As a share of GDP, outstanding credit card balances have moderated further from pre-pandemic levels to 2.1% (Chart 3.14). The fall in unsecured credit could be attributed to the pullback in discretionary spending arising from mobility restrictions and continuations in work-from-home arrangements. Data on footfall from Google’s location notification services as reported in the October 2021 MAS’ Macroeconomic Review, show that mobility at retail and recreational venues was 20–30% below its pre-pandemic levels. The precautionary motive could also be at work, as households cut back on spending amid the uncertain environment. Structurally, the use of credit cards could be on a decline with increased options of non-credit e-payment services that provide the same convenience for payments as credit cards.
Credit quality of short-term debt has improved

As a share of nominal GDP and total number of cardholders, the rollover balances and number of revolvers have also continued to decline throughout the crisis to new lows of 1.0% and 19% respectively in Q3 2021 (Charts 3.15 and 3.16). While this was consistent with the overall decline in card usage, the FIs’ relief measures\(^\text{15}\) could have also capped the rise in the rollover balances and revolvers. Under such arrangements, individuals with payment difficulties were allowed to restructure their debt to term loans at lower interest rates.

\(^{15}\) In March 2020, MAS and the financial industry first introduced a package of relief measures that included assistance for personal unsecured credit and debt consolidation plans. The application of relief measures was subsequently extended a few times till 30 September 2021, to provide individuals experiencing cashflow difficulties in paying their unsecured revolving credit facilities additional time to transition to full loan instalment repayments.
Another indicator of credit quality is the credit card charge-off rate.\textsuperscript{16} It has fallen from a high of 9.1% in Q3 2020 to 4.8% in Q3 2021, which is below pre-crisis levels (Chart 3.17). A key driver for the decline in bad debts being written off has been the fiscal and financial sector support measures. However, as the relief measures expire, the charge-off rate is likely to normalise to higher pre-crisis levels.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{chart3_17.png}
\caption{Credit card charge-off rate has dipped to a low}
\end{figure}

\begin{flushleft}
\textbf{3.4 Assessment of household balance sheet strength}
\end{flushleft}

Aggregate household net wealth increased as household assets rise

Households continued to build up their net wealth (defined as household assets less household debt) over the past year, despite the economic impact of the pandemic. As a share of GDP, aggregate household net wealth rose from 4.4 to 4.6 times over the period between Q3 2020 and Q3 2021 on the back of the higher value of financial and property assets, which more than offset the growth in liabilities (Chart 3.18).

\textsuperscript{16} Charge-off rate refers to the bad debts written off divided by the average rollover balance.
Household debt servicing burden is expected to remain manageable

Liquid assets such as cash and deposits continued to exceed total liabilities (Chart 3.19), providing households with significant financial buffer against income and interest rate shocks. This assessment is also supported by the results of MAS’ stress test which show that the household mortgage servicing ratios (MSRs) remain manageable under a conservative scenario of shocks to income and interest rates arising from a virulent virus outbreak. Specifically, the observed median MSR remains below the maximum threshold of 60% for the Total Debt Servicing Ratio (TDSR) guideline, even if income falls by 10% from the lows seen during the COVID-19 pandemic and interest rate increases by 250bps. As the bulk of the household liabilities are housing loans, the results suggest that the median household would still be able to service its debt.

3.5 Outlook

Households should continue to exercise prudence in taking on debt to ensure resilience against shocks

The macroeconomic environment is expected to be supportive for households given the improving labour market conditions. The resident unemployment rate is projected to ease further from its peak last year (Chart 3.20) to pre-COVID levels in 2022, alongside firmer wage growth.

17 Based on DOS data, median household income fell from SGD9,425 in 2019 to SGD9,189 in 2020.
However, in the event that the shocks described in Chapter 1 materialise, the financial positions of households, particularly the more vulnerable segments, could come under pressure, impacting their debt servicing abilities. The prevailing buffers and macroprudential measures to discourage overleveraging would have contributed to the build-up of some degree of resilience against these shocks.

Nevertheless, households should exercise caution in taking on new commitments, especially with regard to their abilities to service their long-term mortgage obligations. Highly leveraged households should also plan to build up financial buffers where possible, to allow some cushion against stresses emanating from an unexpected deterioration in macroeconomic conditions.

Most households on mortgage reliefs are able to resume repayments

MAS, together with the financial industry, first introduced a set of industry-wide support measures in April 2020, and extended these measures twice in October 2020 and June 2021\(^{18}\) to ease the financial strain on individuals experiencing cashflow difficulties caused by the COVID-19 pandemic. This extension provided impacted borrowers additional time to transit to full loan instalment repayments. More recently, the number of borrowers granted the extended mortgage relief has fallen sharply to 5,000 as of Q3 2021, from 36,000 on the first set of the earlier relief measures. This suggests that most of the borrowers who had applied for the initial relief are now able to resume loan repayments.

As various government reliefs and the extended industry support measures progressively expire over 2021–2022, borrowers are encouraged to resume full loan repayments to avoid

---

\(^{18}\) In March 2020, MAS and the financial industry first introduced a package of relief measures that included the deferring of repayment of residential property loans. In October 2020 and June 2021, the relief measures were extended, to allow reduced instalment payments to provide individuals experiencing cashflow difficulties additional time to transition to full loan instalment repayments. The current extended credit support measures for property loans will expire on 31 December 2021.
unnecessary debt accumulation. Borrowers who remain unable to resume full loan instalment repayments should approach their FIs to work out longer term repayment solutions based on their specific circumstances.
4 Singapore Financial Sector

The financial sector in Singapore has been resilient to the economic and financial impact of the COVID-19 crisis. The banking sector has maintained healthy asset quality alongside strong capital and liquidity buffers, while continuing to support the economy’s demand for credit. Nevertheless, shocks in the form of a resurgence in COVID-19 infections and a sharper-than-expected tightening of global financial conditions could cause vulnerable firms to face renewed liquidity stresses, placing pressure on banks’ asset quality. Banks should thus continue efforts to manage credit risk prudently and strengthen their liquidity profiles. Meanwhile, the non-bank sector has weathered the stresses from COVID-19 well over the past year; investment funds have been able to meet redemptions and insurers have remained well-capitalised.

4.1 Banking sector

The Singapore banking sector entered the COVID-19 crisis from a position of strength. Throughout the crisis, banks maintained strong capital and liquidity buffers. Over the past year, overall credit registered firm growth, underpinned by improving demand for credit both domestically and in the region. Meanwhile, overall asset quality has remained strong and provisioning coverage has been adequate. The results of the IWST 2021 exercise underscore that banks in Singapore have the capacity to withstand further macroeconomic shocks should downside risks materialise.

Nonetheless, banks’ asset quality could deteriorate should economic activity be impacted by more severe disruptions to global supply chains than anticipated, arising from a resurgence in infections and tighter containment measures.

<table>
<thead>
<tr>
<th>Banking sector FVI (y-o-y changes)</th>
<th>Q3 2020</th>
<th>Q3 2021</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 slightly over the past year, with an easing in liquidity vulnerabilities as banks maintained strong liquidity positions. This was accompanied
by a slight increase in leverage vulnerabilities, as credit growth recovered steadily alongside improving economic prospects.

**Lending to non-banks has recovered from its recent trough alongside the pick-up in economic activity**

Overall credit growth declined over the first quarter of 2021 before recovering to reach 5.1% y-o-y in October 2021. Both non-bank and interbank loans contributed to the expansion in credit (see Chart Panel 4A “Banking Sector: Credit Growth Trends”).

The pick-up in credit growth was largely driven by non-bank lending, as economic prospects improved alongside a moderation in new COVID-19 infections globally. The increase in non-bank lending was broad-based as both resident and non-resident non-bank loans expanded.

The recovery in non-bank lending to non-residents was partly driven by an increase in loans to Emerging Asia. Overall, cross-border credit intermediation patterns have remained broadly unchanged, with Singapore continuing to intermediate credit from the rest of the world to Emerging Asia (see Chart Panel 4B “Banking Sector: Cross-border Lending Trends”).

Resident non-bank loan growth accelerated from the trough in November 2020 to 7.9% y-o-y in October 2021, in line with the recovery in domestic economic activity. However, lending to the travel-related, consumer-facing and construction sectors was flat over the past three months, as prospects in these sectors continued to be weighed down by border restrictions, domestic mobility restrictions and supply-side constraints that led to shortages of foreign labour and rising costs of building materials (see Chart Panel 4A “Banking Sector: Credit Growth Trends”).

Based on a survey conducted by MAS in September 2021, banks expect the improving economic outlook, continuing government support and increasing global vaccination rates to underpin rising demand for corporate credit over the next six months. Banks have indicated that they are well-positioned to facilitate this increase in credit demand, while emphasising the importance of prudent underwriting standards as the pandemic continues to remain a source of uncertainty.

**Banks have maintained strong capital buffers and adequate provisions, while NPL ratios have remained low**

The banking system’s overall NPL ratio remained low at 2.2% as of Q3 2021 (see Chart Panel 4C “Banking Sector: Asset Quality and Liquidity Indicators”).

Although overall asset quality has remained healthy, some sectors have registered relatively higher NPL ratios (Chart 4.1). The relatively high NPL ratio for the electricity, gas & water supply sector is likely due to recent sharp increases in global energy prices that

---

19 MAS conducted a survey of banks in September 2021 to seek industry participants’ views on the prevailing credit conditions and expectations over Q4 2021 and Q1 2022.
adversely impacted retail electricity suppliers. Meanwhile, the NPL ratio for the transport & storage sector has remained elevated, primarily due to the NPLs from oil & gas (O&G) firms that had built up following the collapse in oil prices in 2020.

Looking ahead, the recent domestic mobility restrictions\(^\text{20}\) could dampen activity in the consumer-facing and wholesale industries, and could thus potentially affect the asset quality of loans to firms in the accommodation and food services activities, retail trade and wholesale trade\(^\text{21}\) sectors.

**Chart 4.1 Higher NPL ratios were observed in some sectors, including those adversely impacted by fluctuations in energy prices**

Banking System NPL Ratios by Sector (Q3 2021)

![Chart showing NPL ratios by sector](chart.png)

Source: MAS

Note: PSTASSA refers to Professional, Scientific, Technical, Administrative, Support Service Activities. Natural Persons refer to individuals. Examples of loans to natural persons include motor vehicle and credit card loans.

While credit risk has subsided amid recent improvements in the economic outlook, credit quality could deteriorate if downside risks materialise. Business insolvencies and unemployment could rise as vulnerable firms face renewed liquidity stresses. This could be exacerbated in the event of a sharper-than-expected tightening in global financial conditions, which could increase financing costs for highly leveraged firms.

Banks should maintain prudent levels of provisions, even as there had been some write back in allowances as economic conditions brightened. Provisioning coverage has been adequate, with total provisioning coverage\(^\text{22}\) and specific provisioning coverage for the banking system at 99.7% and 51.6% in Q3 2021 respectively. These buffers have been further augmented by general provisions held at the head offices of foreign bank branches.

---

\(^{20}\) Singapore entered the “Stabilisation Phase” from 27 September 2021 to 21 November 2021 as part of its transition towards being a COVID-19 resilient nation. Restrictions initially imposed under this phase included a reduction of group sizes for dining-in at F&B establishments to two fully vaccinated individuals (down from the earlier limit of five individuals), as well as the re-introduction of work-from-home arrangements as the default (for employees able to do so).

\(^{21}\) The Wholesale Trade sector includes wholesale of food and beverages.

\(^{22}\) Banking system’s total provisioning coverage is the sum of general and specific provisions as a share of unsecured non-performing assets.
Banks’ capital positions have remained strong amid the COVID-19 pandemic. The results of the IWST 2021 exercise show that banks in Singapore would remain resilient to further adverse macroeconomic shocks arising from a global resurgence of COVID-19 infections. In addition, results from MAS’ reverse stress tests suggest that macroeconomic stresses would need to be considerably worse than those during Singapore’s past crisis periods for banks’ capital adequacy ratios (CARs) to fall below their regulatory requirements (see Box A “Industry-wide Stress Test of D-SIBs”). Overall, banks’ strong capital buffers and adequate provisions confirm that they would be well-placed to weather further downside risks.

The banking sector’s liquidity positions have continued to be strong

The banking sector’s liquidity vulnerabilities have eased, while maturity vulnerabilities are unchanged from a year ago.

Over the past year, domestic systemically important banks (D-SIBs) have continued to maintain healthy buffers over the all-currency and SGD minimum regulatory Liquidity Coverage Ratio (LCR) requirements. In addition, both the SGD and foreign currency loan-to-deposit ratios (LTD) remained below 100% in October 2021, at 71.9% and 81.8% respectively (see Chart 4C4, Chart Panel 4C “Banking Sector: Asset Quality and Liquidity Indicators”).

USD LTD ratios are below 100% as of October 2021, both on aggregate as well as across all bank types (Chart 4.2). This implies that USD deposits are more than sufficient to fund USD loans. Additionally, the funding structure of the banking system remains healthy as non-bank deposits constitute more than 80% of the system’s total funding, while the share of net unrelated interbank funding remains small (Chart 4.3).

Nevertheless, USD funding risk bears monitoring. Global financial conditions could tighten sharply if major AE central banks normalise monetary policy earlier than expected in the face of unanticipated, persistent above-target inflation. MAS therefore encourages banks to continue efforts to strengthen their USD liquidity profiles. Banks should also manage their
foreign currency risk prudently under a range of business conditions by diversifying foreign currency funding sources, conducting regular liquidity stress tests and having in place adequate liquidity contingency plans.

Over the past year, local banking groups expanded credit while maintaining healthy asset quality and provisioning coverage

Local banking groups continued to expand their loan books over the past year. Loan growth accelerated to 8.1% y-o-y in Q3 2021, due to an increase in both resident and non-resident lending (Chart 4.4).

Local banking groups’ net profits have been healthy, boosted by non-interest income even as net interest margins (NIMs) remained low (see Chart Panel 4D “Banking Sector: Local Banking Groups”).

Asset quality has been stable for the local banking groups, with their NPL ratio remaining unchanged at 1.5% in Q3 2021. In addition, they have continued to maintain healthy provisioning coverage, with total provisioning coverage of 219.1% as of Q3 2021. Strong capital buffers, supplemented by ample provisions, will help the local banking groups withstand a deterioration in asset quality should downside risks materialise.

Chart 4.4 Local banking groups continue to grow their loan books

Local Banking Groups’ y-o-y Non-bank Loan Growth by Residency

Source: MAS, Local Banking Groups’ Financial Statements
Local banking groups’ capital and liquidity positions have remained strong

Local banking groups have maintained robust capital and liquidity positions (see Chart Panel 4D “Banking Sector: Local Banking Groups”), with aggregate CARs and all-currency LCRs remaining well above regulatory requirements. The overall LTD ratio of local banking groups has remained below 100%, with the USD LTD ratio at a healthy 68% in Q3 2021 (Chart 4.5).

![Chart 4.5 Overall, SGD and USD LTD ratios remain low](image)

Source: MAS, Local Banking Groups’ Financial Statements

### 4.2 Non-bank sector

Enhancements to monitoring of NBFI risk

Financial markets have been buoyant in AEs, while conditions in EMEs have tightened somewhat. Market volatility has subsided following the market turmoil experienced in H1 2020, with the implied volatility of EM equities and currencies at relatively low levels over the past year. Nonetheless, shocks to the macro-financial environment could lead to heightened risk aversion, potentially resulting in increased redemptions from investors that could be exacerbated by the liquidity mismatch risk of open-ended investment funds.

To enhance the surveillance of potential liquidity stresses faced by Collective Investment Schemes (CIS), MAS expanded the reporting requirements for fund managers to cover significant redemptions involving Restricted and Exempt CIS. This is in addition to the existing reporting of significant redemptions in Authorised CIS. MAS also launched a new

---

23 Significant redemptions refer to aggregate net redemptions exceeding 5% or 10% of the total assets under management (AUM) of the CIS depending on the dealing frequency of the CIS and the timeframe of redemptions.

24 These refer to CIS registered pursuant to section 305 of the Securities and Futures Act (Cap. 289) (SFA) (i.e. “Restricted CIS”), and CIS that fall within the specified exemptions under sections 302B, 302C and 304 of the SFA (i.e. “Exempt CIS”).

25 These refer to CIS authorised pursuant to section 286 of the SFA.
Fund Gating and Suspension Report to standardise the reporting of fund suspension or gating for all CIS.

Based on the data collected, funds have faced more instances of significant redemptions compared to last year. While the number of significant redemptions for Authorised CIS abated in Q3 and Q4 2020 following the period of heightened market volatility in H1 2020, the number of significant redemptions increased in Q1 2021 and remained at the same level throughout Q2 and Q3 2021 (Chart 4.6).

Chart 4.6 Significant redemptions increased in 2021 after tapering off in H2 2020

Number of Significant Redemptions for Authorised CIS

This increase in significant redemptions was largely driven by asset reallocation or portfolio rebalancing by investors, which also resulted in investors exiting certain funds or certain funds being liquidated. In all instances, fund managers were able to meet all redemption requests within the settlement period without having to gate or suspend the funds.

MAS has also enhanced its supervisory stress testing framework for central counterparties (CCPs) (see Box B “Enhancements to Supervisory Stress Testing of Central Counterparties”). The results from the 2021 stress test show that CCPs would remain resilient against severe shocks, and that contagion risks arising from a common clearing member default would be limited.

The capital positions of insurers have remained resilient

Insurers have weathered the COVID-19 pandemic well as they have continued to maintain healthy capital positions. Their profitability has also improved in 2021 (see Chart Panel 4E “Insurance Sector”). MAS conducted the IWST 2021 exercise to assess the resilience of insurers to a range of macro-financial stresses, including equity price declines, wider credit spreads and lower interest rates. The scope of the exercise this year was also expanded to include significant reinsurers in addition to significant insurers.
Under the adverse scenario prescribed for the exercise, direct life and composite insurers would be impacted mainly from the lower valuation of assets arising from the decline in equity prices and the widening of credit spreads. The lower interest rates assumed in the adverse scenario also increased the value of long-term guaranteed liabilities. However, insurers would be able to continue meeting regulatory capital requirements, through management actions such as changing asset allocations as well as increasing the use of Matching Adjustment\textsuperscript{26} to mitigate the impact of short-term volatility from credit spread movements.

\textsuperscript{26} The Matching Adjustment (MA) and Illiquidity Premium (IP) are new features under the revised Risk Based Capital framework (or RBC 2) which allow for an adjustment to be added to the risk-free discount rates in determining liabilities, so that resulting liabilities will move more in tandem with assets in response to credit spread movements. The use of MA reflects the fact that insurers, particularly life insurers, hold assets for the long term to back their long-term liabilities and are not exposed to short-term spread movements unlike investors with shorter investment horizons.
Box A
Industry-wide Stress Test of D-SIBs

D-SIBs have remained resilient throughout the COVID-19 pandemic

D-SIBs’ capital positions have remained strong throughout the COVID-19 pandemic, with their Common Equity Tier 1 (CET1) CARs rising slightly by 0.1 percentage points between end-2020 and Q3 2021 (Chart A1). D-SIBs have continued to set aside adequate provisions in anticipation of further credit losses amid the gradual phasing out of relief measures this year (Chart A2). Despite the improved economic outlook, there remain downside risks to growth that could negatively impact D-SIBs’ capital positions, particularly in the short term. For instance, the pace of recovery in economic activity could face setbacks should there be unexpected infection spikes in the transition to an endemic COVID-19 state. The effectiveness of vaccines could also decline due to the emergence of more virulent virus strains that are vaccine resistant.

**Chart A1** D-SIBs’ capital positions have remained strong amid the COVID-19 crisis

**Chart A2** D-SIBs have continued to set aside ample provisions to buffer against potential credit losses

![Graph A1](image1.png)

![Graph A2](image2.png)

Source: MAS

*Total Provisions/Total Unsecured NPAs
MAS conducted the IWST exercise to assess D-SIBs’ resilience to downside risks

As part of the IWST 2021 exercise, D-SIBs were required to assess the impact of two macroeconomic scenarios (Central and Adverse) over a three-year horizon on their capital positions.

The Central scenario assumes a gradual recovery in global economic activity, supported by successful COVID-19 vaccination programmes and continued accommodative policy responses by authorities in 2021–2023. Singapore’s domestic-oriented and travel-related sectors see a gradual improvement as the economy progressively reopens, while growth in the trade-related and modern services sectors is supported by the recovery in the global economy.

Conversely, the Adverse scenario features a stalled global recovery, with a resurgence in infections due to more virulent mutated virus strains. This resurgence causes more severe disruptions to global supply chains than anticipated, holding back outputs and exports. As a result, global GDP recovers at a significantly slower pace relative to the Central scenario. Importantly, this scenario also features growing public debt sustainability concerns, with authorities having limited policy space to cushion further downside shocks following the implementation of extensive stimulus programmes in 2020.

Against this backdrop, this Adverse scenario would see economic activity in Singapore continue to decline in 2021 and remain significantly lower over the forecast horizon relative to the Central scenario, only recovering to pre-pandemic levels in early 2023 (Chart A3). Singapore’s resident unemployment rate would also reach a peak of 6.0% in 2021, 2.1 percentage points higher than that of the Central scenario, before moderating slightly to 5.5% in 2022. Relative to the Adverse scenario employed in MAS’ 2020 desktop stress test27, the IWST 2021 Adverse scenario features more severe disruptions to domestic economic activity as well as a slower recovery to pre-pandemic output levels.

The Adverse scenario also features uneven sectoral outcomes domestically to better capture downside risks arising from the resurgence in infections. In particular, the travel-related, food & beverage and construction sectors are more heavily impacted due to travel and mobility restrictions as well as foreign labour supply constraints (Chart A4).28

---

27 Monetary Authority of Singapore (2020), ”Box C: MAS’ Desktop Stress Test of D-SIBs”, Financial Stability Review.
28 For the sectoral breakdown presented in Chart A4, travel-related sectors are represented under transport, storage and communications (“TSC”), while the F&B sector is represented under “Commerce”. 
D-SIBs’ aggregate CET1 CAR is projected to remain well above minimum regulatory requirements under the Adverse scenario

Under the Adverse scenario, D-SIBs’ IWST submissions indicate that their aggregate CET1 CAR would reach its trough of 11.4% in 2021, remaining well above MAS’ minimum CET1 regulatory requirement of 6.5%, and above the combined CET1 and capital conservation buffer (CCB) regulatory threshold of 9.0% (Chart A5). Overall, the results of this year’s IWST exercise show that D-SIBs would have sufficient capital buffers to absorb severe shocks arising from significantly lower levels of economic activity relative to the Central scenario across 2021–2023, while continuing to meet the credit needs of businesses and households.

The CCB refers to the additional 2.5 percentage point capital requirement on top of the minimum CET1 regulatory requirement.
The projected decline in D-SIBs’ CAR in the Adverse scenario is driven by the rise in credit risk-weighted assets (RWAs) and credit impairments.

Under the Adverse scenario, both corporate and retail loan credit quality would deteriorate significantly, giving rise to higher defaults and credit losses relative to the Central scenario. Continued disruptions in economic activity due to renewed mobility restrictions would pose a drag to consumption and put pressure on corporates, especially those in sectors most affected by the pandemic. Weaker corporates would face permanently impaired prospects arising from disruptions to business activity and may have to downsize or cut costs to remain afloat. This would translate to weaker labour market conditions and rising unemployment. The deterioration in credit quality would also be more severe than what was observed in 2020, as governments would no longer be able to provide as much stimulus support as before due to their limited fiscal headroom.

As a result, D-SIBs would incur credit impairments of more than SGD14 billion, equivalent to a 1.4 percentage point decline in their aggregate CET1 CAR in 2021 (Chart A6). The deterioration in the credit quality of D-SIBs’ portfolios would also result in an increase in credit risk weights, with the corresponding increase in total RWAs leading to a 2.9 percentage point decrease in CET1 CAR.

At the same time, weaker economic prospects for corporates and households, along with financial market stresses, would also negatively impact D-SIBs’ profitability primarily through a decline in their net fee and commission income as well as net trading income. Overall, D-SIBs projected their pre-provisioning profits to be lower by SGD5.1 billion in 2021 compared to 2020 levels, constituting a 0.5 percentage point reduction in the positive contribution of pre-provisioning profits to CET1 CAR. This impact on D-SIBs’ capital positions is partly mitigated by lower dividend distributions. In line with reduced net profits in 2021 under this
scenario, D-SIBs projected that they would cut dividend payouts by half (SGD3.1 billion) from 2020 levels.\textsuperscript{30}

**Chart A6** The bulk of the capital impact reflects increases in credit RWAs and credit impairments

Decomposition of the Impact of Drivers on D-SIBs’ Peak-to-Trough Decline in Aggregate CET1 CAR

![Impact Decomposition Chart]

Source: D-SIBs’ submissions, MAS estimates

\*Pre-provisioning profits comprise D-SIBs’ income and other CET1 capital movements, including changes in accumulated other comprehensive income.

MAS conducted a reverse stress test to assess the plausibility of adverse macroeconomic outcomes that could severely impact the D-SIBs’ regulatory buffers and affect their ability to supply credit to the economy.

The reverse stress test scenario features an extreme macroeconomic scenario designed to be severe enough as a 'stress-to-fail' test for D-SIBs. Under this scenario, Singapore experiences a deep and protracted recession with real GDP growth coming in at an unprecedented $-8.5\%$ in 2021, more severe than past crisis periods such as the Asian Financial Crisis (AFC), the dot-com bubble and the GFC.\textsuperscript{31} This is followed by flat growth in 2022 and a relatively muted recovery in 2023. Domestic economic activity declines by about 14% at the trough compared to pre-pandemic levels in 2019 (Chart A7). As a result, Singapore’s resident unemployment rate reaches a historical high of 6.9% in 2022.

Under this extreme scenario, the D-SIBs’ aggregate CET1 capital buffer would decline by 5.7 percentage points from their end-2020 starting positions and fall just below the combined CET1 and CCB regulatory threshold in 2022 (Chart A8). While the reverse stress test features tail risks that appear less plausible at the current conjuncture, it serves as a useful exercise to consider adverse macroeconomic outcomes that could severely impact D-SIBs’ capital buffers

---

\textsuperscript{30} D-SIBs were required to assume a constant dividend payout ratio for their IWST projections over the scenario horizon. Each D-SIB would compute the appropriate dividend payout ratio assumption by taking the simple average of their actual dividend payout ratios over its five most recent profitable years.

\textsuperscript{31} Singapore’s real GDP growth during the AFC, the dot-com bubble and the GFC was $-2.2\%$ (1998), $-1.1\%$ (2001) and $0.1\%$ (2009) respectively. Singapore experienced its worst recession to date in 2020 during the COVID-19 pandemic, where GDP contracted by $-5.4\%$. 

and in turn help inform the need for pre-emptive risk mitigation and capital management actions should the likelihood of such outcomes increase. The results show that macroeconomic stresses would need to be considerably worse than what Singapore had experienced in past crisis periods (AFC, dot-com bubble, GFC, COVID-19) for D-SIBs to fall below their regulatory requirements.

**Chart A7** The reverse stress test features an extreme macroeconomic scenario with a deep and protracted recession for Singapore

**Chart A8** D-SIBs’ aggregate CET1 CAR would fall below the combined CET1 and CCB thresholds under the reverse stress test

**Real GDP Levels for Singapore under the Reverse Stress Test**

<table>
<thead>
<tr>
<th>Year</th>
<th>Index (2019=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>100</td>
</tr>
<tr>
<td>2020</td>
<td>95</td>
</tr>
<tr>
<td>2021</td>
<td>87</td>
</tr>
<tr>
<td>2022</td>
<td>86</td>
</tr>
<tr>
<td>2023</td>
<td>91</td>
</tr>
</tbody>
</table>

**Source:** MAS

**D-SIBs’ Aggregate CET1 CAR under the Reverse Stress Test**

<table>
<thead>
<tr>
<th>Year</th>
<th>CET1 CAR + CCB (9.0%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>14.5</td>
</tr>
<tr>
<td>2022</td>
<td>8.8</td>
</tr>
</tbody>
</table>

**Source:** MAS estimates

---

**Sum-up**

D-SIBs have remained resilient in the face of an unprecedented decline in global economic activity amid the COVID-19 pandemic. While the pandemic remains a source of considerable uncertainty, results from the IWST 2021 exercise confirm that D-SIBs would still be well positioned to weather further adverse macroeconomic shocks arising from a global resurgence in infections and tighter containment measures, with their aggregate CET1 CAR staying well above MAS’ regulatory requirements. In addition, results from MAS’ reverse stress test suggest that macroeconomic stresses would need to be considerably worse than those during Singapore’s past crisis periods for banks to fall below their regulatory requirements. This analysis provides yet another perspective that attests to the strong capital positions of the D-SIBs.

Although credit risk has subsided somewhat given recent improvements in the economic outlook, the potential for further credit quality deterioration remains, especially if downside risks from the COVID-19 pandemic materialise and cause prolonged disruptions to economic activity. Unemployment and business insolvencies could in turn rise abruptly, thereby placing pressure on banks’ asset quality. Banks should therefore continue to remain prudent in managing their balance sheets, to ensure that their capital positions remain robust and resilient to shocks as they continue to support the economy through the latter stages of the recovery from the pandemic.
Box B
Enhancements to Supervisory Stress Testing of Central Counterparties (CCPs)

CCPs are systemically important FIs that play a critical role in the smooth functioning of key financial markets.

CCPs play a critical role in financial markets by centrally clearing the trades of participants. They interpose themselves between counterparties to trades, guaranteeing the terms of trades and assuming the default risk of buyers and sellers. In so doing, CCPs are able to reduce counterparty credit risk for market participants through a number of ways. First, they mitigate aggregate risk by performing multilateral netting of exposures and ensuring that the resulting exposures are covered by risk controls such as margin collateral and a clearing fund. Second, CCPs are able to manage member defaults by mutualising and allocating resulting losses between themselves and the non-defaulted members through a transparent, orderly and rules-based mechanism known as the “default waterfall”. The default waterfall determines the order in which the financial resources contributed by a CCP, its defaulted clearing member, and non-defaulted clearing members are deployed, and is designed to incentivise the CCP and its clearing members to prudently manage the risk that they take on. This arrangement introduces ex-ante transparency and reduces uncertainty for market participants, mitigating the impact of default and contagion risks on non-defaulted members and ensuring a smooth functioning of the financial system.

At the same time, however, the financial system’s reliance on central clearing could result in contagion and systemic risks if not properly managed. Given the nature of their role, CCPs are highly interconnected. In mitigating the counterparty risks of individual market participants, CCPs have had to take on additional risks and manage them through well-established risk management frameworks and processes. However, under the tail risk event of a failure, the CCP could potentially propagate contagion risk, thus adversely impacting market stability. For instance, if a CCP does not have sufficient financial resources to cover losses arising from the default of a clearing member, and fails to meet obligations to non-defaulted clearing members at a critical point, the CCP potentially exposes these members and financial market participants to unexpected credit losses and liquidity stresses.

---

33 The clearing fund is a fund which all clearing members of the CCP are required to contribute to. In the event of a member default, the resources in the clearing fund may be used to cover losses arising from the default.
34 The first layer of resources to be drawn down comprises the defaulted member’s collateral and clearing fund contribution. This is followed by the CCP’s own clearing fund contribution and then the clearing fund contributions of non-defaulted members. If the clearing fund is exhausted, the CCP may also have powers, provided for in its clearing rules, to call for further non-pre-funded financial resources from non-defaulted clearing members.
Stress testing is an important component of MAS’ supervisory toolkit to assess the resilience of CCPs

Given the critical role CCPs play in financial markets, it is important to regularly assess the resilience of CCPs under adverse market conditions. MAS does this through supervisory stress testing, featuring stress scenarios which include extreme market price shocks coupled with clearing member defaults. These supervisory efforts complement CCPs’ own stress tests, as it allows for an independent assessment of the sufficiency of CCPs’ financial resources under separate scenarios formulated by MAS. Beyond assessing the resilience of individual CCPs, MAS may also conduct supervisory stress tests to analyse the interconnectedness between CCPs at the system-level. For example, stress tests could provide insights on the potential impact of market shocks to CCPs that are linked through concentration of exposures to common market participants. Stress tests could also highlight the potential systemic impact arising from the concurrent liquidation of common assets across multiple CCPs that are managing clearing member defaults.

MAS’ enhanced stress testing framework calibrates extreme scenarios that reflect plausible market conditions

MAS enhanced its supervisory stress testing framework in 2020.

In previous iterations of MAS’ supervisory stress tests, scenarios were calibrated by taking reference from peak historical price volatilities, and judgmental overlays were then applied to take into account the economic backdrop.

In contrast, the enhanced stress testing methodology adopts a model-driven approach to generate extreme but still plausible scenarios that reflect hypothetical adverse market developments. In particular, the scenarios are sufficiently extreme to rigorously stress all identified risk factors, and yet such extreme scenarios cannot be ruled out.

To model extreme scenarios, it is recognised that stress shocks that only take into account the possible extreme movements of each risk factor from purely historical events may not provide sufficiently rich reference data points. Instead, methods based on Extreme Value Theory are applied by extrapolating historical data to estimate the probability distribution of extreme movements.36

At the same time, to ensure that MAS’ prescribed stress shocks appropriately capture the co-movement of risk factors during times of stress, a copula approach is used to model

---

the factors based on their correlations.\textsuperscript{37,38} The generated stress scenarios thus reflect market dynamics and provide a realistic characterisation of the co-movements of the risk factors in times of market stress.

Based on the modelled relationships between various risk factors, selected key risk factors are then stressed to derive the stress parameters for other risk factors required to perform the stress test. For example, major global equity indices may be stressed to calibrate the severity of other risk factors, including those from other market segments (e.g. commodities, foreign exchange, interest rates).

MAS’ 2021 stress test features adverse market developments arising from a resurgence in the pandemic

In 2021, MAS simulated a stress scenario featuring a stalled global recovery, with economic disruptions arising from a global resurgence in the pandemic due to more virulent virus strains. Under this scenario, concerns about the negative impact that the protracted pandemic would have on economic activity trigger a risk-off sentiment among investors, causing a widespread repricing of assets across markets. Global and domestic equities sell off, while commodities markets plunge sharply due to weak economic prospects (\textit{Table B1}). As a result, volatility in the underlying markets soars and correlations between asset returns increase.

\textbf{Table B1} Selected Financial Market Parameters

<table>
<thead>
<tr>
<th>Financial Market Parameters</th>
<th>Stress Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity prices</td>
<td>$\sim{8%}\text{ to }{18%}$</td>
</tr>
<tr>
<td>Oil prices</td>
<td>$-12%$</td>
</tr>
<tr>
<td>Metal prices</td>
<td>$-10%\text{ to }-18%$</td>
</tr>
<tr>
<td>Regional currencies (vs USD)</td>
<td>$-2%\text{ to }-5%$</td>
</tr>
</tbody>
</table>

Note: Parameters reflect price changes over a one-day horizon.

These adverse market developments impact Singapore CCPs through various transmission channels. The increased market volatility heightens the risk exposures of

\textsuperscript{37} A copula is a multivariate cumulative distribution function that describes the dependencies between variables and that, together with the marginal distributions of each variable, explains the joint distribution of the variables. For its supervisory stress testing of CCPs, the European Securities and Markets Authority also adopts a copula approach to characterise the joint distribution of risk factors.

\textsuperscript{38} This approach is derived from the framework developed by Jimmy Skoglund and Kaj Nyström in "A Framework for Scenario Based Risk Management" (2002).
Singapore CCPs that clear domestic equities products, as well as equities and commodities derivatives products. In addition, this increased volatility means that larger and more frequent mark-to-market changes need to be passed to clearing members with mark-to-market gains and collected from clearing members with mark-to-market losses. Accordingly, Singapore CCPs would be more exposed to the heightened risk that clearing members with mark-to-market losses are unable to post the mark-to-market variation margins while still remaining liable to pay the gains to the members with mark-to-market gains as part of CCPs’ obligation to guarantee every trade. Increases in volatility also lead to increased initial margin levels collected by Singapore CCPs to cover their exposures, and would result in clearing members being more frequently subjected to margin calls to collateralise their exposures. The financial stress caused by the market turmoil would lead to some members defaulting on their obligations to CCPs.

**CCP financial resources would be sufficient to cover clearing member defaults under stress scenario**

The MAS 2021 stress test finds that financial resources of CCPs would be overall adequate to cover the aggregate loss exposures (after accounting for the defaulted members’ margins) under the Cover-1 and even Cover-2 standards under the Principles for Financial Market Infrastructures (PFMI). These standards require CCPs to maintain sufficient financial resources to cover their largest credit exposure arising from the default of one or two clearing members, depending on the CCPs’ systemic importance. In the event where clearing members with membership at multiple CCPs default simultaneously across these CCPs, the highest aggregate loss exposure arising from such a default scenario would account for a limited proportion of clearing fund resources. Overall, the results suggest that CCPs would remain resilient against severe shocks, and that contagion risks arising from a common clearing member default are limited.

**Continued efforts to improve supervisory stress testing supports MAS’ proactive monitoring and pre-emptive identification of CCP risks**

Stress testing is an important tool in MAS’ supervisory toolkit for CCPs. It allows MAS to better understand the impact of various extreme but plausible stress scenarios on CCPs and pre-emptively identify vulnerabilities that they may be exposed to, which could better inform policies. MAS will continue to augment its stress testing methodology to ensure that its supervisory stress testing efforts continue to facilitate effective risk assessments.

---

39 The PFMI requires CCPs that are involved in activities with a more complex risk profile or that are systemically important in multiple jurisdictions to maintain financial resources to cover the default of the two clearing members and their affiliates that would potentially cause the largest aggregate credit exposure for the CCP, i.e. “Cover-2”. The PFMI requires all other CCPs to maintain financial resources sufficient to cover the default of the clearing member and its affiliates that would potentially cause the largest aggregate credit exposure for the CCP i.e. “Cover-1”. Consistent with the PFMI, Singapore CCPs are not required to maintain resources to meet Cover-2 as they are neither involved in activities with a more complex risk profile nor systemically important across multiple jurisdictions.
Overall loan growth grew by 5.1% y-o-y in October 2021, largely supported by an expansion in non-bank loans. The increase in non-bank loan growth was broad-based, underpinned by improving credit demand both domestically and in the region.

Resident non-bank credit has expanded on a m-o-m basis over the past three months, while the share of trade financing in non-bank loans has ticked up over the past year.

The credit-to-GDP gap for Singapore has narrowed to 0.1% as of Q3 2021.
**Chart Panel 4B  Banking Sector: Cross-Border Lending Trends**

*Emerging Asia has accounted for close to half of cross-border loans to non-residents.*

**Chart 4B1** Cross-border Non-bank Loans by Region

- Emerging Asia
- Developed Asia
- Europe
- Americas
- Others

Source: MAS

**Chart 4B2** Cross-border Interbank Loans by Region

- Emerging Asia
- Developed Asia
- Europe
- Americas
- Others

Source: MAS

*Singapore has continued to intermediate credit from the rest of the world to Emerging Asia. Local and Japanese banks have been the main net lenders to Emerging Asia.*

**Chart 4B3** Net Lending by Region

- Emerging Asia
- Developed Asia
- Europe
- Americas
- Others

Source: MAS

**Chart 4B4** Net Lending to Emerging Asia by Bank Nationality

- Others
- Singapore
- Japan
- Europe
- Emerging Asia
- Developed Asia (excluding Japan)
- Americas

Source: MAS
The overall NPL ratio remained low at 2.2% in Q3 2021. Banks have continued to maintain adequate levels of provisions with total provisioning coverage at 99.7% as of Q3 2021, further augmented by general provisions held at the head offices of foreign bank branches.

Banks’ liquidity positions have continued to be strong. Resident deposits have remained more than sufficient to fund resident loans. All LTD ratios remained below 100% as of October 2021.
Local banking groups’ net profits have been healthy, supported by non-interest income.

Asset quality has been stable, with the NPL ratio unchanged at 1.5% in Q3 2021. Local banking groups have continued to maintain a healthy total provisioning coverage of 219.1% in Q3 2021.

Local banking groups have maintained robust capital and liquidity positions, with aggregate CARs and all-currency LCRs remaining well above regulatory requirements.
The insurance industry in Singapore is well-capitalised. The aggregate CARs for the direct life and direct general insurance industry have remained well above regulatory requirements.\(^4\)

**Chart 4E1** CARs of Direct Life and Direct General Insurers

Source: MAS

New business premiums of the direct life insurance industry grew by close to 40% in Q1–Q3 2021, mainly driven by the strong recovery in the sales of participating products. Net income increased largely due to higher net premiums.

**Chart 4E2** Direct Life Insurers: New Business Premiums

Source: MAS

Gross premiums of the direct general insurance industry increased in 2021, supported by growth in both SIF and OIF business. The industry reported positive underwriting results and investment profits in 2021.

**Chart 4E4** Direct General Insurers: Gross Premiums

Source: MAS

The valuation and capital framework for insurers in Singapore was enhanced (revised Risk Based Capital framework, RBC 2) with effect from Q1 2020. There are some fundamental differences between RBC 2 and RBC which make the CAR of the two regimes less directly comparable.

\(^4\) The valuation and capital framework for insurers in Singapore was enhanced (revised Risk Based Capital framework, RBC 2) with effect from Q1 2020. There are some fundamental differences between RBC 2 and RBC which make the CAR of the two regimes less directly comparable.
**Chart Panel 4F**  
**Over-the-counter (OTC) Derivatives**

*Interest Rate (IR) is the largest asset class for OTC derivatives booked and traded in Singapore, followed by Foreign Exchange (FX).*

---

**Chart 4F1** OTC Derivatives Market in Singapore by Asset Class and Notional Outstanding (End-Sep 2021)

![Chart showing the distribution of asset classes by notional outstanding]

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

---

**Chart 4F2** Breakdown of Top Five Economies in the Global OTC Derivatives Market by Annual Turnover

![Chart showing top five economies]

Source: 2019 BIS Triennial Survey

---

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

---

**Chart 4F3** FX Derivatives by Product: Monthly New Trades

![Chart showing monthly new trades by product]

Source: MAS estimates, DDRS

---

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

---

**Chart 4F5** IR Derivatives by Product: Monthly New Trades

![Chart showing monthly new trades by product]

Source: MAS estimates, DDRS

---

**Chart 4F4** FX Derivatives by Currency: Monthly New Trades

![Chart showing monthly new trades by currency]

Source: MAS estimates, DDRS

---

**Chart 4F6** IR Derivatives by Currency: Monthly New Trades (excluding cross-currency swaps)

![Chart showing monthly new trades by currency]

Source: MAS estimates, DDRS
Special Features on Financial Stability
Special Feature 1

Integrated Macro Policy Frameworks: An Assessment of the Ongoing Research

Introduction

In the past few years, integrated macro policy frameworks (IMPFs) have come to the forefront of central bank research and discourse. IMPFs involve the joint deployment of monetary, exchange rate, macroprudential and capital flows management policies, in support of countries’ domestic and external stability goals when financial or other market frictions are present. The IMF has developed its version of such a framework called the “Integrated Policy Framework” (IMF, 2020), and the BIS has its “Macro-Financial Stability Framework” (BIS, 2019). While both frameworks are still work-in-progress, they are nevertheless likely to inform these institutions’ future policy agendas.

The IMPF concept emerged after the GFC when ultra-low interest rates in AEs and the rise of NBFIs led to massive capital flows to EMEs, resulting in asset price increases, booming economic activity and a difficult policy dilemma for monetary policy as flexible exchange rates failed to insulate these economies from capital flows shocks. Monetary policy tightening in EMEs to prevent overheating further widened interest rate differentials vis-a-vis AEs, thus attracting even more capital inflows with undesirable effects on the economy.

Consequently, EMEs used different combinations of monetary (MP), macroprudential (MPM), foreign exchange intervention (FXI) and capital flows management (CFM) measures to address the policy challenges — in many cases, the efforts successfully contained inflation and financial stability risks. Amid turbulent financial markets in H1 2020, many national authorities also successfully employed a range of policy tools to tackle the COVID-19 crisis. These on-the-ground country experiences, as well as the lack of a consistent framework that is capable of accommodating multiple policy tools and is also robustly grounded in economic and financial underpinnings, have motivated the IMF and BIS to conduct in-depth research work on IMPFs.

IMPF developments at the IMF and BIS


The IMF launched its “Integrated Policy Framework” (IPF) last year, supported by the development of conceptual and empirical general equilibrium models (Basu et al., 2020;
Adrian et al., 2020). The lessons gleaned from the implementation of the IPF will also serve as an input into the review of the IMF’s Institutional View on the Liberalisation and Management of Capital Flows (IMF, 2012).

Both the IMF and BIS view IMPFs as more than just the sum of policies put together. IMPFs take into account interactions among policies as well as overlaps in policy objectives, to find the optimal policy mix that would achieve domestic and external stability.

- The use of additional policy tools (FXI, MPM and CFM) is seen as opening policy space for MP. MPM improves MP trade-offs by leaning against the build-up of financial imbalances. While there is a role for CFMs, these tools are generally recommended only in specific circumstances (e.g. stressed periods) and are viewed mainly as a last resort. The optimal policy mix depends on country characteristics and business cycle conditions.

- Exchange rate flexibility could work as an effective adjustment mechanism only when significant market frictions and/or financial stress are absent. In countries with deep and well-functioning FX markets, full exchange rate adjustment to shocks is usually optimal.

Both institutions have underscored the importance of supporting factors for the IMPF, namely national fiscal, regulatory and structural policies (e.g., policies to deepen financial markets) as well as global financial safety nets such as foreign exchange swap lines. They have also highlighted several downsides: by smoothing exchange rate fluctuations, frequent FXI may amplify the volume of capital flows, incur considerable carry cost for central banks and perpetuate private sector holdings of unhedged foreign currency debt; MPM, usually applied to banks, may divert the role of credit provision to less regulated NBFIs and increase risks; long-term deployment of FXI and CFM may adversely affect financial market development and resource allocation; CFM and MPM may unintentionally deflect capital flows to other countries; deployment of multiple tools complicates policymaking and public communication.

Importantly, the IMF and BIS recognise the factors that might contribute to creating a wedge between the optimum policy setting under perfect market conditions (as assumed in the Mundell-Fleming model) and constrained optimising policy combinations in a world with frictions.

- The IMF focuses on the macroeconomic aspect, specifically the effect of dominant currency pricing (DCP) on the trade channel (Gopinath et al., 2020). Under DCP, the large share of EME trade invoiced or priced in foreign currencies (such as USD) weakens the expansionary effect of an EME currency depreciation through the export channel.

- The BIS views the financial channel of the exchange rate (FCER) and its effect on domestic financial conditions as the key factor (BIS, 2019). Under FCER, an EME currency appreciation reduces unhedged foreign currency debt and credit risk of its borrowers, attracting more capital inflows. This loosens domestic financial conditions and encourages economic expansion. In recent years, the FCER also manifests its effects through foreign investors’ increased holdings of unhedged local currency assets.
Literature review of IMPF tools

There is a fairly rich literature on the use of multiple policy tools going back to just after the GFC, although there has been no comprehensive impact analysis of the full suite of IMPF policies within a fully integrated framework to date (see Appendix). The state of the literature may reflect the technical challenges of simultaneously optimising multiple policy objectives in standard macroeconomic models but also practical issues, such as the apportioning of responsibility for policy levers across different agencies, uncertainties over policy outcomes, and implementation costs which discourage the concurrent activation of policies outside of crisis periods. The available empirical studies, based on fewer tools, suggest that the joint deployment of policies can generate gains over and above single policies.41

Indeed, a scan of the current conjuncture highlights the flexibility that can be gained from the IMPF. Many Asian economies presently face developments and risks which pull in opposing directions: still weak growth and economic outlook, an increase in inflation, a build-up of financial imbalances and tightening financial conditions. These create a dilemma for MP: a rate hike would further tighten domestic financial conditions and stall a nascent recovery, while continued low rates or further easing may exacerbate inflation and financial indebtedness. With the IMPF, MP may be tightened to curb inflation and slow the build-up of corporate/household debt while other tools such as fiscal policy (if it is in the policy mix and still has headroom) could substitute for MP to stimulate economic growth, thus reducing policy trade-offs.

Besides dealing with the trade-offs, the IMPF could address policy constraints such as the present diminishing space for MP, with the policy rate approaching the zero lower bound, and for fiscal policy where government spending is at a historical high. The ability to substitute or to complement these instruments with other policies that share similar objectives, including unconventional tools, would widen the range of policy options available. This is consistent with Bergant and Forbes (2021) who conclude that there is scope for greater policy integration based on its findings that the use of MPM is not significantly affected by the room available for other policy tools (MP, FXI, CFM and fiscal policy) and vice versa.

The studies surveyed suggest that the appropriate policy mix may not be a single solution that is applicable under all circumstances but may differ and evolve, depending on a host of factors such as the types of shocks that hit a country and its structural and cyclical circumstances.

- Many researchers identify the importance of certain country characteristics such as the depth of FX market (Basu et al., 2020), level of debt/leverage (Brandao-Marques et al., 2020), size of balance sheet mismatches (Mano and Sgherri, 2020) and degree of stability in inflation expectations (Adrian et al., 2020).

---

41 For example, Lama and Medina (2020) show that in the face of a foreign interest rate shock and when MP is tightened to contain inflation, adding FXI to a standalone reserve requirement (RR) policy could alleviate the decline in GDP growth due to tighter MP by at least an additional 0.5% point. Brandao-Marques et al. (2020) show that in response to looser domestic financial conditions, MPM tightening accompanied by looser MP translates into a larger gain than a standalone MPM, with the former resulting in a bigger reduction in the central bank’s loss function (16% reduction) than the latter (9% reduction).
Ghosh et al. (2017), Blanchard et al. (2016) and Ostry et al. (2011) highlight the relevance of the nature of the capital flows in determining the impact of policy measures or the activation of the measures in the first place: these include resident versus non-resident flows, FDI versus portfolio and other (mainly banking) flows, and debt versus equity flows. In general, a stronger policy impact or higher likelihood of policy activation applies to non-resident (liability) flows and to riskier flows such as portfolio and other investment flows.

In studies which focus on specific shocks, changes in world interest rates or global financial conditions (Rey, 2015) are the most common events for which the policy impact is analysed. The role of global financial conditions has in fact dominated the more recent papers (Batani and Durand, 2021; Chen et al., 2021; Deb et al., 2021).

The literature also surfaces a number of other observations. Pre-emptive measures are quite prevalent, in recognition of the fact that besides buffering the impact of any fallout, such measures help lean against a build-up of risks in the first place. While this notion is already embedded in MPMs such as the Basel III CCyB and real estate-related measures due to their countercyclical implementation, a number of studies have suggested the use of MP tools (e.g. reserve requirement) and CFM in a likewise pre-emptive manner (Agenor and Pereira da Silva, 2014; Frost et al., 2020). Rajan et al. (2021) finds that Singapore’s pre-emptive MPMs, on the whole, have dampened the growth of the country’s property prices, thus contributing to domestic financial stability.

The use of CFM is becoming a more common topic in recent papers. CFMs comprise a diverse range of instruments affecting capital flows, making their comparison and analysis difficult. The majority of CFMs appear to be structural in nature, with some having been in place for decades (Eichengreen and Rose, 2014; Gupta and Masetti, 2018). This would make it challenging to use CFMs to manage (short-term) cyclical shocks. Batani and Durand (2021) find that CFMs and other policy levers, including warranted macroeconomic adjustments as advocated by the IMF’s Institutional View on capital flows, complement each other in mitigating countries’ sensitivity to changes in global financial conditions.

Some authors have proposed a modification of the MP mandate as an additional option, even as other policies are employed to help address issues beyond the MP mandate. Agenor and Pereira da Silva (2019) and Agenor et al. (2013) have proposed to formally include a credit measure (besides inflation and output) as a target indicator for MP, which they argue could produce a more effective policy solution to achieve macroeconomic and financial stability, when calibrated together with MPM.

Assessing IMPF impacts

While some progress has been made in evaluating the effectiveness of combining multiple macro policy tools on both the theoretical and empirical fronts, there remains much room for development that could usefully guide policymaking. From a theoretical perspective, efforts to include multiple policy tools within standard economic frameworks have yet to produce clear results on optimal policy responses, especially in contrast to the corpus of knowledge on the conduct of conventional MP accumulated over the past few decades.
Considerable challenges persist on the empirical front: there are significant issues with data on MPMs, making it difficult to measure the macroprudential stance consistently across countries. In particular, there remains significant gaps in applying the predictions of theory to country experiences, especially in the open-economy settings relevant for EMEs.

Recent research work has been done at Economic Policy Group (EPG), MAS to bridge some of these gaps. De Carvalho Filho and Ng (2021) formulate a model of a small-open economy based on a neoclassical Dynamic Stochastic General Equilibrium (DSGE) framework with a financial sector to analyse the macroeconomic and financial impacts of deploying MPMs and conventional MPs in response to US MP surprises. The model’s testable predictions are then evaluated using a cross-country panel regression analysis of MPM responses to these surprises.

The analysis goes beyond the literature’s typical focus on closed economy settings, and relates the IMPF discussion to recent research on the impact of a global financial cycle on domestic macro-financial outcomes. The normative analysis in the paper shows that the welfare benefits of countercyclical MPMs are conditional on country characteristics, and highlights the finding that active macroprudential management may be particularly important for certain emerging markets and international financial centres which receive and intermediate large volumes of financial flows. The empirical analysis finds that countries that tend to loosen their MPM stance when the US tightens MP show faster growth in domestic credit-to-GDP ratios for about five quarters after the surprise tightening, relative to countries that do not. However, there are no significant differences in GDP growth outcomes between the two groups.

**Description of the model**

EPG’s DSGE model features a small-open economy with a banking sector subject to financial frictions, with two key differences distinguishing it from standard frameworks that facilitate the analysis of IMPFs. The first is the addition of international financial markets. Domestic banks can borrow internationally at the foreign interest rate \( i_t^f \). Only a fraction of banks’ foreign borrowing can be hedged against foreign exchange risk, with the remaining share of foreign debt exposed to changes in nominal exchange rate movements. The supply of international credit declines when the foreign interest rate rises or the domestic exchange rate depreciates, due to net capital outflows and a rise in adverse risk sentiment.

Second, the central bank wields MPM instruments in addition to conventional MP—in particular, it can adjust LTV limits and CAR limits, in response to changes in debt volumes and asset prices. LTV allows the central bank to tighten or loosen constraints on borrowing by domestic firms, limiting credit demand. CAR allows the central bank to adjust leverage requirements for the banking sector, regulating credit supply.

---

42 Miranda-Agrippino and Rey (2019) find that US monetary policy tightening leads to tightening global financial conditions, falling risky asset prices, rising bond spreads and retrenchments in capital flows (especially banking flows) globally.
Key model mechanisms

A US MP tightening can impact other economies in the world through balance sheet channels, similar to those that have been emphasised in the literature on the financial accelerator (see Bernanke, Gertler and Gilchrist, 1999) and the credit channel of MP (see Kashyap and Stein, 1994). In particular, two balance sheet channels create scope for MPMs to improve welfare in the other economies.

i) Credit supply frictions: costs incurred by banks when deviating from a target bank capital requirement. A US MP tightening increases bank liabilities as overseas funding costs rise, which negatively impacts banks’ future profit streams, reducing bank capital levels. This leads to higher costs incurred for deviations from capital adequacy requirements. Banks respond by reducing credit supply to entrepreneurs, in turn curtailing investment and lowering output in the domestic economy.

ii) Credit demand frictions: collateralised borrowing constraints on borrowers depend on LTV, which sets up a financial accelerator mechanism. A US MP tightening lowers asset prices and collateral value, resulting in a tighter borrowing constraint and causing credit demand, investment and output to fall.

In the model, balance sheet channels interact with standard macroeconomic mechanisms to amplify the effects of foreign interest rate shocks. Essentially, an increase in foreign borrowing rates, by reducing bank profits, leads to a cutback in domestic credit supply, compounding the effects of rising lending rates on investment and output. At the same time, a domestic currency depreciation that increases the liabilities of banks holding foreign currency debt reduces net foreign borrowing, in addition to the direct effects from higher foreign borrowing costs.

Model implications

Chart S1.1 shows the model-generated responses to a US MP tightening, comparing the macroeconomic outcomes between an economy that uses countercyclical MPMs, and one that does not. Countercyclical MPMs involve an increase in the maximum LTV ratio (i.e., a loosening), and a lowering of minimum CAR, when financial conditions tighten. Without the use of MPM tools, a US MP tightening leads to sharp declines in total debt (deleveraging), investment and output. The domestic currency depreciates, driving up inflation and prompting the central bank to raise policy rates, which dampens output. Balance sheet channels exacerbate the reductions in lending and output as rising external borrowing costs reduce bank profits, while higher domestic lending rates lower asset prices and weigh on credit demand.
**Chart S1.1** Impulse response functions for a positive shock to the US interest rate, for an economy with countercyclical MPMs versus no deployment of MPMs

Output

- **CC MPMs**
- **No MPMs**

Investment

- **CC MPMs**
- **No MPMs**

Inflation

- **CC MPMs**
- **No MPMs**

Nominal FX Rate

- **CC MPMs**
- **No MPMs**

Policy Rate

- **CC MPMs**
- **No MPMs**

Total Debt

- **CC MPMs**
- **No MPMs**

Bank Leverage

- **CC MPMs**
- **No MPMs**

Asset Price

- **CC MPMs**
- **No MPMs**

Note: The interest rate shock imparts a 1 percentage point increase in the US interest rate with all parameters remaining the same as in the baseline calibration of the model.
Relative to the no MPM economy, the declines in both output and debt are attenuated under a countercyclical MPM regime. As total debt and asset prices fall, LTV is raised and CAR is lowered. A higher LTV ratio eases the borrowing constraints on domestic borrowers, while a lower CAR reduces the costs of increasing bank lending (conditional on bank capital levels). Both policies mitigate the fall in total domestic lending and investment, which alleviates the decline in output. Although MPMs pose a drag on economic growth during periods of loose global financial conditions, they also help to stabilise macroeconomic and financial outcomes. In sum, MPMs entail a general trade-off between growth and stability. Further, the model shows that a country’s optimal MPM response to external financial shocks depends to a significant extent on three crucial parameters.43

**Currency denomination of debt.** In countries where financial intermediaries or corporates have large unhedged liabilities denominated in foreign currencies, currency depreciation amplifies the balance sheet effects and worsens the decline in bank lending, exacerbating the negative shock on the economy. For these countries, relying on foreign borrowing to supplement growth comes with large risks to financial stability, which could be mitigated by active countercyclical MPMs.

**Elasticity of foreign credit supply with respect to movements in the real exchange rate.** Countries facing less fickle capital flows suffer smaller reversals when global financial conditions tighten and are subject to milder contractions in bank balance sheets and declines in asset prices. As a result, they can rely on external financing while facing a smaller risk of recession and have less to gain from an active countercyclical MPM regime.

**Elasticity of the current account with respect to movements in the real exchange rate.** Countries with current accounts that respond positively to an exchange rate depreciation are better positioned to avoid a recession after a depreciation because the improvement in the current account may offset the negative impact on overall credit provision in the economy. These countries face smaller risks from reversals in external financing and also have less to gain from an active countercyclical MPM regime.44

In sum, model simulations show that high unhedged foreign liabilities, high responsiveness of foreign credit supply to global interest rates, and low responsiveness of net exports to the real exchange rate are characteristics that increase a country’s vulnerability to foreign interest rate shocks. From a welfare perspective, countries with these features are more likely to benefit from countercyclical MPMs since they are more vulnerable to the economic and financial risks stemming from US MP surprises, even as MPMs restrain GDP growth during boom times.

---

43 The welfare analysis assumes a standard utility function for the macroprudential authority that takes expected growth and the variance of national debt as arguments. For a range of plausible weights for each argument, the optimal policy response depends on the three parameters.

44 Recent research has shown that international trade increasingly operates under DCP, where trade is invoiced in only a few currencies. Under DCP, countries with a larger share of their exports invoiced in US dollars are likely to feature a more muted response of the current account to currency movements (Adler et al., 2020). In these economies, the exchange rate will be relatively ineffective in its role as an automatic stabilizer working through current account adjustments. The economies may benefit relatively more from countercyclical MPMs that serve to support domestic credit and reinforce monetary policy autonomy.
Empirical analysis

To validate the results of the DSGE model and simulations, a panel regression analysis is carried out to: identify the countries which have consistently adjusted MPMs in response to US MP surprises (countercyclical MPM response); test the hypothesis implied by the DSGE model about the type of countries that would benefit from countercyclical MPMs; and explore whether countercyclical MPMs make a significant difference in macroeconomic outcomes.

The empirical analysis explores the MPM responses to US MP surprises in 40 countries, with two objectives in mind. First, countries that had on average across the sample used MPMs in response to US MP shocks are identified. Second, the impact of MPMs on macroeconomic and financial outcomes are estimated, to assess if countries’ experiences with MPMs are in line with the model’s predictions. On a country-by-country basis, MPM and MP responses to US MP surprises were estimated using the local linear projections model (Jordà, 2005), while controlling for shocks to global financial integration and global risk aversion (proxied by the VIX), as well as domestic macroeconomic developments (GDP growth, inflation, real exchange rate and credit growth). The measure of macroprudential stance is the number of cumulative tightening or loosening decisions in the Integrated Macroeconomic Policy (iMaPP) database (Alam et al., 2019).

The estimated response functions reveal significant heterogeneity across countries, which allowed their classification with respect to the MPM response to US MP surprises: 14 countries whose MPM settings were countercyclical to US MP (i.e., those where MPM settings were loosened when US MP was tightened and vice versa) and 26 other countries whose MPM settings were not. The split is shown on Table S1.1.

Guided by the model’s predictions, the empirical analysis sought to ascertain whether country characteristics help to explain the countercyclical MPM response to US MP. A few variables were considered as potential determinants: the sensitivity of net inflows to global capital flows shocks; the sensitivity of exports to the real exchange rate; measures of volatility of net other inflows and net portfolio flows as percent of GDP; the ratio of external debt liabilities in foreign currency to GDP and currency mismatches as percent of GDP (Bénétrix et al., 2019). Of these, the only statistically significant variable is the currency mismatch as percent of GDP, suggesting that countries which are net short on debt liabilities denominated in foreign currency (for instance, if their foreign reserves are smaller than their external debt liabilities) are more likely to adopt a countercyclical MPM response to US MP surprises. When a country is net short on debt liabilities in foreign currency, other things equal, a depreciation worsens its balance sheet.

---

45 The iMaPP database compiles records of tightening and loosening actions on 17 instruments at a monthly frequency, from Q1 1990 to Q4 2016. For each instrument, the observation takes the value of 1 for tightening, −1 for loosening and 0 for no change.

46 However, the lack of statistical significance for some variables may be due to small sample size or correlation with omitted or other variables in the regression.
Table S1.1 Simplified characterisation of the effects of domestic interest rates on an FI’s balance sheet

<table>
<thead>
<tr>
<th>Countercyclical macroprudential response to US monetary surprises (14)</th>
<th>Other countries (26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Australia</td>
</tr>
<tr>
<td>Belgium</td>
<td>Brazil</td>
</tr>
<tr>
<td>Chile</td>
<td>Canada</td>
</tr>
<tr>
<td>Finland</td>
<td>China</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Colombia</td>
</tr>
<tr>
<td>Israel</td>
<td>Czech</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Republic</td>
</tr>
<tr>
<td>Poland</td>
<td>Denmark</td>
</tr>
<tr>
<td>Romania</td>
<td>France</td>
</tr>
<tr>
<td>South Africa</td>
<td>Germany</td>
</tr>
<tr>
<td>Spain</td>
<td>Greece</td>
</tr>
<tr>
<td>Sweden</td>
<td>Hungary</td>
</tr>
<tr>
<td>Turkey</td>
<td>India</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Ireland</td>
</tr>
<tr>
<td></td>
<td>Italy</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
</tr>
<tr>
<td></td>
<td>Korea</td>
</tr>
<tr>
<td></td>
<td>Netherlands</td>
</tr>
<tr>
<td></td>
<td>New Zealand</td>
</tr>
<tr>
<td></td>
<td>Norway</td>
</tr>
<tr>
<td></td>
<td>Peru</td>
</tr>
<tr>
<td></td>
<td>Philippines</td>
</tr>
<tr>
<td></td>
<td>Portugal</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
</tr>
<tr>
<td></td>
<td>Singapore</td>
</tr>
<tr>
<td></td>
<td>Switzerland</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
</tr>
</tbody>
</table>

Next, differences in macroeconomic and financial outcomes for countries with varying MPM responses are examined. Interestingly, countercyclical MPM countries tightened their domestic MP less than other countries immediately after a US MP tightening, which indicates that their MPM responses may buy them some monetary autonomy at the margin. However, the ability to maintain a relatively looser MP in the face of US tightening is only temporary, with differences between the two groups disappearing after one year.

Chart S1.2 shows that countercyclical MPM countries exhibit faster growth in credit (relative to GDP) in the aftermath of a US surprise MP tightening, with the difference relative to other countries peaking at about five quarters after the shock. While countercyclical MPMs support credit growth—thereby mitigating the impact of an external financial shock—there are no differences in the path of GDP. This could be because countercyclical MPM countries were affected by US monetary tightening through other channels that were not counteracted by countercyclical MPMs or it could be their MPM settings mitigated a contraction that would have been deeper. Inflation is lower in the countercyclical MPM countries immediately after the shock but, in cumulative terms, it is higher for these countries six months after the shock.
**Chart S1.2** Impulse response to US monetary surprise, difference between countercyclical macroprudential countries and others

Credit-to-GDP

- **Impulse response**
- **Confidence interval**

GDP Level

- **Impulse response**
- **Confidence interval**

Price Level

- **Impulse response**
- **Confidence interval**

Note: Estimates based on local linear projections estimated in a system of seemingly unrelated regressions, controlling for up to two lags of domestic variables (credit-to-GDP, GDP growth, real effective exchange rate and inflation), external shocks (US monetary policy, VIX and global capital flows), seasonal and country fixed effects. Dashed lines represent 66% confidence intervals.

**Summary of results**

The analysis in De Carvalho Filho and Ng (2021) finds that MPMs help insulate domestic financial systems from US MP shocks. Relative to countries that do not use countercyclical MPMs, countries that tend to loosen their MPM stance experience lower domestic interest rates, higher aggregate credit-to-GDP ratios and lower inflationary responses the year after a US MP tightening. In line with findings in the literature (e.g. Mano and Sgherri, 2020), the analysis finds that currency mismatch on a country’s balance sheet can influence the impact and choice of MPM interventions. In practice, countries with net short positions on foreign currency are more likely to use countercyclical MPMs in response to US policy tightening.

Overall, the paper by De Carvalho Filho and Ng (2021) serves to relate the IMPF discussion to recent research on the impact of a global financial cycle on domestic macro-financial outcomes, thus going beyond the literature’s typical focus on closed economy settings. The results indicate that MPMs can help to offset spillovers from external monetary shocks, while providing some monetary autonomy at the margin. Going forward, further research is needed to evaluate the positive and normative impact of using a fuller suite of...
IMPF policy tools in response to global monetary shocks, in ways that can be incorporated into central banks’ analytical frameworks.

Sum-up

Many countries have recognised the practical benefits of complementing MP responses to external shocks with other policy instruments by making use of the IMPF. The conceptual apparatus of the IMPF has been particularly pertinent during the COVID-19 recovery, when the divergence in growth performance between the US and EMEs and inflationary pressures in the US led to the risk of a strengthening USD, capital flows reversals, and tightening financial conditions in EMEs.

The growing research, some of which has been reviewed in this Feature, has corroborated the benefits of the use of multiple instruments to secure financial and price stability. EMEs and other open economies should have the latitude to flexibly employ a host of policies preemptively, in order to insulate their economies from external shocks and ensure domestic macro-financial stability to support economic growth. While some analytical discipline is useful, optimal IMPF implementation will likely vary across countries depending on their specific characteristics. Indeed, the EPG study described in this Feature shows that the welfare benefits of countercyclical MPMs depend on the extent of currency mismatch on balance sheets, the responsiveness of capital flows to foreign interest rates, and other factors. Given that a consensus on how best to combine IMPF policy tools has not been reached, mechanistic applications of one-size-fits-all policy rules are not likely to prove fruitful.
# Appendix

Table S1.2 Summary of studies on the use of multiple policy tools

<table>
<thead>
<tr>
<th>Study</th>
<th>MP</th>
<th>MPM</th>
<th>FXI/ other FX policy</th>
<th>CFM</th>
<th>Others</th>
<th>Degree of policy interaction*</th>
<th>Policy choice or impact depends on shock-type / country characteristic / nature of flow?#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mano &amp; Sgherri (2020)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Partial</td>
<td>Yes, country characteristic, nature of flow.</td>
</tr>
<tr>
<td>Chen et al (2021)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>None</td>
<td>Yes, country characteristic, shock-type.</td>
</tr>
<tr>
<td>Deb et al (2021)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>None</td>
<td>Yes, country characteristic, shock-type.</td>
</tr>
<tr>
<td>Korinek &amp; Sandri (2016)</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>Full</td>
<td>Yes, country characteristic.</td>
</tr>
<tr>
<td>Rey (2015)</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>None</td>
<td>Yes, shock-type.</td>
</tr>
</tbody>
</table>

* ‘None’ refers to separate analyses done for different policies, as opposed to the assumption of no interaction among policies.

# ‘No’ refers to no mention of particular features (shock-type, country characteristic and nature of flow) in the study. For studies that specify particular feature(s) and do not generalise the results, the findings are treated as dependent on those feature(s).
References


Special Feature 2

Climate Transition Risk Exposure of Singapore’s Banking and Insurance Sectors

Introduction

There is growing awareness of the risk that climate change poses to the financial system, with many central banks and regulators seeking to better understand the nature of this risk and assess its implications for financial stability. Building on MAS’ earlier work in the FSR 2020, which outlined the transmission channels of physical risk and transition risk, this Feature provides preliminary estimates of the transition risk exposure of the banking and insurance sectors in Singapore.

The focus on transition risk is motivated by the significant adjustments that may be imminent amid the shift to a low-carbon economy in Singapore and globally. In addition, data and methodologies for transition risk assessments are also more established at this juncture, relative to those for physical risk.

MAS applied the concept of Climate Policy Relevant Sectors to estimate the financial system’s exposure to transition risk

The concept of Climate Policy Relevant Sectors (CPRS), as developed by Battiston et al. (2017), provides a standardised classification of sectors in which activities and revenues could potentially be affected in a disorderly transition to a low-carbon economy. It is based on the European Union’s Statistical Classification of Economic Activities (NACE), and groups economic activities into nine sectors of differing transition relevance, based on their greenhouse gas emissions and their cost sensitivity to changes in climate policy. Six of these—“fossil fuel”, “utility”, “energy-intensive manufacturing”, “housing”, “transport” and “agriculture”—are considered CPRS. Three sectors, “finance”, “scientific R&D”, and “others” are considered non-CPRS.

MAS estimated the equivalent CPRS exposure of Singapore’s banks and insurers through their loans and investments respectively, allowing for a broad assessment of the overall transition risk exposure of the banking and insurance sectors. The Singapore Standard

---

47 Physical risk refers to the economic costs and financial losses from the exposure of human and natural systems to climate-related events. These climate-related events include acute weather events (e.g. flash floods) and more gradual, long-term changes in climate patterns (e.g. gradual melting of polar ice sheets).

48 Transition risk refers to the economic and financial costs of the adjustment to a low-emissions economy, including those induced by policy changes, technological breakthroughs, and shifts in investor preferences and social norms.

Industrial Classification (SSIC) codes (for banks’ sectoral loan exposures) and the General Industry Classification Standard (GICS) (for insurers’ sectoral investment exposures) codes were first mapped to the NACE to obtain the equivalent CPRS and non-CPRS classification codes. This was followed by the sizing of the actual exposure of loans and investments to CPRS and non-CPRS, using the data collected under MAS Notice 610 and MAS Notice 122, respectively.50

Next, the transition risk exposure of banks’ loans was assessed by estimating the emissions that are financed by these loans in the respective CPRS.51 The intuition is that financing to a given CPRS would be more vulnerable to transition risk if the emissions in that CPRS are higher relative to other CPRS. The emissions of each CPRS are estimated from the OECD Carbon Dioxide Emissions Embodied in International Trade (OECD TECO2) dataset, which provides local and imported emissions data on an annual basis for various economic activities across 34 jurisdictions, including Singapore. Specifically, the economic activities in OECD TECO2 were first mapped to the CPRS to obtain the corresponding emissions for each activity in the CPRS. The emissions intensity corresponding to loans for each CPRS is then computed, in the form of the emissions per SGD million of loan (EML). A CPRS with higher EML will likely be more affected by changes in climate policy (e.g. the introduction of a carbon tax), and hence more susceptible to transition risk (Battiston, 2017).

Assessing Singapore’s banking and insurance sector exposures to climate transition risk

The banking sector’s loan exposures to CPRS (excluding residential mortgages) have remained stable...

In Singapore, the proportion of banking loans52 extended to CPRS (excluding residential mortgages) between 2015 and 2020 has remained stable at 29–31%. Averaging over these years, the housing CPRS (excluding residential mortgages)53 formed the largest proportion (14%) of total loan exposures, followed by transport (8%) and energy-intensive manufacturing (6%) (Chart S2.1). Together, these three CPRS formed about 28% of the banking sector’s total loan exposures. An estimation by the European Central Bank (2020) based on a similar methodology showed that the proportion of the Euro area’s total banking loan exposures to CPRS (including residential mortgages) was 32–38% over the same period.

---

50 MAS Notice 610 refers to the Submission of Statistics and Returns for Banks, and MAS Notice 122 refers to the Submission of Asset & Liability Exposures for Insurers.
51 As a first-level estimation, banks’ loans and the emissions financed by such loans can be mapped to each other as non-bank corporates and households in Singapore mainly obtain financing from bank loans.
52 Includes loans to residents and non-residents.
53 Housing includes building and construction loans but excludes residential mortgages.
...and mainly comprise exposures to CPRS with lower EML, suggesting less susceptibility to impairments from changes in climate policy

The bulk of CPRS loan exposures in the Singapore banking sector are to CPRS with lower EML (Table S2.1), suggesting less susceptibility to impairments from changes in climate policy. The housing CPRS (excluding mortgages), which has the lowest EML among the CPRS, accounts for the majority of the CPRS exposures.

<table>
<thead>
<tr>
<th>CPRS</th>
<th>Share of total loan exposures (%)</th>
<th>Emissions (Mt CO₂)</th>
<th>EML by specific CPRS (tCO₂/SGD mil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuel</td>
<td>0.1</td>
<td>7.1</td>
<td>6760.9</td>
</tr>
<tr>
<td>Energy-intensive manufacturing</td>
<td>6.0</td>
<td>14.5</td>
<td>207.1</td>
</tr>
<tr>
<td>Housing (excluding residential mortgages)</td>
<td>15.3</td>
<td>1.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Transport</td>
<td>7.9</td>
<td>25.1</td>
<td>238.9</td>
</tr>
<tr>
<td>Agriculture</td>
<td>2.1</td>
<td>0.7</td>
<td>22.2</td>
</tr>
</tbody>
</table>

Source: MAS estimates, OECD TECO2, IEA
Note: The emissions and EML by specific CPRS are coloured by percentile. CPRS with relatively high emissions or EML are depicted in shades of red, while those with relatively low emissions or EML are depicted in shades of green, based on the colour scale below. The latest share of loan exposures in 2020 was used. EML was computed using OECD TECO2 and IEA emissions data. 2018 is the latest year where IEA emissions data for Singapore is available.
The insurance sector’s investment exposure to CPRS has likewise remained stable

The insurance sector’s investment exposures to CPRS remained stable from 2015 to 2020 at about 32–33% (Chart S2.2). About two-thirds of the sector’s CPRS exposure is attributable to housing54 and transport CPRS.

Chart S2.2 Singapore insurance sector’s investment exposures to CPRS is at 32–33%

Source: MAS estimates

A more comprehensive assessment of the Singapore banking and insurance sectors’ transition risk exposure would need to account for jurisdiction-level differences in emissions across various CPRS

The analysis in this Feature is based on emissions in Singapore. However, given Singapore’s role as a regional financing hub, a more comprehensive assessment of transition risk exposure would need to account for jurisdiction-level differences in emissions across the various CPRS financed by banks and insurers. For instance, the energy-intensive manufacturing sectors of different jurisdictions would use factors of production that have different emissions. While data on loans and insurer investment exposures by sector and jurisdiction of issuer are available in MAS Notice 610 and MAS Notice 122 returns, respectively, there is insufficient data on the emissions of overseas counterparties and the share of financing provided by banks and insurers in Singapore relative to other creditors to these counterparties at this stage. Such data would be helpful to better apportion the financed emissions to the banks and insurers in Singapore and hence estimate the degree of transition risk exposure more accurately.

To overcome these data limitations, one potential bottom-up approach could involve obtaining emissions data of individual counterparties for each loan and investment, and aggregating them to get estimates of the Singapore financial system’s financed emissions across jurisdictions and CPRS. Such an approach is currently limited by the lack of reliable data.

54 Equity exposure to housing includes real estate management and development, as well as real estate investment trusts.
climate-related disclosures, but efforts to improve and standardise such disclosures are underway, which would make such analysis more feasible going forward. In the interim, it could be useful to explore potential top-down approaches to size such risk. For example, one possible approach is to estimate the EML of a CPRS in another jurisdiction by applying a scaling factor\textsuperscript{55} to the EML of that CPRS in Singapore.

**Sum-up**

The transition risk analysis in this Feature marks the first of MAS’ research on assessing financial sector risk associated with climate change, and the findings will help to inform further work in this area.

As the world grapples with climate change, more research and analysis will be needed to address the knowledge gaps associated with understanding and managing climate risks. Given the pervasive effects of climate change, it is also imperative for FIs and authorities to build up capabilities for assessing the risks across various economic activities (e.g. financed emissions) and support their transition to a low-carbon economy.

The analysis in this Feature is an important first step in MAS’ ongoing work to assess the impact of climate risks on Singapore’s financial system. By using MAS’ statistical returns and information from industrial classifications, this analysis has obtained high-level estimates of the banking and insurance sectors’ exposure to transition risk. MAS’ preliminary estimates suggest that 30% of financial assets are in CPRS (which is broadly in line with the EU), and the majority are in CPRS with a relatively low EML. The methodology provides a means to identify asset exposures that could pose relatively more risk to our financial sector as the world adjusts to a low-carbon future. In turn, the findings would inform future work on quantifying the effects of specific transition risk drivers (e.g. changes in carbon prices) and their mitigating factors (e.g. greener technologies and financing for sustainability initiatives). As data becomes more readily available, MAS will be able to further refine its analytical approaches to better quantify banks’ and insurers’ exposures at risk across time, and monitor institutions’ efforts in managing their transition risk exposure.

MAS will also continue to work in partnership with the industry, academia and other regulators to strengthen our understanding of the financial stability impact of climate change.

Beyond the transition risk exposure and related vulnerabilities examined in this Feature, physical risk arising from climate change would also present an important source of risk to the financial system. However, there remain significant challenges in estimating the impact of physical risk at this juncture, given data limitations as well as the complexity and uncertainty associated with extreme weather events. For instance, the prevailing lack of data on the physical risk scores of FIs’ counterparties’ production sites along the entire value chain makes it difficult to comprehensively assess counterparty-level vulnerabilities to physical risk as well as the corresponding financial impact. MAS is working with other government agencies and

---

\textsuperscript{55} The ratio of emissions per unit of output for a CPRS in another jurisdiction to the emissions per unit of output for that CPRS in Singapore
is also looking to engage with research and educational institutes in Singapore and the region, to better understand the implications of physical risk that would be relevant for our FIs’ exposures.

In addition, to provide a more forward-looking view of the impact of climate risk on the financial sector, MAS will incorporate a range of thematic climate scenarios as part of the 2022 IWST. These exploratory scenarios will feature both physical and transition risks over a 30-year horizon, and will take reference from the long-term climate scenarios developed by the Network for Greening the Financial System (NGFS) as well as feedback obtained from FIs in MAS’ earlier engagements.\(^56\) MAS will continue to work in partnership with industry, academia, other regulators as well as international organisations to assess the resilience of the financial system to climate risks.

References

**Basel Committee on Banking Supervision** (2021), “Climate-related financial risk – measurement methodologies”.

**Baseline Committee on Banking Supervision** (2021), “Climate-related risk drivers and their transmission channels”.


**Network for Greening the Financial System** (2021), “NGFS Climate Scenarios for central banks and supervisors”.

**Organisation for Economic Co-operation and Development** (2018), “Trade in Embodied CO\textsubscript{2} database (TECO2)”.  

---

\(^{56}\) MAS consulted selected FIs in 2021 to better understand their analytical capabilities and the data requirements for the assessment of climate risks, including engagement on stress testing templates that incorporated exploratory climate scenarios.
Special Feature 3
Enhancing Corporate Surveillance with Probability of Default Model\textsuperscript{57}

Introduction

Timely surveillance of corporate financial health is essential

The COVID-19 pandemic has underscored the importance of timely surveillance of NFCs in assessing their vulnerabilities and informing the design of appropriate policy responses.

To this end, timely firm-level data, relating to financial ratios and balance sheets, is integral for an accurate and updated assessment of NFCs' vulnerability. However, there are two key data challenges. First, such firm-level financial data are typically published with a lag. For example, most listed firms in Singapore report their financial results semi-annually, with a one-quarter lag from the end of the period.\textsuperscript{58} Second, there are data gaps. Not all firms readily publish the financial ratios or the information to derive the financial ratios, such as the ICR, which are critical for vulnerability assessment.

To overcome these data challenges, this Feature presents how EPG-MSD could enhance its corporate surveillance framework by incorporating key elements of the Probability of Default (PD) model developed by the NUS Credit Research Initiative (NUS-CRI). This model-based approach provides a market-based, timely and forward-looking assessment of the PD of corporates, taking input from macro-financial factors and market-based expectations as well as accounting-based measures of firm-specific financial attributes. More specifically, this Feature also discusses how the NUS-CRI PD model could complement the EPG-MSD framework in the comprehensive surveillance of NFCs, as well as to overcome the trade-offs in reducing both “Type I” and “Type II” errors, i.e. to reduce the error of wrongly identifying vulnerable firms that are actually not vulnerable, as well as reduce the error of not identifying vulnerable firms that are actually vulnerable.

\textsuperscript{57} This Feature was prepared in collaboration with the NUS Credit Research Initiative (NUS-CRI), which falls under the research pillar of the Asian Institute of Digital Finance (AIDF). AIDF is a university-level institute at NUS, jointly founded by the MAS and the National Research Foundation (NRF), with the aim of expanding digital financial technology capabilities and education in Singapore and the wider region.

\textsuperscript{58} On 9 January 2020, the Singapore Exchange Regulation (SGX RegCo) announced that quarterly reporting would no longer be required for listed companies and would apply only to companies associated with higher risks. A company is associated with higher risks if (i) the company has received a disclaimer of opinion, adverse opinion or qualified opinion from its auditors on its latest financial statements; (ii) its auditors have expressed a material uncertainty relating to going concern on its latest financial statements; or (iii) SGX RegCo has regulatory concerns relating to, for example, material disclosure breaches or issues with material financial impact.
Foundations of EPG-MSD corporate surveillance framework

The EPG-MSD framework for corporate surveillance takes a balance sheet-based approach to identify firm-level vulnerabilities.

Generally, the corporate surveillance approach taken by central banks for the purpose of financial stability assessment involves monitoring a combination of firm-specific financial indicators (leverage ratios, debt servicing ratios, and liquidity ratios) to assess overall corporate vulnerability. In the EPG-MSD framework, firm vulnerability is assessed from two perspectives—short-term viability centred on liquidity and refinancing risk, as measured by earnings and cash buffers relative to short-term liabilities; and medium-to-longer term viability based on firms’ leverage in relation to their profitability and capital structure. The specific indicators used are liquidity ratios such as the cash coverage ratio (computed as cash and cash equivalents over short-term debt) which assesses liquidity and refinancing risk, as well as ICR and Debt-to-EBITDA, which measure debt servicing ability.

One key advantage of this approach, relative to a model-based approach, is the informational value of firm-level financial ratios, which allows for a more granular understanding of underlying drivers of NFCs’ vulnerability. For instance, a weaker debt servicing ability could be a result of imbalances arising from capital structure (high leverage) and/or weak earnings growth, while higher liquidity risk could be due to challenges in the firm’s operations (relatively low cashflows) or imbalances arising from its debt maturity profile (relatively higher proportion of shorter-term debt). This approach further facilitates a differentiated surveillance approach for different industries and for various segments of firm characteristics (e.g. by firm size). Such information and analysis were critical in the vulnerability assessment of NFCs that were more affected by COVID-19 than others, helping to inform the policy design and implementation of more targeted support measures.

In addition, a surveillance framework based on financial ratios can facilitate further risk analysis to assess the vulnerability of NFCs across industries through sensitivity analysis and stress testing under different scenarios (e.g. rise in interest rates and impact on earnings).59

Currently, firms are deemed as vulnerable if they have high liquidity and refinancing risk, with their cash coverage ratio less than 1.5, and weak debt servicing ability as indicated by ICR that is less than 1 or Debt-to-EBITDA at negative or above 4 (Figure S3.1). These thresholds were validated from an internal EPG-MSD study, and will be re-calibrated based on incoming data. Details of this study are described below.

---

59 For instance, Special Feature 4 in MAS’ 2020 Financial Stability Review focused on Singapore-listed Real Estate Investment Trusts (S-REITs)’ performance during the COVID-19 pandemic. Using the framework, the Special Feature simulated shocks on financial ratios and assessed S-REITs’ resilience against a potentially protracted and severe COVID-19 crisis.
NUS-CRI PD Model

The NUS-CRI PD model incorporates market-based data for its PD computations.

The NUS-CRI PD model is built on the forward intensity model of Duan et al. (2012). The model accommodates both defaults and other corporate exits (such as mergers and acquisitions) and is based on forward rates instead of spot rates, which enables the model to produce forward-looking PD term structures for public firms on a daily basis. Calibration of the NUS-CRI PD model is based on observed default data of firms spanning across more than 80,000 publicly listed firms in over 130 economies (including Singapore), from 1990 to present.

The model input for the calculation of a firm’s PD are from a few sources: firm-specific accounting and market-based inputs, and macro-financial factors. Specifically, firm-specific inputs are based on accounting variables covering perspectives on leverage and liquidity (adjusted for sectoral differences), and market indicators such as relative size, market valuations, and firm-specific volatility. The inclusion of market-based data (e.g. equity prices) allows the model to update changes to firms’ credit outlook in a more timely manner, compared to information obtained from firms’ balance sheets. These inputs are combined with macro-financial factors, including the broader stock index and interest rates. The complete list of input variables is set out in Table S3.1.

---

Specifically, in the forward-intensity model, a firm’s default is signalled by a jump in the Poisson process, determined by its intensity at time periods in the future relative to the values of input variables at the time of prediction.
Table S3.1 NUS-CRI PD model inputs

<table>
<thead>
<tr>
<th>Model inputs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock index return</td>
<td>Trailing 1-year return of the prime stock market, winsorisation and currency-adjusted</td>
</tr>
<tr>
<td>Short-term risk-free rate</td>
<td>Yield on 3-month government bills</td>
</tr>
<tr>
<td>Economy-level Distance-to-default (for financial/non-financial firms)</td>
<td>Median Distance-to-default of financial/non-financial firms in each economy/country inclusive of those foreign firms whose primary stock exchange is in this economy/country (Not applicable to China)</td>
</tr>
<tr>
<td>Distance-to-default (level and trend)</td>
<td>Volatility-adjusted leverage based on Merton (1974) with special treatments</td>
</tr>
<tr>
<td>Cash/Total assets (level and trend)</td>
<td>For financial firm’s liquidity — logarithm of the ratio of each firm’s sum of cash and short-term investments to total assets</td>
</tr>
<tr>
<td>Current assets/Current liabilities (level and trend)</td>
<td>For non-financial firm’s liquidity — logarithm of the ratio of each firm’s current assets to current liabilities</td>
</tr>
<tr>
<td>Net income/Total assets (level and trend)</td>
<td>Profitability — ratio of each firm’s net income to total assets</td>
</tr>
<tr>
<td>Relative size (level and trend)</td>
<td>Ratio (logarithm) of each firm’s market capitalisation to the economy’s median market capitalisation over the past one year</td>
</tr>
<tr>
<td>Relative Market-to-book ratio</td>
<td>Individual firm’s market mis-valuation / future growth opportunities relative to the economy’s median level of Market-to-book ratio</td>
</tr>
<tr>
<td>Idiosyncratic volatility</td>
<td>1-year idiosyncratic volatility, computed as the standard deviation of the residuals obtained from regressing each firm’s daily returns of its market capitalisation against the daily returns of the economy’s stock index</td>
</tr>
</tbody>
</table>

Source: NUS-CRI

Exploiting complementarities between the NUS-CRI Model and EPG-MSD’s vulnerability assessment

This section presents three sets of analyses comparing the vulnerability assessment of both approaches and examining how the NUS-CRI model could enhance the EPG-MSD framework. First, each approach was separately assessed for its predictive ability. Second, an event study approach was used to investigate how the NUS-CRI model would behave under past crises, in the context of the EPG-MSD framework. Specifically, the focus was on the extent of divergence in PDs generated by the NUS-CRI model between vulnerable and non-vulnerable firms identified under EPG-MSD’s framework. Third, the analysis examined how the NUS-CRI model could be used to reduce “false positives” and “false negatives” of firm vulnerability under EPG-MSD’s framework.
The EPG-MSD framework and the NUS-CRI PD model, independently, have sufficient predictive accuracy

Under the EPG-MSD framework, vulnerable firms are defined as those that are likely to experience corporate distress within the next one year. Such corporate distress events include (i) bankruptcy, dissolution or liquidation; (ii) delisting; or (iii) firms sustaining significant losses.61

The effectiveness of the EPG-MSD framework for corporate surveillance was empirically validated based on financial data from more than 7,000 firms in the ASEAN-5 and China region over the period of Q1 2005 – Q4 2018. Specifically, firms below the ICR and cash cover thresholds of 1.5 were found to be 5 times and 1.5 times more likely to become distressed in the following year respectively, compared to firms that exceeded such thresholds. Separately, using a logistic regression model that controlled for financial and macroeconomic conditions62, the analysis also showed that ICR and cash cover were statistically significant, with increases in either the ICR or cash cover resulting in a decrease in the probability that a firm becomes distressed in the next year.

Further tests were conducted to evaluate the predictive accuracy of the financial ratio thresholds against the three criteria of sensitivity, specificity and precision:

(i) Sensitivity is the proportion of firms in distress that are correctly identified by the thresholds (maximising true positive cases);

(ii) Specificity measures the proportion of firms not in distress that are not identified by the thresholds (maximising true negative cases); and

(iii) Precision is the proportion of firms identified by the thresholds that are actually in distress (maximising model accuracy).

The analysis found that among the various financial indicators, the ICR and its associated threshold have the best “informedness” in predicting firm vulnerability.63 The findings also suggested that using a combination of indicators comprising debt servicing, liquidity and leverage indicators gives a better predictive performance of firms in distress.64

61 For (ii), using delisting of a firm as an indicator of a firm being in distress is similar to the approach used in Shumway (2001). While firms could delist for multiple reasons, one of the main reasons is financial distress. For (iii), identifying firms in distress based on whether they have sustained significant losses is based on a similar approach taken in Senapati and Ghosal (2016). Specifically, firms are defined to have sustained significant losses if they have negative total shareholders’ equity with a magnitude greater than 50% of their assets over a prolonged period of four consecutive quarters.

62 The variables that are used as proxies for these conditions include macroeconomic variables (output gap, inflation growth, exchange rates, domestic lending rate, the US policy rate and external corporate spread), and firm-specific financial variables (firm’s effective interest rate, short-term debt ratio, and return on assets).

63 Informedness comprises the performance criteria for sensitivity and specificity. The analysis found that the ICR threshold for optimal informedness was 0.92. Hence, a threshold of 1 for ICR is used in the current EPG-MSD framework for identifying corporate vulnerability. The International Monetary Fund (2019) also uses a threshold of 1 for ICR in its corporate vulnerability surveillance work.

64 The combination of financial ratio thresholds has a higher informedness and F1 score than each threshold in isolation. The F1 score is a harmonic mean of precision and sensitivity, which provides an alternative to evaluating model performance. Typically, a predictive assessment focuses only on the ability of a model to maximise positive cases. The F1 score provides a more comprehensive perspective, by balancing between identifying more positive cases and ensuring all cases identified by the model are actually positive cases.
Compared to the EPG-MSD framework which aims to identify firms likely to experience corporate distress, the NUS-CRI PD model generates probabilities of default for corporates where defaults are recognised as events arising from (i) bankruptcy filings\textsuperscript{65}; (ii) a missed or delayed payment of interest and/or principal (excluding delayed payments within a grace period); or (iii) debt restructuring/distressed exchange.\textsuperscript{66}

Due to the differences in modelling procedure and definitions, it is not appropriate to compare the two models directly. As such, in the case of NUS-CRI PD model, the Accuracy Ratio\textsuperscript{67} (AR) is evaluated.\textsuperscript{68} As noted in Duan and Shrestha (2011), AR or the equivalent Area Under the Receiver Operating Characteristic is one of the most popular and meaningful measures of the discriminatory power of a credit rating system. In short, if firms that have defaulted had been assigned among the highest PD compared to other corporates in the same testing group prior to default, the model is evaluated to have a higher AR. When applied to the 1-year PD forecast\textsuperscript{69} of corporates in Singapore, the AR was found to be significant at 0.721—the AR ranges between [0,1], where 0 indicates a completely random credit rating system and 1 stands for a perfect credit rating system.

An event study of past crises suggests NUS-CRI’s model could complement EPG-MSD’s framework in discriminating between vulnerable and non-vulnerable firms


The methodology involves comparing the median estimated PD of two groups of firms, namely vulnerable firms (identified based on the EPG-MSD corporate surveillance framework), and non-vulnerable firms (i.e. the rest of the firms, acting as the control group). To the extent that the median PD\textsuperscript{70} of the vulnerable group is significantly higher than the non-vulnerable group at the onset of or during a crisis, this suggests that the NUS-CRI PD model can complement EPG-MSD’s corporate surveillance framework in sufficiently discriminating between vulnerable and non-vulnerable firms, as identified under the EPG-MSD framework.

---

\textsuperscript{65} This includes filings for receivership, administration, liquidation or any other legal impasse to the timely settlement of interest and/or principal payments.

\textsuperscript{66} Instances where debt holders are offered a new security or package of securities that result in a diminished financial obligation (e.g. a conversion of debt to equity, debt with lower coupon or par amount, debt with lower seniority, debt with longer maturity).

\textsuperscript{67} AR is the ratio between \(a_r\) and \(a_p\) where \(a_r\) is the area between the Cumulative Accuracy Profile (CAP) of the rating model being evaluated and the CAP of the random model, and \(a_p\) is the area between the CAP of the perfect model and the CAP of the random model. The CAP is obtained by first ordering the PDs from the highest to lowest values. Then, for a given fraction \(x\) of the total number of firms, the CAP curve indicates the fraction of the defaulted firms whose PDs are greater than or equal to the minimum PD up to fraction \(x\), where fraction \(x\) will be varied from 0% to 100%.

\textsuperscript{68} Details on the accuracy evaluation of the NUS-CRI model can be found in NUS-CRI’s technical report (2021).

\textsuperscript{69} A single calibration is conducted using data until the end of the data sample. As an example, 1-year PD forecasts are made for 31 December 2019 by using the data on or before 31 December 2019 and the parameters from the calibration. These PD forecasts can be compared to actual defaults that occurred at any time in 2020.

\textsuperscript{70} The findings were also consistent when the event study was replicated for the PDs at the 25th and 75th percentile, suggesting that the trends for median PDs were representative of the values for the specified data set.
Across the three crisis events, the group of vulnerable firms identified through EPG-MSD’s corporate surveillance framework had a median PD (computed by the NUS-CRI PD model) which began to rise and diverge from the non-vulnerable firms during the earlier stages of the crisis. At the height of the crisis, the rise and divergence peaked when compared to the median PD of the group of non-vulnerable firms (Charts S3.1, S3.2 and S3.3).

In the case of sector-specific shocks, the NUS-CRI PD model could also be used to assess the vulnerability of specific firms and track their PDs as the crisis unfolds. For example, the oil price plunge in 2014–2016 resulted in a significant increase in PD for firms in the O&G sector, together with the narrowing of margins and excess capacity across oil producers (Chart S3.4). In conjunction with EPG-MSD’s framework, the NUS-CRI PD model could help to identify vulnerable O&G firms that warrant a more targeted assessment of the financial impact associated with further declines in oil prices.

Another useful feature of the NUS-CRI PD model is that it could provide real-time surveillance, since the model can continuously update PDs over time based on market-based indicators. This feature could allow for the tracking of firm-level vulnerabilities as a crisis evolves. It could also complement the surveillance focus of EPG-MSD’s framework. To illustrate, EPG-MSD’s surveillance framework indicated that the proportion of vulnerable firms in H2 2020 had fallen to around pre-COVID levels. When overlaid with NUS-CRI’s PD model, the surveillance showed that these vulnerable firms had become more vulnerable as indicated by their higher PDs (Chart S3.3).

While this has to be further studied carefully, an extended application of the NUS-CRI model could involve using it to first identify a list of potentially vulnerable firms (e.g. those in the top quartile of the PD distribution) separate from EPG-MSD’s framework, at a time when accounting-based information is unavailable. This is especially crucial in the lead up to or in the early stages of a crisis. This could then be followed by the application of the EPG-MSD corporate surveillance framework as another lens to filter the firms that are vulnerable based on bottom-up driven, albeit less up-to-date, accounting-based information. Using both approaches in a complementary but meaningful way would require some calibration and back testing of the NUS-CRI model to identify a suitable percentile PD threshold that would generate a list of potential firms that are aligned with the definition of vulnerable firms under EPG-MSD’s framework. After calibration, this combined approach would allow the list of vulnerable firms to be more dynamically updated. When the firm-level data is aggregated, EPG-MSD can also perform real-time surveillance of industry sectors that are weaker, as well as assess the extent of the banking sector’s exposures to weak firms.
**Chart S3.1** Median PD of vulnerable firms (identified by EPG-MSD’s framework) had risen for the GFC (2007–2009) period, compared to non-vulnerable firms

Median PDs

![Graph showing median PDs for non-vulnerable, vulnerable, and all firms during the GFC (2007–2009) period.](image)

Source: MAS estimates, Thomson Financial, NUS-CRI

**Chart S3.2** Median PD of vulnerable firms (identified by EPG-MSD’s framework) had risen during the oil price crisis (2014–2016) period, compared to non-vulnerable firms

Median PDs

![Graph showing median PDs for non-vulnerable, vulnerable, and all firms during the oil price crisis (2014–2016) period.](image)

Source: MAS estimates, Thomson Financial, NUS-CRI
Chart S3.3 Proportion of vulnerable firms (from EPG-MSD’s framework) had fallen in H2 2020, but have not translated to reduced risks (in terms of PDs) for firms that are still vulnerable

Monthly Percentage of Vulnerable Firms (illustrated by bars) and Median PDs (illustrated by lines)

Source: MAS estimates, Thomson Financial, NUS-CRI

Chart S3.4 A significant increase in PD for firms was observed in the O&G sector during the oil price crisis

Median PDs

Source: MAS estimates, Thomson Financial, NUS-CRI

Differences in vulnerability assessment of the two approaches reflect additional firm-specific and market-based inputs of the NUS-CRI PD model

Next, the analysis turns to how the NUS-CRI PD model could be used to enhance the predictive accuracy of vulnerable firms under EPG-MSD’s framework, as well as reduce the “false positives” and “false negatives”. Two cases were examined: (1) Case I, where a firm is identified as vulnerable under EPG-MSD’s framework but has a low PD under the NUS-CRI PD model; and (2) Case II, where a firm is classified as non-vulnerable under EPG-MSD’s framework but has a high PD under the NUS-CRI PD model.

For this comparative analysis, the data set used was all NFCs in Singapore drawn from the sample period of H2 2020. The definition of high and low PD under the NUS-CRI model is based on the median PD of firms identified under the EPG-MSD framework. Specifically, for Case I, a firm is defined as having a low PD if the default measure is lower than the median
PD of firms considered as non-vulnerable under EPG-MSD’s framework. In Case II, a firm defined as having a high PD is one where its default measure is higher than the median PD of firms considered as vulnerable under EPG-MSD’s framework.

1. **Case I — Vulnerable firms (identified by EPG-MSD’s framework) but with low PDs**

   A closer examination of the firms with low PDs under the NUS-CRI model showed that such firms had “implied large asset holdings” relative to all other firms, as derived from the Black-Scholes option pricing formula using the firms’ market capitalisation. Such firms were mostly from the real estate sector, comprising property developers and REITs. The median asset holdings of such a firm was about 12 times the median asset size of a firm in Singapore’s corporate sector.

2. **Case II — Non-vulnerable firms (identified by EPG-MSD’s framework) but with high PDs**

   About 80% of non-vulnerable firms with high PDs faced increased solvency risks, reflecting their relatively smaller implied asset holdings or high implied asset volatility. For the rest of such firms, they had high PDs due to firm-specific characteristics, e.g. firm volatility. Profitability (net income to total assets) was also a factor for some of these firms. Unlike Case I where the bulk of the firms were in the real estate sector, the firms with high PD in Case II were spread across various sectors.

   The findings suggest that the NUS-CRI model could provide useful additional perspectives in trying to more accurately identify vulnerable and non-vulnerable firms under EPG-MSD’s framework. For Case I, firms with low PDs could be re-classified from vulnerable to be non-vulnerable, thereby reducing false positives. More importantly, the identification of high PDs in Case II highlights an important group not captured by the current EPG-MSD approach, as the PD model incorporates the latest market-based information in the assessment of vulnerability. Non-vulnerable firms with high PDs could be more closely assessed if there is a basis to reclassify such firms as vulnerable. This would enhance the comprehensiveness of EPG-MSD’s corporate surveillance and reduce false negatives. In sum, there could be a reduction in false positives and false negatives when the NUS-CRI model is used in conjunction with EPG-MSD’s framework, without the need to further calibrate the financial indicators’ thresholds.

---

71 Firms that are facing a decrease in their market capitalisation—which could be driven by a decrease in share price—will generally face a lower implied asset holding as the implied asset value of the firm computed through the Black-Scholes option pricing formula will be lower.

72 These firm-specific inputs include volatility-adjusted leverage, liquidity, profitability, relative size, market mis-valuation or future growth opportunities, and idiosyncratic volatility.
Conclusion

The Feature has established that the use of the NUS-CRI PD model within EPG-MSD’s framework for corporate surveillance would enhance assessment of corporate vulnerability, given the complementary strengths of each approach. Through the NUS-CRI PD model, corporate surveillance can pivot to focus on real-time firm-level PDs in the event of a sudden shock to the economy. At the same time, the fundamental assessment underpinning the EPG-MSD framework continues to provide an intuitive interpretation of its findings to inform policy. EPG-MSD’s framework also allows sufficient versatility to delve further into the financial ratios of firms, conduct stress testing across various scenarios, and to take a differentiated surveillance approach for different segments of firms and across different sectors as needed. EPG-MSD will look to incorporate the NUS-CRI PD model in our framework to support our ongoing surveillance of the health of Singapore’s corporate sector.

References


Special Feature 4

An Empirical Analysis of the Determinants of Domestic Interest Rates and Net Interest Margin

Introduction

In Singapore, domestic interest rates such as deposit and lending rates affect banks’ cost of funding and revenue, which in turn determine their NIM—a primary indicator of bank profitability and, at the aggregate level, the banking system’s resilience to shocks. Further, banks’ lending rates affect the cost of borrowing for households and corporates, with an impact on the private sector’s leverage and debt vulnerabilities. Accordingly, an understanding of the drivers of interest rates and NIM would help to provide insights into the financial system’s resilience against shocks.

The Singapore banking landscape has experienced structural shifts over the past two decades. This Feature provides an update on an earlier analysis by examining how the sensitivity of domestic interest rates to interbank funding conditions, proxied by Singapore Interbank Offered Rate (SIBOR), has changed over the years. It extends the analysis to NIM and performs an empirical assessment of the asymmetric impact of interest rate changes across different borrower profiles.

Structural changes in the banking industry could have reduced the sensitivity of domestic interest rates and NIM to interbank funding conditions

The different types of domestic interest rates in Singapore can be classified according to their potential impact on and relevance for the assets and liabilities of an FI’s balance sheet, as set out in Table S4.1. The analysis in this Feature focuses on rates that are pertinent to households and corporates, which have important financial stability implications.

---

73 This Feature has benefited from useful discussions with Allaudeen Hameed, Tang Peng Yeu Professor of Finance at the National University of Singapore (NUS) Business School.

74 MAS (1999) found that among the domestic rates, the savings deposit rate had a larger response than the prime lending rate to a given change in SIBOR.
Table S4.1 Simplified characterisation of the effects of domestic interest rates on an FI’s balance sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lending rate to banks</strong></td>
<td><strong>Funding rate from banks (i.e. interbank funding)</strong></td>
</tr>
<tr>
<td>• E.g. SIBOR, Swap Offer Rate (SOR),</td>
<td>• E.g. SIBOR, SOR, and SORA</td>
</tr>
<tr>
<td>Singapore Overnight Rate Average (SORA)</td>
<td></td>
</tr>
<tr>
<td><strong>Lending rate to non-bank corporates</strong></td>
<td><strong>Funding rate from non-bank corporates</strong></td>
</tr>
<tr>
<td>• Floating rates—e.g. <strong>Prime lending rate</strong>, rates pegged off reference rates based on cost of funds such as SIBOR, SOR or SORA</td>
<td>• Floating rates—e.g. Pegged off reference rates such as SIBOR</td>
</tr>
<tr>
<td>• Fixed rates and others</td>
<td>• <strong>Fixed deposit rates</strong></td>
</tr>
<tr>
<td><strong>Lending rate to households</strong></td>
<td><strong>Funding rate from households (i.e. retail funding)</strong></td>
</tr>
<tr>
<td>• <strong>Mortgage rates</strong>—e.g. <strong>Rates related to HDB and private residential properties</strong>, pegged off various reference rates including SIBOR, SOR, SORA and board rates,</td>
<td>• <strong>Savings deposit rates</strong></td>
</tr>
<tr>
<td>• Fixed rates and others</td>
<td>• <strong>Fixed deposit rates</strong></td>
</tr>
</tbody>
</table>

Notes:
1. An increase in the lending rate, *ceteris paribus*, raises the asset values of the FI and strengthens its balance sheet. An increase in the funding rate raises the liabilities of the FI, leading to a deterioration in its balance sheet.
2. The domestic interest rates assessed in this Feature are in bold.

**Chart S4.1** shows a weakening relationship between domestic interest rates\(^{75}\) and interbank funding conditions since the mid-2000s, as the savings deposit rate and prime lending rate have remained relatively stable despite fluctuations in the SIBOR. In comparison, the NIM’s\(^{76}\) relationship with interbank funding conditions appears to have strengthened.

These changes over time could reflect several structural developments in the domestic financial system.

**Savings deposit rate**

The reduced sensitivity of savings deposit rates to interbank funding conditions could have been due to the flush liquidity environment precipitated by high global savings in the 2000s and more recently, unprecedented monetary easing by the major central banks in the 2010s. Under these financial conditions, banks faced weaker incentives to bid aggressively for savings deposits to raise funding.

---

\(^{75}\) Domestic interest rates include savings deposit rate, prime lending rate, as well as mortgage rate (where data is available). The savings deposit rate refers to the floating deposit rate in the savings account with no locked-in period, unless otherwise stated. The prime lending rate refers to the interest rate that banks charge on a select group of corporate customers with good credit standing. Mortgage rates for public and private residential properties refer to the average interest rates of the respective outstanding mortgage loans. Data on domestic interest rates are based on the average rates reported by ten leading (market share) banks and finance companies. HDB mortgage rates refer to interest rates of loans extended by banks to borrowers to finance purchases of public housing properties under the Housing & Development Board (HDB) programme, either through a direct purchase from HDB or through a resale transaction in the secondary market.

\(^{76}\) In this Feature, NIM refers to the simple average NIM of the three local banks, namely DBS, UOB and OCBC.
Prime lending rate

The liberalisation of the banking industry from the late 1990s and consequent increase in competition have led to a change in banking practices, including shifting towards pricing of loans off market-based benchmarks, as opposed to referencing of prime lending rate that primarily served as the base for other lending rates for non-bank customers. For example, the Association of Banks in Singapore (ABS) has observed that the lending rates of banks for non-bank customers are increasingly referenced off SIBOR instead of the prime lending rate.77 Similarly, a recent survey of mortgage loan pricing practices by MAS shows that the share of mortgage loans referencing the prime lending rate was relatively small (Chart S4.2).

Chart S4.1 Domestic interest rates appear less associated with changes in SIBOR since the early 2000s, while the correlation with NIM is stronger

Domestic Interest Rates, NIM and SIBOR

Chart S4.2 The prime lending rate accounts for a very small share of mortgage loan packages extended by FIs

Share of Mortgage Loans by Interest Rate Type from 2015–2021

Source: MAS data

Notes:
1. The data covers outstanding value of mortgage loans.
2. The labels for the respective pies refer to the reference rates used to price mortgage loans.

The change in reference rates to market-based benchmarks for non-bank customers could in turn reduce the need to adjust the prime lending rate over time as more loans were benchmarked to other rates. Notably, mortgage rates have generally tracked the trend of SIBOR, suggesting that banks adjusted their mortgage rates in response to changes in broader funding conditions, regardless of whether the loans were on fixed or floating rates, or priced off different benchmarks (Chart S4.3).

Please refer to ABS website which details FAQs on “Rates & Charges”: https://www.abs.org.sg/consumer-banking/consumers/rates-charges, as part of responses for “Why is it that when banks slash interest rates for deposits, the cuts are substantial but when they reduce their prime rate, the reduction appears to be minimal?”.
NIM

In comparison, the response of NIM to interbank funding conditions has increased in recent years, reflecting the behaviour of its component interest rates. In particular, lending rates were more responsive to movements in the interbank rate as more loans were increasingly priced off SIBOR (as opposed to referencing off the prime lending rate). This is even as saving deposit rates have remain relatively insulated from SIBOR movements over the same period.

Statistical tests suggest that banking liberalisation might have affected the sensitivity of the various domestic interest rates to interbank funding conditions. For example, recursive regression estimates point to a gradual weakening in the relationship between domestic interest rates and SIBOR from the mid-2000s (Chart S4.4). This is in contrast to the test result for NIM, which shows greater sensitivity of NIM to SIBOR, supporting the earlier observation of the stronger co-movement between the two variables.

**Chart S4.3** Mortgage rates for both HDB and private properties track the trend of SIBOR

**Chart S4.4** The sensitivity of deposit and prime lending rates to SIBOR has fallen since the mid-2000s but that of NIM has increased

Responses of Domestic Interest Rates and NIM to a 1 Percentage Point Change in SIBOR

Source: MAS data, Bloomberg

Notes:
1. The coefficients are obtained from recursive regressions (with a constant, SIBOR and the lagged dependent variable). As the quarterly data for NIM is only available from Q2 2002, the first recursive estimate of the coefficient for the NIM regression starts from Q4 2010 to ensure that there is sufficient data for the estimation.
2. Mortgage rates are not included in the analysis, as data prior to 2013 is not available.
Framework and scope of empirical analysis

The empirical analysis in this Feature aims to examine the determination of domestic interest rates and NIM in the Singapore economy.

The mainstream approach to banks’ interest rate-setting behaviour can be traced to the original frameworks in Klein (1971) and Monti (1972), though there have been a number of extensions to these conventional models, mainly to incorporate elements of imperfect competition and adjustment costs (e.g. Elyasiani et al., 1995; Kopecky and VanHoose, 2012).

The initial core framework is centred on a monopolistic bank which faces a downward sloping demand curve for loans and an upward sloping supply curve of deposits. With the maximisation objective specified in terms of a target amount of loans and deposits, the bank sets its lending and deposit rates based on marking up or down the respective interest rates over the risk-free rate, depending on its market power. In such a framework, the risk-free rate is typically the policy interest rate – interbank funding conditions such as SIBOR would be the reference rate in Singapore’s exchange rate policy framework, though it is determined in the capital market.

Using the Monti-Klein framework as the microfoundation, this study estimates the influence of several macroeconomic and structural factors on interest rate determination. Following previous studies for other jurisdictions, including the US and Asia (e.g. Christiano et al. 2014; Almarzoqi and Naceur, 2015; Jamaludin et al., 2015), this Feature focuses on banks’ financial characteristics and market competition within the banking industry as explanatory variables.

The baseline regressions take the functional form\(^\text{78}\) specified in equation (1) below:

**Equation 1:**

\[ y_t = c + a_1 \times SIBOR_t + a_2 \times x_t + \varepsilon_t \]

where \( y \) is the dependent variable which will be either the various domestic interest rates or the NIM; \( c \) is the constant term; \( x \) represents a list of independent variables to be defined below; \( a \) represents the coefficients to be estimated; and \( \varepsilon \) is the white noise error term.

Next, consideration is given to the possibility of asymmetric effects whereby the response to the SIBOR depends on its level or direction of change, as set out in equation (2).

**Equation 2:**

\[ y_t = c + a_1 \times d_1 \times SIBOR_t + a_2 \times SIBOR_t + a_3 \times x_t + \varepsilon_t \]

\(^\text{78}\) Dynamic linear models that include lagged dependent variables are estimated to better capture the effects of regressors over time. These models produce coefficient estimates of explanatory variables that are similar with the regression analyses that exclude the lagged dependent variables.
where \( d_1 \) represents dummies that capture either an increase in the SIBOR or a higher level of the SIBOR.

Finally, the analysis turns to a threshold regression as specified in equation (3) to study whether the asymmetric effects are present under different states of the lagged dependent variable.

**Equation 3:**

\[
y_t = c + a_1 \times SIBOR_t + a_2 \times x_t + \varepsilon_t
\]

where \( a_1 = x_1 \) when \( y_{t-1} < y_{\text{threshold}} \) and \( a_1 = x_2 \) when \( y_{t-1} > y_{\text{threshold}} \).

The variables used in the empirical exercise are now defined and motivated.

**Characteristics of the dependent variables**

The dependent variables used in the empirical analysis are as follows:

- **Savings versus fixed deposits**—The pass-through of interbank funding conditions to these two key deposit rates could be influenced by important changes in the regulatory environment. In particular, the regulation on the LCR was introduced in 2015, under which banks are required to hold high-quality liquid assets (HQLA) against their projected total net cash outflows. As fixed deposits are considered a more stable source of funding than savings deposits, a greater reliance on fixed deposits reduces the required amount of HQLA for the same amount of funding. Considering that HQLA is lower-yielding than other assets, banks are likely to focus on raising more fixed deposits relative to savings deposits. This in turn suggests that greater competition could result in fixed deposit rates being more sensitive to changes in interbank funding conditions than savings deposit rates.

- **Mortgage Rates offered by local versus foreign banks**—The different funding models of local and foreign banks may have implications for their pricing of lending rates as interbank funding conditions fluctuate. Local banks are more dominant in the retail deposit business than foreign banks and rely less on the interbank market for funding. They also have a larger captive market in the domestic lending business. According, changes in interbank funding conditions may lead to relatively smaller adjustments in lending rates for local banks as their cost of funding is less sensitive to the movements in interbank funding conditions.

- **Mortgage Rates offered to private residential versus HDB flats**—Mortgage loans are for HDB public housing flats and private residential properties. The extent of adjustment

---

79 Only applicable to fixed deposits with remaining maturity of more than 30 days.

80 There could also be asymmetric responsiveness of the mortgage rate to a change in interbank funding conditions due to competition. When SIBOR increases (decreases), the competition to gain market share could lead to a more inelastic (elastic) lending rate. This is investigated in the later section.
in response to interbank funding conditions would provide information on the degree of competition among banks in these two segments of the market.

Role of the independent variables

The set of independent variables covers a broad range of domestic macroeconomic factors and industry drivers (such as market competition) that are expected to significantly affect the demand and supply of banks’ funding and lending. This would help inform whether the earlier postulations, including structural shifts in the banking landscape, can explain the observed changes in the behaviour of domestic interest rates and their responses to interbank funding conditions. The specific variables used in this study are described below, with the corresponding indicators shown in Table S4.2.

Table S4.2 List of determinants and proxy indicators used

<table>
<thead>
<tr>
<th>Category of determinant(s)</th>
<th>Proxy indicator used</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market competition</td>
<td>- Size of debt securities market</td>
<td>- BIS</td>
</tr>
</tbody>
</table>
|                           | - Market concentration | - Based on Herfindal-Hirschmann index (HHI)
| Financial regulation      | - Liquidity regulations | - Based on indices constructed
|                           | - Capital adequacy regulations | |
| Collateral value           | - Growth in private residential property prices | - Urban Redevelopment Authority (URA) |
|                           | - Growth in industrial property prices | |
| Liquidity buffer of the banking system | - LTD ratio | - MAS |
| Macroeconomic environment | - Unemployment rate | - Department of Statistics (DOS) |
|                           | - Rate of cessation of business entities | |
| Current credit quality     | - NPL ratios | - MAS |

Note: GDP, the inflation rate, the share of the working population as well as monthly earnings are included as additional independent variables to ensure robustness, but they were found to be statistically insignificant.

- **Market competition**—Financial deepening and a greater availability of alternative financial products offer borrowers and lenders more options, and could lead to increased competition for funding and lending (MAS, 1999; Saborowski and Weber, 2013) as well as asymmetric responses of deposit and lending rates to a change in interbank funding conditions. For example, banks decrease lending rates in response to a lower SIBOR to compete for market share but may not increase it to the same extent when SIBOR increases. Conversely, banks may pass through a larger extent of an increase in SIBOR to maintain their deposit base compared to a decline in SIBOR. These differential responses

---

81 HHI is computed by squaring the market share of each bank competing in the market (e.g. non-bank deposits) and then summing the resulting numbers, with the final HHI ranging from near 0 to 10,000. A larger HHI implies a more monopolistic market, with higher concentration and lower competition.

82 Indices are constructed to represent capital adequacy and liquidity regulations. When a tightening (loosening) of the regulation is implemented, the index increases (decreases) by 1.
between deposit and lending rates arising from market competition could lead to a negative effect of SIBOR increases on NIM (Jamaludin et al., 2015). The implications for competition and the pass-through to lending and deposit rates may also differ across local and foreign banks, depending on their funding models and mix of products. Growth in the debt securities market and a market concentration measure are used as proxies, respectively, for financial deepening and competition in the regressions.

- **Financial regulations**—A bank’s NIM could be adversely affected by regulations on liquidity ratios such as LCR. However, the literature on the impact of regulations on banks’ profitability is inconclusive. Stronger bank capitalisation and liquidity positions arising from tighter regulations could be positive for banks’ profitability, for instance through lower equity and loan losses (Jayaratne and Strahan, 1998; Naceur and Omran, 2011; Saunders and Schumacher, 2000; Islam and Nishiyama, 2016). Other studies (Almarzoqi and Naceur, 2015; Jamaludin et al., 2015) find that the impact of regulatory costs on interest rates is not statistically significant. To investigate the effects of financial regulations, indices representing a tightening of capital and liquidity regulations are constructed and used in the regression analysis.

- **Collateral values**—Collateralised lending is associated with lower lending rates given the lower credit risk for lenders (Calcagnini et al., 2014; Bellucci et al., 2021). For example, the median interest rate of new secured loans was estimated to be a third of that on new unsecured loans in Singapore (MAS, 2018). Should the value of collateral fall, lenders may charge a higher rate to reflect the increased market risk, in addition to reducing the amount of loan relative to the value of collateral. As real estate is most commonly used as collateral for lending, real estate prices are used as a proxy in the regressions.

- **Liquidity needs of the banking system**—The level of interest rates reflects the market-clearing price of liquidity. In the context of the banking system, the non-bank loan-to-deposit ratio can be viewed as an indicator of liquidity needs, which in turn affect the broader demand for deposits and supply of credit. For example, an increase in the ratio is expected to result in greater competition for deposits as banks increase liquidity to maintain regulatory ratios and ensure sufficient funds for payment and settlement.

- **Macroeconomic environment**—The pricing of credit and deposits is also influenced by the prevailing macroeconomic environment (proxied by the unemployment and business cessation rates), given its impact on demand for loans and banks’ funding. The effects of

---

The study focused on credit extended to small and medium-sized enterprises (SMEs) from Q2 2012 to Q2 2017, based on survey data gathered from local and foreign banks as well as finance companies in Singapore.

When lending to non-bank customers, a bank does not use its deposits for loans. Instead, the bank creates the loan, which is shown as an asset on its balance sheet, and credits the loan amount in the borrower’s account, which is reflected as deposits on the liabilities side of its balance sheet. However, the bank would need to have sufficient liquidity in its account with the central bank to meet the withdrawal of loan amount (as the borrower draws down the loan to make payment to other banks). It is also important to note that even if the borrower does not withdraw the deposit, the bank would still need to acquire sufficient liquid assets (via the central bank) to meet various regulatory requirements arising from a larger balance sheet. To this end, it would have to compete for deposits from the other banks or raise funding from capital markets in the absence of an injection from the central bank into the banking system.
such factors are also typically controlled for in other empirical studies (e.g. Jamaludin et al., 2015; Klein, 2020).

- **Credit quality**—Lending rates are also affected by credit risk, which is proxied by NPLs (Jamaludin et al., 2015).

**Data description**

Major FIs comprising a significant share of non-bank loans are selected for this study and assessed to be representative of the Singapore banking system. While the coverage of domestic interest rates is based on ten FIs, the investigation of NIM is narrowed down to only the local banks due to data unavailability.

The various regression equations are estimated on quarterly data over the period from 2004 Q3 to 2020 Q4 (an average of 67 observations for each regression). The analyses relating to mortgage rates cover a shorter period from 2013 Q2 to 2020 Q4 (31 observations), as the granular mortgage loan data necessary for the analysis are only available from more recent surveys.

**Empirical estimation and results**

**Main drivers of domestic interest rates and NIM**

Table S4.3 shows the key determinants of domestic interest rates and NIM based on the estimation of equation (1). Specifically, the Ordinary Least Squares (OLS) regression coefficient estimates of the independent variables are reported. As a robustness check, the regressions are also re-estimated using the US interest rate as an Instrumental Variable (IV), alongside the other explanatory variables. The results from this alternative specification (not reported here) are found to be similar to those presented below.

The empirical findings summarised in Table S4.3 affirm the role of SIBOR as a driver of domestic interest rates and NIM. There are also important heterogeneity effects observed across the deposit, prime and mortgage rates (discussed in the next section).

Among the various domestic interest rates, the savings deposit rate is the least responsive to changes in SIBOR. This is in line with the anecdotal observation that banks have little incentive to adjust deposit rates and compete for funds as market conditions change. Structurally, the flush global liquidity environment, as postulated earlier, could have

---

85 Augmented Dickey Fuller (ADF) unit root tests are conducted on all the dependent and independent variables. Where necessary, variables are differenced to ensure stationarity in the time series data.

86 The SGD SIBOR is a market rate and should approximate the sum of the US market interest rate and the expectation of SGD through the uncovered interest parity relationship. While the US market interest rate is exogenous to the Singapore economy, market expectations about the SGD is likely to be driven by domestic factors, among them, MAS’ monetary policy stance. To address potential endogeneity issues that could arise from the close association between the US interest rate and SIBOR, the former is used as an instrumental variable for SIBOR.

87 These funds are placed in the current and savings accounts (CASA), which allow on-demand withdrawal without any charges. On the part of the customers, there is strong inertia to shift deposits around in search of the highest rate, as they have to make administrative changes (such as a change in payment details for the crediting of salary) to enable the new account for daily transactions.
dampered the pass-through effect of a change in SIBOR, resulting in relatively stable and low savings deposit rates.

In comparison, changes in SIBOR appear to have the largest pass-through to the mortgage rate. Meanwhile, the sign of the coefficient in the regression for the prime lending rate is negative, which is less intuitive and may be attributed to a shift in pricing reference for loans to more directly reflect SIBOR.

Empirical results for NIM also suggest that it is relatively responsive to changes in SIBOR. This is consistent with the finding that banks adjust the mortgage rate to a larger extent than the savings deposit rate as funding conditions change. The estimate therefore implies that a rising interest rate environment is positive for banks.

Table S4.3 Estimated regression coefficients for Equation 1

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Indicator</th>
<th>Dependent variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Savings deposit rate</td>
</tr>
<tr>
<td>Market competition</td>
<td>Size of debt securities market</td>
<td>−0.023***</td>
</tr>
<tr>
<td>Market competition</td>
<td>Market concentration</td>
<td>−0.0001**</td>
</tr>
<tr>
<td>Liquidity needs of the banking system</td>
<td>LTD ratio</td>
<td>0.001***</td>
</tr>
<tr>
<td>Macroeconomic environment</td>
<td>Unemployment rate*</td>
<td>−0.006***</td>
</tr>
<tr>
<td>Macroeconomic environment</td>
<td>Rate of cessation of business entities</td>
<td></td>
</tr>
<tr>
<td>Credit quality</td>
<td>Overall non-bank NPL ratios##</td>
<td>0.008***</td>
</tr>
<tr>
<td>Credit quality</td>
<td>Mortgage NPL ratios</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>Liquidity regulations</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>Capital adequacy regulations</td>
<td></td>
</tr>
<tr>
<td>Collateral value</td>
<td>Growth in private residential property prices</td>
<td></td>
</tr>
<tr>
<td>Collateral value</td>
<td>Growth in industrial property prices</td>
<td></td>
</tr>
<tr>
<td>SIBOR##</td>
<td></td>
<td>0.009***</td>
</tr>
<tr>
<td>Standard error of regression</td>
<td></td>
<td>0.008</td>
</tr>
</tbody>
</table>

Notes:
1. "-" indicates that the estimated coefficient of the specified independent variable is not statistically significant.
2. *, ** and *** represent statistical significance at the 10%, 5% and 1% levels, respectively.
3. "#": The savings deposit rate is lower with a higher unemployment rate, as the attendant increase in precautionary savings leads to an increase in savings deposits.
4. "##": The prime lending rate is the only variable that declines with an increase in SIBOR.

The other salient findings on the determinants of domestic interest rates and NIM are set out below.
First, market competition matters in banks’ pricing of loans and NIM, with greater competition resulting in a decline of lending rates and NIM. This is not surprising given the liberalisation of Singapore’s banking sector since the 2000s and competition from the growing capital markets, which provide alternatives for funding and investments.

Second, the increased liquidity needs of the banking system result in an increase in the savings deposit rate. This is in line with the earlier expectation that banks compete to raise funding alongside a decline in their liquidity buffer, as proxied by an increase in the LTD ratio.

Third, lower credit quality mortgage loans, as proxied by higher NPLs, leads to an upward repricing of mortgage rates. To a lesser extent, credit quality is also assessed to be a driver of NIM and the savings deposit rate, with a lower credit quality associated with smaller NIM (given the larger credit losses) and a higher deposit rate (possibly reflecting higher risk aversion of depositors towards banks given the increased credit risk).

Fourth, additional regulations are associated with higher NIM even as the prior expectation was that NIM could be negatively impacted by the imposition of stiffer liquidity regulations. One possible explanation is that the additional regulations could have contributed to a more stable and safer financial and banking system, and less risky banks, thereby lowering the cost of funding for banks.

**Detailed results on the pass-through of SIBOR**

To provide further perspectives on the pass-through of SIBOR to domestic interest rates and NIM, Table S4.4 compares the results of the baseline regressions (equation 1), with the findings on asymmetric effects when subject to different market conditions (equation 2). Chart S4.5 then compares how NIM responds to SIBOR under different prevailing starting positions for NIM (equation 3).

---

88 The regression result shows that credit quality of the overall loan portfolio is also statistically significant, although the coefficient is negative. Separate regressions are carried out to better assess the impact of mortgage and overall NPLs on mortgage rates, respectively. In the absence of mortgage NPLs, the responses of mortgage rates are found to be statistically insignificant for overall NPLs. In the absence of overall NPLs, the responses of mortgage rates are found to be statistically significant, and positively associated with mortgage NPLs. These results suggest that the effects of mortgage NPLs on mortgage rates are more dominant than overall NPLs.

89 Credit quality of the overall loan portfolio is also statistically significant in the regression for the prime lending rate, although the coefficient is negative, i.e. an increase in the prime lending rate is associated with a lower NPL. This less intuitive finding could reflect the lack of data given the shift in pricing reference for loans to SIBOR. In addition, as the prime lending rate is offered to customers of good credit standing, there may not be instances of poor credit quality within this group of customers and hence, the upward repricing of lending rates for such customers.
Table S4.4 Pass-through of a 1 percentage point change in SIBOR to domestic interest rates and NIM

<table>
<thead>
<tr>
<th>Analysis type</th>
<th>Fixed deposit rate</th>
<th>Savings deposit rate</th>
<th>Prime lending rate</th>
<th>Mortgage rate (Private)</th>
<th>NIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on equation (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-asymmetric analyses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-run impact of a 1% pt change in SIBOR</td>
<td>0.036**</td>
<td>0.009***</td>
<td>−0.010**</td>
<td>0.389***</td>
<td>0.024***</td>
</tr>
<tr>
<td>Long-run impact of a 1% pt change in SIBOR</td>
<td>0.260**</td>
<td>0.042***</td>
<td>−0.030***</td>
<td>0.646***</td>
<td>0.176***</td>
</tr>
<tr>
<td>Based on equation (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetric analyses (short-term impact)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 1% pt increase in SIBOR</td>
<td>0.011**</td>
<td>0.003**</td>
<td>−0.003</td>
<td>0.015</td>
<td>0.011*</td>
</tr>
<tr>
<td>A 1% pt decrease in SIBOR</td>
<td>0.029***</td>
<td>0.007***</td>
<td>−0.006**</td>
<td>0.357***</td>
<td>0.019***</td>
</tr>
<tr>
<td>High SIBOR</td>
<td>0.016**</td>
<td>0.006*</td>
<td>0.001</td>
<td>0.035</td>
<td>−0.021</td>
</tr>
<tr>
<td>Low SIBOR</td>
<td>0.015</td>
<td>0.001</td>
<td>−0.010**</td>
<td>0.335***</td>
<td>0.049</td>
</tr>
</tbody>
</table>

Notes:
1. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.
2. For a 1% pt in decrease in SIBOR, a positive coefficient means that the specific rate has fallen with SIBOR.
3. The long-run impact of the regressors are derived by summing the contemporaneous and lagged coefficients.

As noted above, the baseline results for the lending rates show that the pass-through of SIBOR to the prime lending rate is much lower than that for mortgage rates. Specifically, the pass-through to the prime rate is close to zero, while the corresponding effect on mortgage rates shows an increase of 39bps and 65bps in the short run and long run respectively, following a 100bps change in SIBOR.

The empirical results confirm the earlier observation of a structural shift in the relationship between the prime lending rate and SIBOR, with the latter having a minimal impact on the prime lending rate since 2004. As mentioned earlier, this could be due to the changes in bank practices that reduced the referencing of the prime lending rate, while a sizeable share of mortgage loans is referenced off SIBOR directly. The credit assessment of mortgage loans has also become more standardised across banks, given the prudential measures introduced over the past decade, resulting in more uniform financing based on borrower profiles. To compete for market share, banks may have to offer competitive loan packages as broader market funding conditions shift.

There is also evidence of asymmetric effects associated with the level of, and the direction of a change in, the mortgage rate. Specifically, when SIBOR is at low levels, a 100bps change in SIBOR is associated with a larger response in the mortgage rate (compared to the statistically insignificant change when SIBOR is at relatively higher levels). In situations where SIBOR falls, the extent of decline is larger and statistically significant relative to an increase in SIBOR. A possible interpretation of these asymmetric effects is the presence of stronger competition for mortgage loans as banks seek to maintain their NIM with a greater volume of loans amid a low or falling interest rate environment. This is further facilitated by the relative

---

90 The short- and long-run coefficients provide estimates of the extent of pass-through across the different horizons.
ease of refinancing between banks in the Singapore mortgage loan market whereby borrowers can typically pay a nominal fee and switch providers after fulfilling a lock-in period of about 1–2 years. The transparency in mortgage rate packages offered by various banks and the presence of independent mortgage brokers also lower information asymmetry between borrowers and banks, which further enhances market competition.

Turning to the savings deposit rate, the baseline results show a small pass-through of the SIBOR. Asymmetric effects, where present, are also negligible in terms of the size of the impact. The findings support the earlier inference that banks have little incentive to adjust the savings deposit rate. To assess if this holds for all type of deposits, the analysis is extended to the fixed deposit rate, which shows relatively stronger baseline and asymmetric responses. This suggests that banks are likely to actively re-price their fixed deposits by a greater extent in response to market funding conditions, this could be because fixed deposits are considered a more stable source of funding compared to savings deposits under the existing liquidity regulations. Depositors are also likely to be actively seeking the highest fixed deposit rate by comparing various rates in the market, leading to a greater response in such rates relative to the savings deposit rate.

Nevertheless, the overall magnitudes of the various responses are still relatively small, reflecting the structural liquidity surplus of the banking system. In terms of the asymmetric adjustments, both savings and fixed deposit rates increase by a smaller extent when the SIBOR increases, compared to a decline in response to a fall in SIBOR. Such asymmetric pricing behaviour reflects the profit-maximising behaviour of banks, as they attempt to reduce the funding from savings and fixed deposit rates amid a broader easing in the interest rate environment, and refrain from paying up for deposits when SIBOR increases.

Finally, the results for NIM in Table S4.4 confirm that a rising interest rate environment is positive for banks’ profitability, as banks re-price their loans (as proxied by mortgage rates) higher to a larger extent compared to deposits. However, the tests for asymmetric effects suggest that the negative impact on NIM could be larger when SIBOR falls. This is consistent with the other finding on an asymmetric effect for mortgage rates whereby banks cut their lending rates by a larger extent, again possibly associated with competition effects. While deposit rates are also lower (by a greater extent relative to its increase when SIBOR rises), the magnitude, as shown by the coefficient of the asymmetric effect, is too small to mitigate the impact of the decline in lending rates on NIM. Competition for funding could have also limited the decline in the savings deposit rate in this instance.

---

91 As a close alternative to savings deposits, Singapore Savings Bonds (SSB), which are issued by the Singapore Government, provide higher returns that track market conditions closely. Investors can redeem the SSB in any given month, with no penalty for exiting the investment early. There is also no market risk as investors will get back the full principal amount plus interest accrued upon withdrawal or maturity. The minimum amount of investment each time is SGD500, and the maximum holding is capped at SGD200,000. Please refer to the SSB website for more information: [https://www.mas.gov.sg/bonds-and-bills/Singapore-Savings-Bonds](https://www.mas.gov.sg/bonds-and-bills/Singapore-Savings-Bonds).
The starting position of the NIM also matters for the impact of a change in SIBOR. Results based on the threshold regression specification in equation (3) suggest that NIM is more correlated with a change in SIBOR when the initial NIM is at a low level (Chart S4.5). Specifically, the response of NIM to a change in the interbank rate is about three times higher at low NIM levels (<1.8%) than high NIM levels (≥1.8%). This implies that banking sector profitability is more sensitive to fluctuations in SIBOR when profitability is already low. Under such a scenario, there is a need for increased surveillance and vigilance on the drivers of banks’ NIM given the broader implications for the resilience of the banking system. It is also important to monitor closely the non-interest income components, as such sources could help to offset the impact of a decline in NIM on the overall profitability of banks.

**Further analysis of mortgage rates’ association with SIBOR**

This section delves further into the association of mortgage rates with SIBOR based on whether loans extended by FIs are: (i) for the purchase of HDB flats or private residential properties; and (ii) provided by local or foreign banks.

The results in Table S4.5 suggest that in the short run, the change in mortgage rates for HDB and private residential property loans are similar at around 28bps in the event of a 100bps change in SIBOR. Over the long run, the pass-through for both types of property loans rises further, with private residential properties mortgage rates increasing by a larger 65bps, compared to 41bps for HDB rates.
Table S4.5 Pass-through of a 1 percentage point change in SIBOR to mortgage rates

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Horizon</th>
<th>Non-asymmetric analyses</th>
<th>Asymmetric analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>↓ 1%pt in SIBOR</td>
<td>↑ 1%pt in SIBOR</td>
</tr>
<tr>
<td>HDB</td>
<td>Short-run</td>
<td>0.370***</td>
<td>−0.024</td>
</tr>
<tr>
<td>Private residential properties</td>
<td>Short-run</td>
<td>0.389***</td>
<td>0.015</td>
</tr>
<tr>
<td>HDB</td>
<td>Long-run</td>
<td>0.411***</td>
<td>−0.027</td>
</tr>
<tr>
<td>Private residential properties</td>
<td>Long-run</td>
<td>0.646***</td>
<td>0.027</td>
</tr>
</tbody>
</table>

Notes:
1. ***,** and * represent statistical significance at the 1%, 5% and 10% levels, respectively.
2. For “↓ 1% pt in SIBOR”, a positive value reflects that the rates have fallen with SIBOR.

The greater long-term responsiveness of the mortgage rate for private residential properties could reflect a more competitive market for such loans. Banks may be adjusting their rates further beyond the initial impact of the decline in cost of funding, given that private residential property loans are typically larger in size and therefore, potentially more profitable. Mortgage loans for HDB flats could also be more sticky, as they have a higher hurdle cost to re-finance with another bank, especially when loans are paid down over time, and loans do not fulfil the minimum loan quantum for the waiver of legal and valuation fees.92 Tests for asymmetric effects also support the inference of stronger competition in mortgage loans for private residential properties. The changes in mortgage rates are statistically significant for a 100bps decline in the interbank rate, with the rate on private residential properties showing a larger decline in the long run.93

With regard to the mortgage rates offered by local and foreign banks, there are significant asymmetric effects amid a decline in the interbank rate (Chart S4.6). Foreign banks’ mortgage rates for both private residential and HDB properties fall by a larger 43bps, compared to the 14–26bps for local banks, in response to a 100bps decrease in SIBOR. This could reflect foreign banks competing aggressively for mortgage loan share in both markets with the local banks. That said, the results are restricted to the adjustment of mortgage rates with respect to changes in interbank funding conditions94, which is only one aspect of FIs’ overall pricing decision.

---

92 Legal and valuation fees typically range from SGD2,000 to SGD3,000.
93 While the coefficients for the mortgage rates are not statistically significant under the scenario of a 100bps increase in SIBOR, this does not imply that banks will not raise their rates. The results could be reflective of a sample period that was dominated by episodes of declines in SIBOR and mortgage rates.
94 The findings should not be construed as the setting of FIs’ final rates charged on borrowers.
Chart S4.6 Compared to local banks, foreign banks are more competitive in pricing their mortgage loans amid a decline in SIBOR

Pass-through of a 1 Percentage Point Decrease in SIBOR to Mortgage Rates for Private Residential and HDB Properties by Local and Foreign Banks

Source: MAS estimates

Notes:
1. Local banks refer to DBS, UOB and OCBC, and foreign banks refer to all other banks.
2. Results are significant at the 1% level.

Sum-up

The drivers of domestic interest rates have evolved significantly with the structural developments in the banking industry. The empirical findings in this Feature suggest that these structural drivers, in addition to conjunctural factors, are key determinants of domestic interest rates. In particular, competition among banks matters in their asymmetric pricing of interest rates, including the extent of pass-through of interbank funding conditions across different market conditions, and for both loans and deposits.

The study also examined the drivers of NIM, given the broader nexus between banks’ capital buffer and resilience to shocks. Two key findings emerged. First, a rising interest rate environment is positive for banks’ NIM and hence their overall profitability, reflecting the positive differential in the pass-through for lending and deposit rates. Second, banks with low NIM are more susceptible to larger declines in NIM when interbank funding conditions loosen. This would happen if the competition-induced decline in lending rates outpaces the softening in deposits rates. This finding highlights the need for increased surveillance of the implications for banks’ NIM when interest rates fall, and more generally for profitability in a low interest rate environment.

Finally, the shift toward more transparent market-based interest rates as references in lending products implies that the prime lending rate has become significantly less relevant as an indicator of lending conditions. At the same time, the relationship between market-based reference rates, lending conditions and NIM bears further watching as SORA will soon replace...
SOR and SIBOR as the main domestic interest rate benchmark. SOR and SIBOR will be discontinued immediately after 30 June 2023 and 31 December 2024, respectively. The transition has gathered pace in recent months. D-SIBs in Singapore started to offer a full suite of SORA-based products to their customers from February 2021, with other banks doing the same from end-April 2021. All FIIs also ceased usage of SOR and SIBOR in new contracts by September 2021. MAS will continue to monitor developments in the domestic interest rate space closely, as loan products are increasingly priced off SORA.

References


Monetary Authority of Singapore (2018), Financial Stability Review.


Except for purposes of risks management and transition of legacy exposures.
Data Annex

Impact of Recent Regulatory Revisions on Banking Sector’s Indicators

Changes to indicators on the banking sector

Banking sector regulatory framework has undergone two major changes

On 1 July 2021, MAS implemented two major changes to its banking sector regulatory framework, namely (i) revisions to the MAS Notice 610 to banks and the MAS Notice 1003 to merchant banks (the MAS 610/1003), and (ii) the removal of the Domestic Banking Unit – Asian Currency Unit (DBU-ACU) divide. These changes, which have had implications for regulatory reporting requirements, were implemented following MAS’ review of developments in the regulatory landscape as well as feedback obtained from industry consultations in 2015 and 2017. The revised reporting requirements will (i) keep pace with international accounting standards and reporting requirements, (ii) better address MAS’ supervisory and surveillance needs and (iii) streamline regulatory reporting by consolidating multiple data collection efforts.

MAS estimated historical data for comparability and to monitor trends

To ensure continuity in key indicators for surveillance purposes, MAS estimated the revised “historical” data for the new MAS 610/1003 based on trends observed in the old MAS 610/1003. This estimation process drew on data collected during the “parallel run” of the old and the new MAS 610/1003, where banks and merchant banks were required to submit data under both the old and new Notices. Methodologically, MAS employed estimation techniques that were in line with international best practices, and worked to ensure data consistency by observing accounting identities. In addition, MAS sought to maximise data usability by estimating levels data, as it would enable other parameters of interest (such as growth rates and ratios) to be derived.

Revised data for the historical period were not estimated for indicators that relied on DBU activity as a proxy for resident transactions, such as DBU non-bank loans by sector. This is because the correlation between DBU and resident activity had progressively weakened over the years, making it difficult to derive a stable relationship to conduct estimations.

Similarly, revised data for the historical period were not estimated for indicators that relied on ACU activity as a proxy for non-resident transactions, as the relationship between ACU and non-resident activity had also weakened. Regulatory developments had reduced the
relevance of the DBU-ACU divide; at the same time, banks had concentrated new resident and non-resident businesses in DBU for operational efficiency.

Historical estimations were not carried out for credit quality indicators such as the overall NPL ratio, the NPL ratio by sector, and the provisioning coverage ratio. This is because there are changes in the measure of NPLs, as well as the classification of sectors and eligible collaterals. For instance, the new MAS 610/1003 distinguishes between NPLs and other non-performing assets, whereas the old MAS 610/1003 used total non-performing exposures as a measure of NPLs. For the classification of sectors, the new MAS 610/1003 states that accounts should be classified based on the principal activity of the immediate borrower, while the old MAS 610/1003 classified accounts based on the end use or purpose of the loan.

**Refinement of banking sector indicators**

The new MAS 610/1003 features clearer and more precise data definitions and enables more granular data collection. This has allowed MAS to refine the computation of several indicators, to more accurately reflect the underlying risk that each indicator seeks to capture. The following section presents a description of computational revisions for key indicators in the FSR chart panels.

**Credit indicators**

Overall credit aggregates are generally lower under the new MAS 610/1003. This is largely due to the exclusion of placements with central banks, as such placements are primarily meant for money market operations and hence are not representative of credit to the broader economy. The exclusion of placements with central banks has been reflected in the interbank loans series (see Chart Panel 4A “Banking Sector: Credit Growth Trends”, Chart 4A1 and Chart Panel 4B “Banking Sector: Cross-border Lending Trends”, Chart 4B2).

The computation of non-bank loans has been refined to reflect credit to non-banks more accurately, by excluding bills discounted or purchased with banks. This exclusion was made possible as the new MAS 610/1003 distinguishes between lending to banks and non-banks for bills discounted or purchased. Since bills discounted or purchased largely comprise import and export bills meant for trade, this has impacted the non-resident non-bank loans series (see Chart Panel 4A “Banking Sector: Credit Growth Trends”, Chart 4A2 and Chart Panel 4B “Banking Sector: Cross-border Lending Trends”, Chart 4B1).

In addition, trade financing in non-bank loans is more accurately captured under the new MAS 610/1003 as a result of clearer definitions. Trade financing now specifically includes factoring loans, trust receipts, buyers’ credit, forfaiting, invoice financing and other facilities for the purpose of trade financing to non-banks (see Chart Panel 4A “Banking Sector: Credit Growth Trends”, Chart 4A4).
Liquidity indicators

Non-bank deposit aggregates are generally higher under the new MAS 610/1003, largely due to the inclusion of deposits from central banks. This revised definition allows MAS to more comprehensively capture sources of funding that banks can tap on to support their lending and liquidity needs. Consequently, the LTD ratios are lower, consistent with the higher levels of non-bank deposits (see Chart Panel 4C “Banking Sector: Asset Quality and Liquidity Indicators”, Charts 4C3 and 4C4).

Asset quality indicators

Provisioning coverage ratios are generally lower under the new MAS 610/1003, as updated definitions and guidelines resulted in a higher level of unsecured NPLs. Specifically, the assessment criteria of secured NPLs was amended to exclude bank or government guarantees, to better reflect the underlying risk profiles of such exposures (see Chart Panel 4C “Banking Sector: Asset Quality and Liquidity Indicators, Chart 4C2).

Conclusion

The revision of the MAS 610/1003 has provided MAS with the opportunity to enhance data collection as the new regulatory reporting requirements are accompanied by greater definitional clarity and granularity of data reported. Due to the collective efforts of the industry, MAS has been able to augment the indicators to better reflect risks in Singapore’s banking system.