



SINGAPORE

FINANCIAL SYSTEM STABILITY ASSESSMENT

July 2019

This paper on Singapore was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on June 24, 2019.

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KEY ISSUES

Context: Singapore is a small and very open economy and a major financial center. The financial system is highly integrated into international financial markets and serves as an important regional financial hub. After a period of subdued economic activity, growth accelerated in 2017–18, but is expected to moderate in 2019. To strengthen long-term growth prospects, amid population aging, the government is pursuing a strategy to transform the economy by harnessing emerging digital technologies. In the financial services area, this strategy has put Singapore at the forefront in fintech.

Findings: The financial system is exposed to global and regional macrofinancial shocks through significant trade and financial channels but appears resilient even under adverse scenarios. However, banks' U.S. dollar liquidity is vulnerable to stress conditions. Fintech developments so far have focused on partnerships with existing financial institutions and do not appear to contribute significantly to systemic risk. Still, as in other advanced economies, the expansion of fintech poses challenges to financial oversight. The Monetary Authority of Singapore (MAS) has managed to strike a good balance between promoting financial innovation and preserving financial stability, investor protection, and financial integrity.

Policies: Singapore authorities should continue to enhance its strong oversight of the financial system. Given the importance of dollar funding and liquidity for Singapore's banks and the economy more broadly, strengthening banks' U.S. dollar liquidity should be a priority for the MAS. Moreover, to minimize potential reputational risk, the MAS should remain vigilant of the balance between supervision and the promotion of financial innovation. This could entail formalizing and clarifying that MAS may require prenotification of material outsourcing arrangements if the MAS is not satisfied that a bank has managed its outsourcing risk adequately. Strengthening the framework for resolution and safety nets, namely by devoting more resources to the MAS' Resolution Unit; and enhancing the oversight of MAS Electronic Payments System by ensuring more staffing resources are two other important areas for action.

- The FSAP team was led by Ulric Eriksson von Allmen (Mission Chief) and Luis Brandao-Marques (Deputy Mission Chief) and included Romain Bouis, Alan Feng, Eija Holttinen, Heedon Kang, Tanai Khiaonarong, Galen Sher, and Christopher Wilson, (all MCM), Jiae Yoo (APD), and Richard Gresser and David Hoelscher (experts). Nadine Schwarz (LEG) and Jochen Schmittmann (IMF resident representative in Singapore) contributed to the team’s work. At headquarters, Stephanie Ng and Kiran Sastry provided research support and Margarita Aguilar and Vanessa Guerrero provided administrative and editorial assistance. The mission met Monetary Authority of Singapore (MAS) Managing Director Ravi Menon, MAS senior officials and staff, officials from the Ministry of Finance and the Ministry of National Development, academics, and representatives of the private sector.
- FSAPs assess the stability of the financial system as a whole and not that of individual institutions. They are intended to help countries identify key sources of systemic risk in the financial sector and implement policies to enhance its resilience to shocks and contagion. Certain categories of risk affecting financial institutions, such as operational or legal risk, or risk related to fraud, are not covered in FSAPs.
- Singapore is deemed by the Fund to have a systemically important financial sector according to SM/10/235 (9/16/2010), and the stability assessment under this FSAP is part of bilateral surveillance under Article IV of the Fund’s Articles of Agreement.
- This report was prepared by Ulric Eriksson von Allmen and Luis Brandao-Marques with contributions from the FSAP team.

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This report was prepared in the context of the Financial Sector Assessment Program (FSAP) missions held in Singapore during October 29–November 14, 2018 and February 13–27, 2019, led by Mr. Ulric Eriksson von Allmen. The FSAP findings were also discussed with the authorities during the Article IV consultation mission in May 2–14, 2019.

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Glossary

AML/CFT	Anti-Money Laundering/Combating the Financing of Terrorism
ASEAN	Association of Southeast Asian Nations
BIS	Bank for International Settlements
CCPs	Central Counterparties
CPSS	Committee on Payment and Settlement Systems
D-SIB	Domestic Systemically Important Bank
FATF	Financial Action Task Force
FMI	Financial Market Infrastructure
FSAP	Financial Sector Assessment Program
FSI	Financial Soundness Indicators
FSSA	Financial System Stability Assessment
FX	Foreign Exchange
GDP	Gross Domestic Product
G-SIB	Global Systemically Important Bank
IOSCO	International Organization of Securities Commissions
LCR	Liquidity Coverage Ratio
LTV	Loan-to-Value
MAS	Monetary Authority of Singapore
MEPS+	New MAS Electronic Payments and Book-Entry System
ML/TF	Money Laundering/Terrorist Financing
NPL	Nonperforming loan
NSFR	Net Stable Funding Ratio
PFMI	Principles for Financial Market Infrastructures
RAM	Risk Assessment Matrix
SGD	Singapore Dollar
STeM	Stress Testing Matrix
USD	U.S. Dollar

EXECUTIVE SUMMARY

As a financial center, Singapore is exposed to regional and global shocks. Global and regional shocks, such as a decline in growth in key emerging markets or heightened volatility in global capital markets, would have a significant effect on banks in Singapore and the rest of the financial system. Moreover, given the size and interconnectedness of the financial system, especially with the rest of Asia, such shocks could have a major impact not only on Singapore but also on the financial systems in the region. Financial stability in Singapore is thus a regional public good.

The attractiveness of Singapore as a financial center is underpinned by strong economic fundamentals, sound economic policies, and a sophisticated financial oversight framework. A credible macroeconomic policy framework, robust public finances, and ample international reserves constitute important buffers to cope with shocks. Through the proactive use of macroprudential policy, the Monetary Authority of Singapore (MAS) has demonstrated its ability and willingness to act to suppress emerging threats to financial stability. More broadly, the strong framework for financial oversight has been enhanced further in recent years.

The MAS and the Singapore Government have implemented many reforms to address the recommendations of the 2013 FSAP (Appendix I). Notably, the MAS has clarified its mandate, through amendments to the MAS Act, that in the event of conflicts between its prudential supervision and development objectives, the former prevails. Other important reforms include the implementation of Basel III capital and liquidity requirements and enhancements to the framework for crisis resolution and safety nets. Building on this progress in financial sector reform, the next steps should focus on enhancing the resolution framework, including by extending the new bail-in powers to senior unsecured creditors, strengthening the MAS' Resolution Unit, and by developing guidelines and playbooks for the new resolution tools. It would be important to ensure more resources for the oversight of the New MAS Electronic Payments and Book Entry System (MEPS+).

The main parts of the financial system appear resilient even under adverse scenarios. The financial health of major banks in Singapore—in particular, their sizeable capital buffers and strong profitability—allows them to absorb the sharp increase in credit losses in severe but plausible scenarios of the FSAP's solvency stress tests. Similarly, insurance companies have strong capital positions, though stress tests point to vulnerabilities in parts of the sector.

However, banks' overall liquidity position is mixed—domestic currency liquidity is comfortable, but U.S. dollar liquidity is vulnerable to stress conditions. Banks prudently rely mostly on deposits for funding. However, the system-wide loan-to-deposit ratio in foreign currency remains high at 128 percent though it has declined for the largest banks. The results of the FSAP's cashflow stress tests confirm the vulnerability in U.S. dollar liquidity. Given the importance of dollar funding and liquidity for Singapore's banks and economy, strengthening banks' foreign exchange liquidity should be a priority.

Singapore has also become an important hub for financial innovation, under the firm and proactive guidance and support of the MAS. Fintech developments so far have focused on partnership with—rather than disruptions to—existing financial institutions or on serving markets outside of Singapore. The MAS has managed to strike a good balance between promoting financial innovation and preserving financial stability, investor protection, and financial integrity, but this is a challenge that will require continued vigilance, not least to minimize potential reputational risk. One area where the balance between supervision and the promotion of financial innovation could be improved is in the requirement of prenotification of material outsourcing arrangements if the MAS is not satisfied that a bank has managed its outsourcing risk adequately.

Financial innovation has amplified the risk of cyber events and the MAS is at the forefront in international efforts to reinforce cyber resiliency. The 2018 Cybersecurity Act promotes cyber security, and all banks are taking steps to strengthen their computer systems. Mitigating and staying ahead of the risks in this rapidly evolving area will remain an analytical and policy challenge for policymakers and regulators, including in Singapore.

Recommendations	Time*
The MAS should strengthen U.S. dollar liquidity among D-SIBs. (¶135)	MT
Establish a core staff within the MAS Resolution Unit (RSU) dedicated to resolution work and over time, transfer resolution planning to the RSU. (¶154)	I
Expand the scope of bail-in to include senior unsecured debt securities. (¶154)	MT
Continue to develop guidelines and playbooks for the new resolution tools. Staff should be trained, and processes tested. (¶154)	I
The MAS should formalize and clarify that it may require pre-notification of material outsourcing arrangements where the MAS is not satisfied that a bank has managed its outsourcing risk adequately. (¶141)	MT
Devote more resources to the oversight and supervision of the payments systems. (¶138)	NT
Enhance the cyber resiliency of the central bank and MEPS+ by: (i) clarifying the role of Chief Cyber Security Officer; and (ii) continuing to strengthen its cybersecurity resiliency. (¶148)	I
Develop a cyber network map that takes into account both financial linkages and Information and Communications Technology connections and use it for cyber risk surveillance. (¶147)	MT
* "I-Immediate" is within one year; "NT-near-term" is 1–3 years; "MT-medium-term" is 3–5 years.	

SCOPE OF THE FSAP

1. This FSAP assesses the soundness and resilience of Singapore’s financial system with a focus on cross-border linkages and fintech. The 2013 FSAP undertook a comprehensive and detailed assessment of Singapore’s financial system and its oversight and found the Monetary Authority of Singapore’s (MAS) supervision and regulation to be very strong. The 2019 FSAP follows up on the findings and recommendations of the 2013 FSAP and takes a deep look at risks related to the financial system’s cross-border links and the challenges posed by current and prospective financial innovation. This focus is warranted by Singapore’s role as a financial center, and the country’s emerging and rapidly evolving fintech sector that is being actively promoted and supported by the MAS. In addition to a focused assessment of bank regulation and supervision, the FSAP pays special attention to two areas where standards have evolved considerably since the last FSAP: financial markets infrastructures, where it undertakes a detailed assessment of MAS’ and the new MAS Electronic Payments and Book-Entry System’s (MEPS+) compliance with the Principles for Financial Market Infrastructures (PFMI); and crisis management and resolution.

A FINANCIAL HUB IN ASIA...

A. Extensive Cross-Border Links

2. Singapore is a very open economy and an important global and regional economic and financial hub. The financial sector has extensive cross-border linkages, especially to countries in Asia and through dollar funding markets. The largest components of the financial system are banks (with assets equal to about 600 percent of GDP), asset management firms (with assets under management also equal to 701 percent of GDP), and insurance companies (with assets equal to 55 percent of GDP) (Table 2). The asset management industry—which offers mostly traditional fund products—caters mainly to foreign investors and invests primarily outside of Singapore and, therefore, does not appear to be a significant source of domestic systemic risk. For banks, the share of cross-border lending exposures stands at about 60 percent of total exposure, more than half of which is to emerging Asia. As a regional financial center, Singapore intermediates credit from advanced economies to emerging markets in Asia and the bulk of cross-border lending is denominated in U.S. dollars, some of which includes funding from parent banks to foreign branches and loans extended by these to corporates from their country of origin.

3. Singapore’s significant external linkages expose the financial system to cross-border spillovers, and Singapore is a potential source of contagion to the region. Although, at the aggregate level, cross-border exposures can improve the diversification of risk by the financial system, they can also increase its exposure to external financial shocks. In Singapore, although a large share of funding is cross-border in nature, three-quarters of interbank funding is within banking groups and reflects the large presence of foreign subsidiaries and branches (Figure 1). This intragroup funding worked as a stabilizing factor for some foreign branches and subsidiaries

Table 2. Singapore: Financial Sector Structure (2013-2018)

(In billions of Singapore dollars)

	2013			2018Q2		
	Number	Total Assets	In percent of GDP	Number	Total Assets	In percent of GDP
Commercial banks	124	2,147.9	564	128	2,644.9	569
Local Banks	5	719.6	189	4	982.7	211
Foreign Banks	119	1,428.3	375	124	1,662.2	358
Merchant Banks	41	84.9	22	29	86.5	19
Finance Companies	3	15.0	4	3	16.9	4
Insurance Companies	171	169.8	45	176	254.5	55
Direct Insurers	76	153.4	40	76	225.4	48
Life Insurers	16	72.3	19	16	119.7	26
General Insurers	56	11.5	3	53	13.8	3
Composite Insurers	4	69.6	18	7	91.8	20
Reinsurers	31	13.3	3	31	25.1	5
Captive insurers	64	3.1	1	69	4.1 2/	1
Insurance Brokers	67	2.0	1	80	2.8 2/	1
Central Provident Fund 1/	1	255.6	67	1	363.2 2/	78
Holders of CMS license	295	44.8	12	694	66.9 2/	14
Brokers-Dealers	97	36.6	10	134	51.0 2/	11
Licensed Fund Managers	158 5/	7.1	2	497	13.4 2/	3
Others 7/	40	1.1	0	63	2.5 2/	1
Holders of Financial Advisers Licenses	58	0.3	0	64	0.5 2/	0
Licensed Trust Companies	51	0.3	0	58	0.4 2/	0
Asset Management Firms (AUM) 4/	553 6/	1,818.0 3/	477	715 2/	3,260 2/,3/	701
Discretionary AUM	.. 10/	955.0 3/	251	.. 10/	1,735 2/,3/	373
Advisory AUM	.. 10/	863.0 3/	227	.. 10/	1,525 2/,3/	328
Memo:						
Domestic Systemically Important Banks	- 11/	- 11/	- 11/	12	1,390.5 8/	299
Local D-SIBs	- 11/	- 11/	- 11/	4	982.7	211
Foreign D-SIBs	- 11/	- 11/	- 11/	8	407.8	88
Foreign Banks	119	1,428.3	375	124	1,662.2 9/	358
Foreign subsidiaries	2	69.8	18	4	95.7	21
Foreign branches	117	1,358.4	357	120	1,566.5	337
Nominal GDP		381.0	100		464.9 2/	100

Sources: MAS; Haver; and IMF staff calculations.

1/ Data from the Central Provident Fund.

2/ Data for 2017.

3/ Based on annual Singapore Asset Management Survey for 2013 and 2017. Financial Institutions surveyed and responded include Banks, Capital Markets Services licensees and other financial sector entities conducting asset management activities.

4/ AUM = Assets under management.

5/ As at March 31, 2013.

6/ Registered and licensed fund managers.

7/ Other holders of CMS license comprise real estate investment trust managers, credit rating agencies, and corporate finance advisers.

8/ The MAS has designated three local banking groups and four foreign banking groups as D-SIBs in April 2015, which comprise twelve individual D-SIB entities.

9/ Foreign banks include foreign D-SIBs.

10/ Data not available.

11/ Not reported.

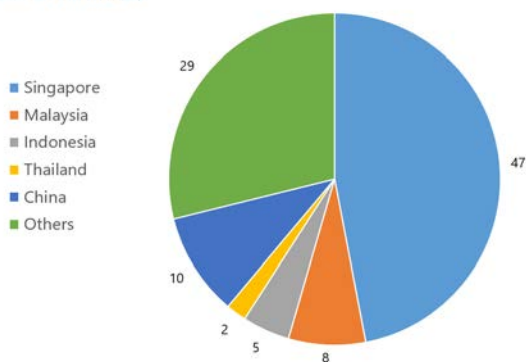
during past crises. The network analysis of cross-border bank lending (Figure 2) suggests that Singapore is most exposed to potential inward spillovers from major advanced economies, namely Japan, Hong Kong SAR, and the United States, while spillovers from Singaporean banks would primarily affect other Association of Southeast Asian Nations (ASEAN) countries. A complementary analysis using equity return volatility suggests bank stress in Singapore is correlated with bank stress in China, Hong Kong SAR, and ASEAN (Figure 3). Domestic unrelated interbank exposures are small.

Figure 1. Cross-border Linkages of the Banking System

ASEAN-5 and Greater China account for most cross-border lending.

Lending of Local D-SIBs by Country

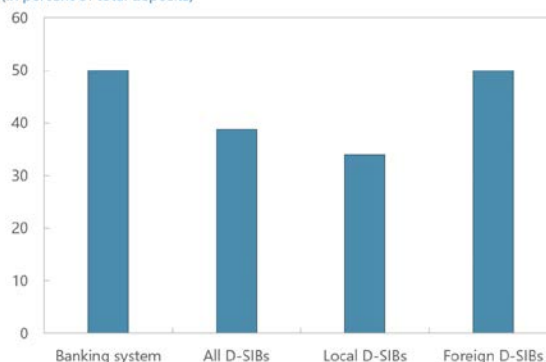
(In percent, as of 2018Q2)



Foreign currency denominated deposits comprise about 40 percent of D-SIBs' funding.

Share of Foreign Currency Denominated Deposits

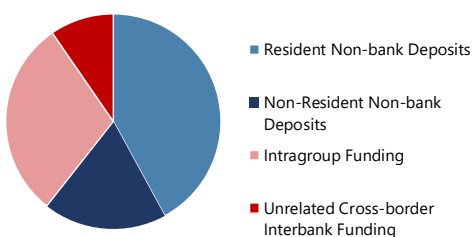
(In percent of total deposits)



Note: Deposits account for about 80 percent of total liabilities of D-SIBs.

Intragroup funding represents a large share of interbank funding...

Banking System Funding by Residency, Q3



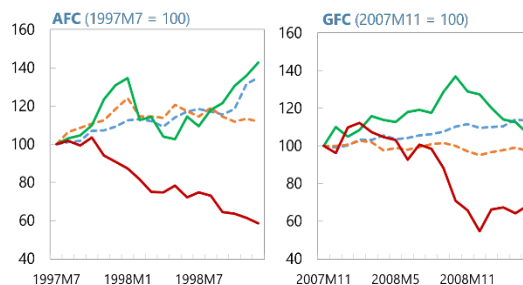
Note: Totals do not include unrelated domestic interbank funding which is very small.

Source: MAS.

... and tends to be stabilizing during stress periods.

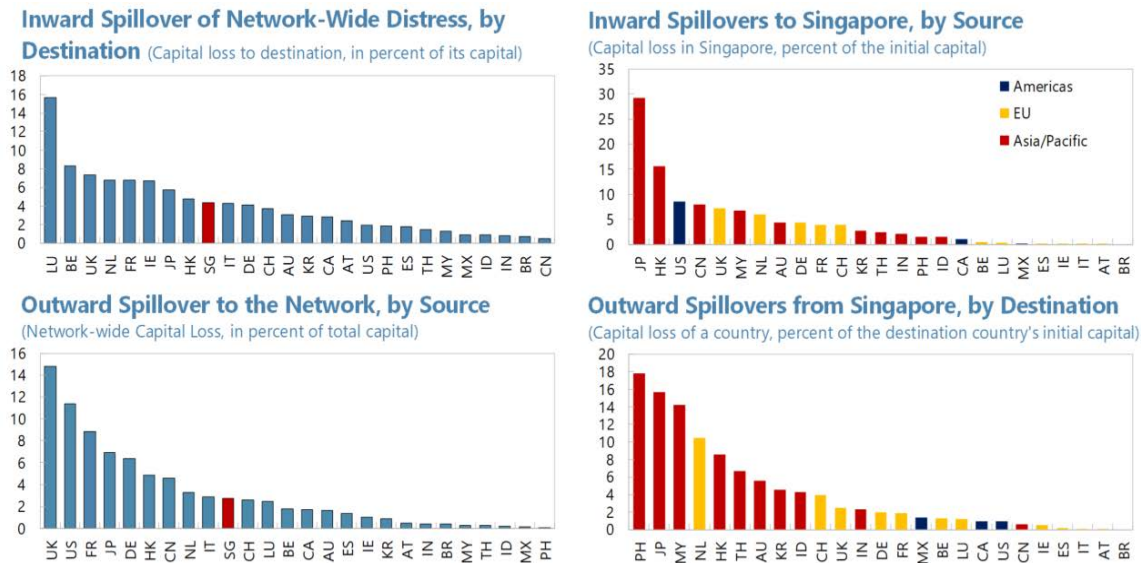
Banking System Funding Trend during Crisis Periods

Legend: Resident Non-bank Deposits (dashed blue), Non-Resident Non-bank Deposits (dashed orange), Intragroup Funding (solid green), Unrelated Cross-border Interbank Funding (solid red).



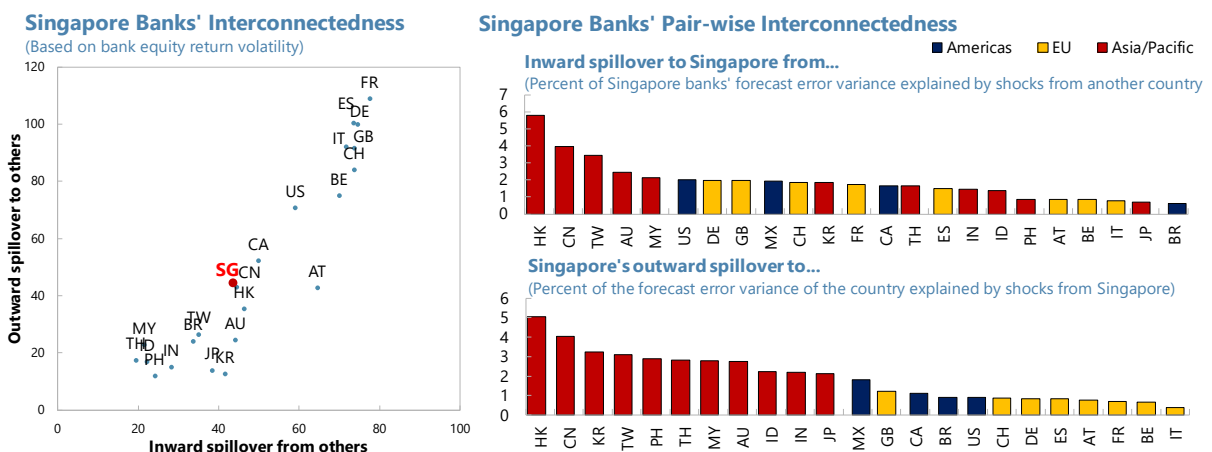
Note: AFC=Asian Financial Crisis; GFC=Global Financial Crisis.

Figure 2. Spillover of Credit and Funding Shocks through Cross-border Interbank Exposures



Sources: Bank for International Settlements (BIS) Locational Banking Statistics; MAS; and IMF staff estimates.
 Notes: The analysis measures spillover through aggregate, unconsolidated cross-border bank flows using the unconsolidated BIS Locational Banking Statistics, based on the methodology by Espinosa-Vega, Marco, and Juan Solé, 2010, "Cross-Border Financial Surveillance: A Network Perspective," IMF Working Paper, WP/10/105. As a benchmark case, this assumes that banks need to absorb 50 percent of loss given defaults of another banking system and unable to source 50 percent of lost funding thus leading to fire sale of assets at 50 percent discount. The size of spillover measured by capital impairment varies depending on assumed parameters, but relative order across countries remain largely the same. The data on cross-border interbank exposures on unconsolidated basis used here include bank flows intermediated through foreign branches and subsidiaries which may not be very important to Singapore's financial system and economy. An analysis using the Consolidated Banking Statistics—not available—could have shed light on the country and sectoral composition of banks' risk exposures, the extent of pure cross-border versus local claims, and risk transfers. The inward spillover of network-wide distress is the average impact to a destination country over individually triggered failure of all other countries.

Figure 3. Cross-border Spillover of Bank Equity Return Volatility



Sources: Worldscope; and IMF staff estimates.
 Notes: Full sample spillover during January 2016 and December 2018 based on the methodology by Diebold, Francis, and Kamil Yilmaz, 2014, "On the network topology of variance decompositions: Measuring the connectedness of financial firms," *Journal of Econometrics*, 182, 119–134. Pair-wise spillover measures the percent of a country's forecast error variance explained by shocks to another country. Total directional spillover is the sum of inward spillover to the country from all other countries and outward spillover from the country to all other countries.

4. Singapore's large currency swap market is an important link between Singapore and the global financial system. The swap market for currency consists of foreign exchange (FX) swaps for shorter maturities (typically under 1 year) and, to a lesser extent, cross-currency swaps for longer maturities (1-30 years). The most significant users are asset managers (hedging of investments), bank treasurers (arbitraging funding costs across currencies), and corporate treasurers (cash flow hedging and funding). The MAS also participates in the FX swap market as part of its money market operations.

5. Local and foreign banks have different business models. The banking sector consists of three large local banking groups and four large foreign banking groups (these seven groups were designated as domestic systemically important banks (D-SIBs) by the MAS in 2015), and a string of smaller regional offices for global banks. The local banks (which are all D-SIBs) provide a full range of services in retail and institutional banking and run a growing wealth management business. The foreign banks, which account for half of total financial sector assets, have different business models depending on whether they are branches or subsidiaries. Foreign branches use corporate deposits and intra-group funding to lend to non-financial corporates and provide financial services like treasury and wealth management across the region, while foreign subsidiaries focus on local retail banking.

B. Macrofinancial Developments

6. Since the last FSAP, Singapore has weathered economic cycles closely linked to the external environment. Economic growth slowed in 2015-16, reflecting the trade and global growth slowdown and lower oil prices. The economy experienced a strong cyclical upswing in 2017 (real GDP growth reached 3.7 percent and inflation edged up from low levels) and the first half of 2018 as the external sector benefitted from the global recovery (Table 3). However, slowing external demand and tighter monetary and macroprudential policy contributed to a moderation in GDP growth in 2018. Growth is expected to slow to 2.0 percent in 2019 closing the positive output gap, and inflation is likely to remain modest (Figure 4).

Table 3. Singapore: Selected Economic and Financial Indicators

	2013	2014	2015	2016	2017	2018	Projections	
							2019	2020
Growth (percentage change)								
Real GDP	4.8	3.9	2.9	3.0	3.7	3.1	2.0	2.3
Consumption	4.6	3.0	5.9	2.9	3.6	3.0	3.0	2.6
Gross capital formation	4.9	0.8	-8.6	10.2	11.6	-2.1	3.8	1.0
Net exports (contribution to GDP growth, percentage points)		2.1	3.6	0.0	-1.1	2.0	0.1	0.7
Saving and investment (percent of GDP)								
Gross national saving	45.7	47.4	42.6	44.2	44.5	44.5	43.5	43.3
Gross domestic investment	30.0	29.4	25.4	26.7	28.2	26.6	27.7	27.5
Inflation and unemployment (period average, percent)								
CPI inflation	2.4	1.0	-0.5	-0.5	0.6	0.4	1.0	1.3
MAS core inflation 1/	1.7	1.9	0.5	0.9	1.5	1.7	1.5	1.7
Unemployment rate	1.9	2.0	1.9	2.1	2.2	2.1	2.0	2.0
Money and credit (end of period, percent change)								
Broad money (M2)	7.9	7.6	4.0	8.4	4.1	5.1	3.3	3.6
Credit to private sector	15.5	7.0	2.5	5.5	3.6	4.9	2.0	2.3
Three-month S\$ SIBOR rate (percent)	0.4	0.5	1.2	1.0	1.5	1.9
Balance of payments (percent of GDP)								
Current account balance	15.7	18.0	17.2	17.5	16.4	17.9	15.8	15.8
Overall balance 2/	18.2	6.8	1.1	-1.8	27.4	12.5	6.0	8.0
Gross official reserves (US\$ billions) 3/								
(In months of imports) 4/	273.1	256.9	247.7	246.6	279.9	287.7	260.9	270.9
Singapore dollar/U.S. dollar exchange rate (period average)	1.25	1.3	1.4	1.4	1.4	1.3
Nominal effective exchange rate (percentage change) 5/	2.60	0.6	-0.9	1.9	0.0	1.0
Real effective exchange rate (percentage change) 5/	2.73	-0.6	-2.7	-0.2	-1.2	-0.5

Sources: Data provided by the Singapore authorities; and IMF staff estimates and projections.

1/ MAS core inflation excludes the costs of accommodation and private road transport but includes foods and energy items.

2/ Following the BPM6 sign convention, a positive entry implies net outflows.

3/ The projections for official reserves for 2019 and onward reflect the transfer of S\$ 45 billion to GIC Pte. Ltd. as announced in May 8, 2019.

4/ In months of following year's imports of goods and services.

5/ Increase is an appreciation.

7. A strong policy framework has helped preserve macroeconomic and financial stability.

Reflecting global conditions and an accommodative monetary policy stance, macrofinancial conditions eased and credit growth recovered in 2016-17. Asset prices increased, with a buoyant stock market in 2017 and the turnaround of property market prices. Accommodating macrofinancial conditions were followed by policy tightening in 2018.

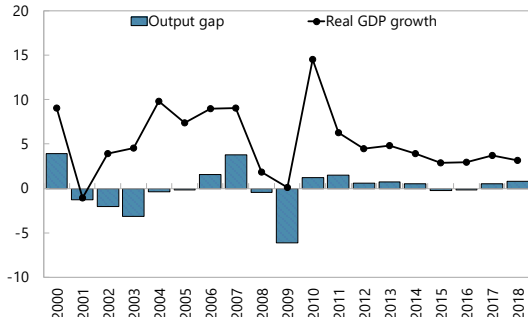
- The MAS tightened monetary policy in April 2018, for the first time in two years, and again in October, as the economic upswing took hold and broadened to domestic sectors. In April 2019, the MAS decided not to tighten further its monetary policy stance.
- Property market measures, including prudential measures, were also tightened. With household mortgages exceeding 50 percent of GDP and property sector related loans amounting to 30 percent of banks' total loans, avoiding property price bubbles is crucial for financial stability. The MAS, together with other government agencies, has been proactive in mitigating systemic risk through prudential measures such as limits on total debt servicing ratios and loan-to-value (LTV) ratios, as well as stamp duties and supply-side measures (Table 4). Since late 2017 and after four years of decline, private residential prices began to rise rapidly (9.1 percent increase, y/y, in 2018Q2). The authorities responded by raising stamp duties and lowering LTV limits in July 2018, proactively muting the potential build-up of financial risk.

Figure 4. Key Macroeconomic Variables

Output gap is closing.

Real GDP Growth and Output Gap

(In percent)

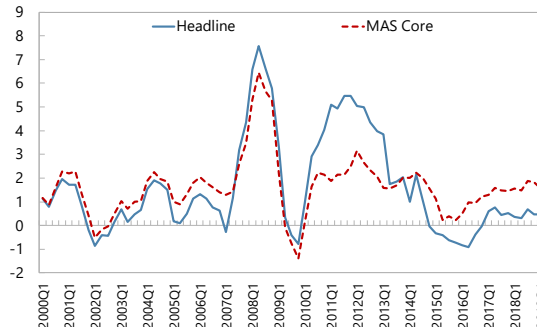


Sources: Haver Analytics; and IMF staff calculations.

Inflationary pressure is modest with MAS core inflation below 2 percent.

CPI Inflation

(In percent; Y-o-Y)



Sources: Haver Analytics; and IMF staff calculations.

The credit gap has almost closed.

Credit Cycle

(Intensity)



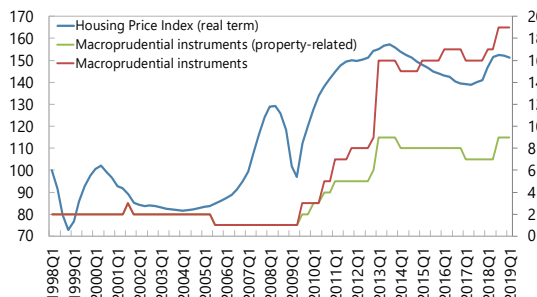
Source: IMF staff calculations.

Notes: Green and red colors show periods in credit cycle with low and high vulnerabilities, respectively. The first four indicators are standardized with its mean and standard deviation. In the last row ("overall assessment"): red shows a strong signal of a build-up of systemic risk, with (i) either the change in the credit-to-GDP ratio above 5 percent (y-o-y) or (ii) the credit-to-GDP gap greater than 1.5 standard deviations and the annual growth rate of the credit-to-GDP ratio above 10 percent (y-o-y); orange denotes modest systemic risk build-up with the change in the credit-to-GDP ratio between 3 and 5 percentage points.

Nominal house prices have moderated since the peak in 2013, as macroprudential policy tightened significantly.

House Prices and Macroprudential Instruments

(1998Q1 = 100 for housing prices)



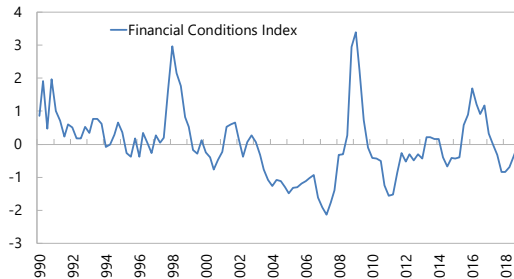
Sources: Bank for International Settlements; IMF iMaPP database; and IMF staff calculations.

Notes: The macroprudential instrument index summarizes cumulative tightening(+)/loosening(-) of various measures. Property-related instruments include LTV limit, DSTI limit, loan requirements on households, and tax-based measures.

8. With these measures, financial conditions have tightened and were about neutral at end-2018 (text figure). According to end-2018 data, there is no sign of excessive credit growth because credit growth has eased, and the credit gap has closed to 1.5 percent of GDP (Figure 4). Domestic credit growth has been stable contributing to the stabilization of private sector leverage.

Financial Conditions Index

(Increase = tightening of financial conditions)



Source: IMF Staff Estimate. Notes: FCI includes the first three principal components of the real short-term interest rate, the interbank spread, the sovereign local debt spread, the corporate local and dollar debt spreads, equity price returns, and a debt-weighted exchange rate return. The FCI differs from the one used in the IMF's Global Financial Stability Report which only uses one principal component.

Table 4. Singapore: Key Property-Related Macprudential Measures

	Non-individuals	Foreigners	Permanent Residents (PRs)	Singapore Citizens
Loan-to-Value Ratio 1/				
1 st loan granted by financial institutions (previous ratios still apply to HDB loans)	From Jul. 2018: 15% Previous: 20%		From Jul. 2018: 75% (55%) Previous: 80% (60%)	
2 nd loan granted by financial institutions			From Jul. 2018: 45% (25%) Previous: 50% (30%)	
3 rd loan granted by financial institutions			From Jul. 2018: 35% (15%) Previous: 40% (20%)	
Mortgage Servicing Ratio				
Loan for purchase of HDB flat granted by financial institutions			From Jan. 2013: 30% of a borrower's gross income	
Loan granted by HDB			From Aug-2013: 30% of a borrower's gross income Previous: 35% of a borrower's gross income	
Loan for purchase of Executive Condominium granted by financial institutions			From Dec-2013: 30% of a borrower's gross income	
Total Debt Servicing Ratio				
All types of housing and loans			From Mar. 2017: Disapply Total Debt Servicing Ratio to mortgage equity withdrawal loans with loan-to-value ratios of 50% and below Previous (and all other loans): 60%	
Maximum tenure				
Loan for purchase of HDB flat granted by financial institutions			From Aug. 2013: 30 years Previous: 35 years	
Loan granted by HDB			From Aug. 2013: 25 years Previous: 30 years	
Loan for purchase of private residence granted by financial institutions			From Oct. 2012: 35 years	
Seller's Stamp Duty				
Up to 1 year holding period			From Mar. 2017: 12%; Previous: 16%	
1-2 years			From Mar. 2017: 8%; Previous: 12%	
2-3 years			From Mar. 2017: 4%; Previous: 8%	
3-4 years			From Mar. 2017: 0%; Previous: 4%	
Additional Buyer's Stamp Duty 2/				
1 st property	From Jul. 2018: 25% to 30% Previous: 15%	From Jul. 2018: 20% Previous: 15%	From Jan. 2013: 5% Previous: 0%	
2 nd property			From Jul. 2018: 15% Previous: 10%	From Jul. 2018: 12% Previous: 7%
3 rd property				From Jul. 2018: 15% Previous: 10%

Sources: MAS; Ministry of Finance; and IMF staff.

1/ Numbers in parentheses indicate loan-to-value limits for borrowers older than 65 or having loans with a tenure larger than 30 years (25 years, if the property purchased is a Housing and Development Board (HDB) flat).

2/ The Additional Buyer's Stamp Duty is a residency-based capital flow management (CFM)/macroprudential measure (MPM) based on the Fund's Institutional View on capital flows. The Singapore 2019 Article IV recommended eliminating residency-based differentiation by unifying rates and then phasing out the measure once systemic risks from the housing market dissipate.

... WITH A RESILIENT FINANCIAL SYSTEM...

A. Sources of Vulnerability and Buffers

9. As noted earlier, exposures to regional and global shocks are the most relevant vulnerabilities for Singapore at this time. Regardless of the trigger, global and regional shocks, such as a growth shock in key emerging markets or heightened volatility in global capital markets, would have a significant impact on banks in Singapore and the financial system more broadly. Moreover, given the size and cross-border interconnectedness of the financial system, especially with the rest of Asia, such risks could have a major impact not only on Singapore but also on the financial systems in the region. At the time of the FSAP, the main macrofinancial risks relate to a sharp growth slowdown in China and to a disorderly normalization of monetary policies in advanced economies, with increased volatility in financial markets (including in the dollar funding market).

10. The MAS has strengthened bank capital and liquidity requirements in line with Basel III. The minimum capital requirement includes a total capital requirement of 8 percent and a D-SIB surcharge of 2 percent. Banks must also maintain a capital conservation buffer of 2.5 percent and a counter-cyclical capital buffer.¹ The MAS has also introduced a minimum leverage ratio of 3 percent for locally incorporated D-SIBs. On the liquidity side, the MAS has introduced a minimum Liquidity Coverage Ratio (LCR) and Net Stable Funding Requirements (NSFR) for D-SIBs in all currencies and in Singapore dollars. Other banks can choose to comply with the LCR or the minimum liquid asset requirement.

11. The solvency and profitability of Singapore's banks compares well to those of other financial centers. Banks' risk-weighted capitalization is strong (16.9 percent in 2018) and provides a buffer of 7 percentage points that can be used in a stress scenario (Table 5). Although lower than those seen in other financial centers, these capital ratios are comparable to other international banks and reflect the conservative approach to risk-weighted asset calculation in Singapore (Figure 5). Singapore's D-SIBs have a leverage ratio of 7.2 percent, higher than the 6 percent average for globally systemically important banks (G-SIBs). Banks in Singapore enjoy higher stable net interest margins than banks in other financial centers and also benefit from rising fee and commission income. Nonperforming loans (NPLs) are low, especially for D-SIBs (1.9 percent of total loans) and are adequately provisioned. The weak spots in this bright picture largely reflect legacy exposures to transportation (including in oil-related sectors) and manufacturing firms, and relatively high "problem loans" (NPLs plus special mention loans and restructured loans) in a few foreign D-SIBs. Cross-border asset quality has stabilized as NPL ratios for loans to Malaysia and Indonesia have declined over the past year. However, a growth slowdown in China could trigger, including via regional spillovers, credit stress and a rise in NPLs. Finally, banks have substantial lending to the property sector, including residential mortgages and loans to building and construction companies

¹ The MAS has not activated the counter-cyclical capital buffer, which appears appropriate based on recent macrofinancial developments, but banks must maintain such a buffer as part of reciprocity agreements due to exposures in other countries.

(in total about 30 percent of banks' loans to nonbanks), but the potential risks associated with these exposures have been dampened by proactive macroprudential policy.

Table 5. Singapore: Financial Soundness Indicators (2013-2018)

(In percent)

Financial Soundness Indicators for Banks						
	2013	2014	2015	2016	2017	2018
Capital adequacy						
Regulatory capital to risk-weighted assets	16.4	15.9	15.9	16.7	17.2	16.9
Core Tier-1 capital to risk-weighted assets	13.8	13.5	13.8	14.6	15.5	15.0
Leverage ratio of D-SIBs	-	-	7.5	7.7	7.8	7.2
Asset quality						
Nonperforming loans to gross loans (NPL ratio)	1.2	1.1	1.6	2.2	2.0	1.9
NPL ratio of local banks	1.0	0.9	1.1	1.4	1.6	1.5
Provisions to unsecured NPLs	154.8	160.1	128.1	105.9	111.5	98.0
Earning and profitability						
Return on average assets of local banks	1.2	1.1	1.2	1.1	1.3	1.3
Net interest margin of local banks	1.7	1.7	1.8	1.7	1.8	1.8
Liquidity and funding						
Liquid assets to total assets	-	-	-	11.0	11.8	13.9
Loan to deposit ratio	107.0	109.1	104.4	100.6	105.6	107.6
Loan to deposit ratio of local banks	85.9	86.4	87.4	86.9	86.1	88.5
Financial Soundness Indicators for Insurers						
	2013	2014	2015	2016	2017	2018
Direct insurers						
Capital adequacy ratio	258	239	241	240	251	247
Return on equity	9	19	11	12	14	5
Return on assets	1.0	1.9	1.3	1.1	1.6	0.4
Reinsurers						
Financial resources to policy liabilities	72	76	76	75	71	50

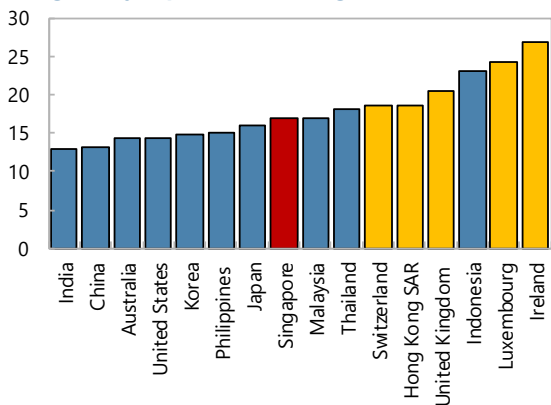
Source: MAS.

Note: The capital adequacy ratio is defined under Singaporean risk-based capital regulations to be the ratio of available capital to risk-weighted assets (i.e., required capital).

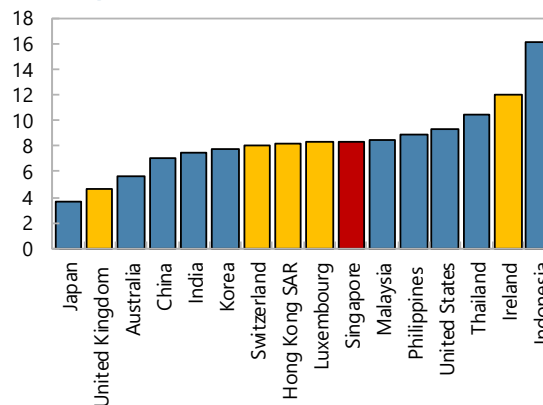
Figure 5. Singapore and Peer Economies: Financial Soundness Indicators (FSIs)
(In percent, latest)

Bank capital ratios in Singapore are lower than the ones in other similar-sized financial centers but compare well with those of neighbors and other international banks, reflecting conservative risk-weighted asset calculation.

Regulatory Capital to Risk-weighted Assets

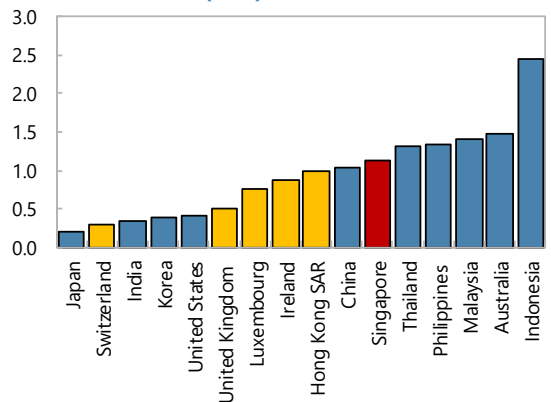


Tier 1 Capital to Assets

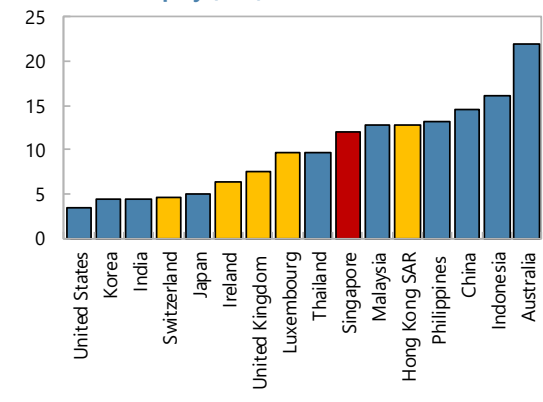


Profitability of local banks has been stronger than that of other financial centers, thanks to high fee and commission income.

Return on Assets (ROA)

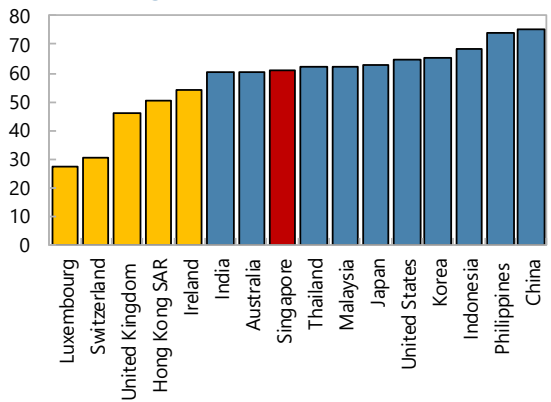


Return on Equity (ROE)

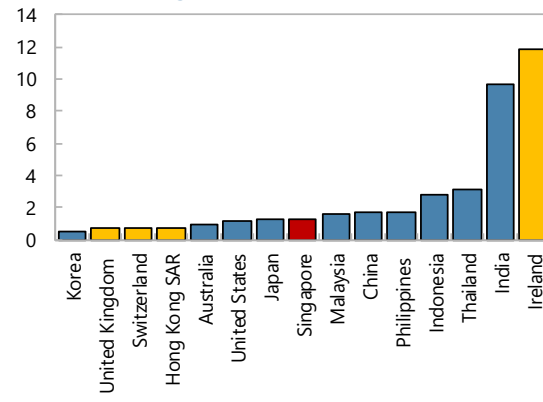


Interest margins are also high, and NPL ratios are at a low level but have increased recently.

Interest Margin to Gross Income



Nonperforming Loans to Gross Loans



Sources: IMF Financial Soundness Indicators; national authorities' websites; and Haver Analytics.

Note: Yellow bars refer to Singapore's peer group of financial centers and economies with financial sectors that account for a large share of GDP.

12. The picture is mixed regarding banks' liquidity positions. D-SIBs rely on non-bank customer deposits for funding (73 percent) and their funding structure has improved in recent years, as evidenced in the decline in their foreign currency loan-to-deposit ratios until 2015 (text chart). Overall bank liquidity is adequate, thanks to strong liquidity in Singapore dollars, and D-SIBs have healthy buffers over the minimum LCR requirements in all currencies and in Singapore dollars (Figure 6). Although there is no minimum requirement for foreign currency liquidity, the asset-weighted average U.S. dollar LCR of D-SIBs is low at 48 percent (at the entity level), which amounts to a shortfall of liquid U.S. dollar assets (relative to a 100 percent LCR) of some 20 percent of GDP (Table 6).

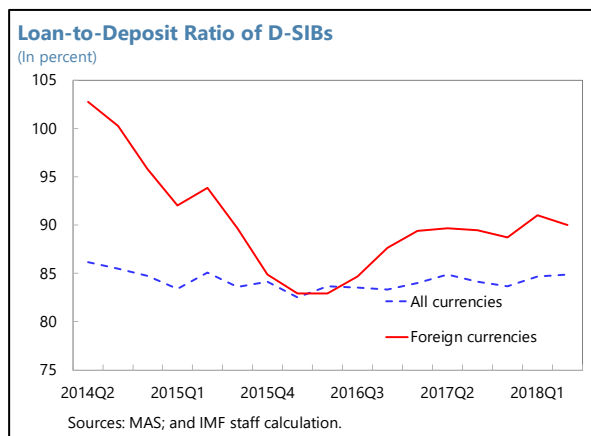
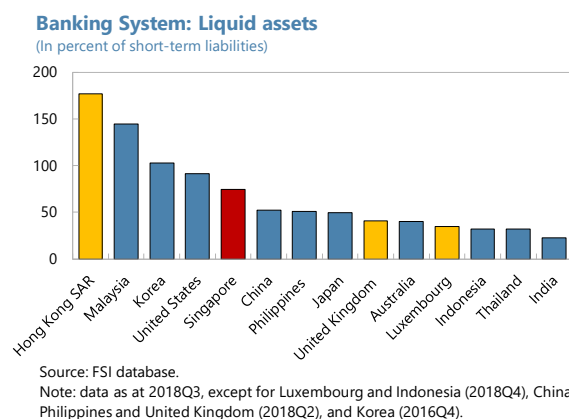
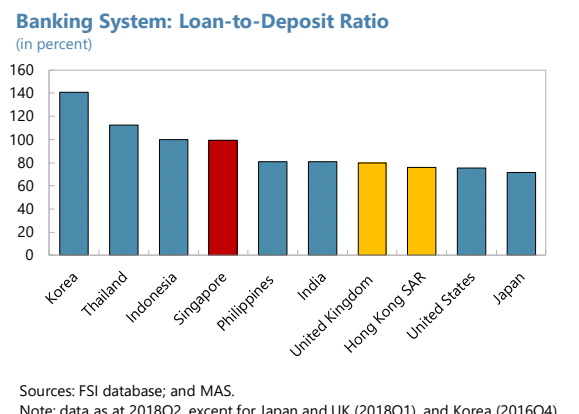


Figure 6. Singapore and Selected Economies: Bank Liquidity Indicators

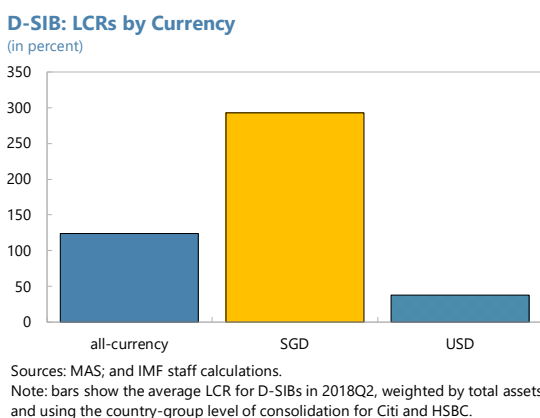
Singapore's banks have a similar liquid assets to those in peer countries



Loan-to-deposit ratios are high but in a large part because of foreign banks



LCRs in foreign currency are low



And loan-to-deposit ratios in foreign currency are on the rise

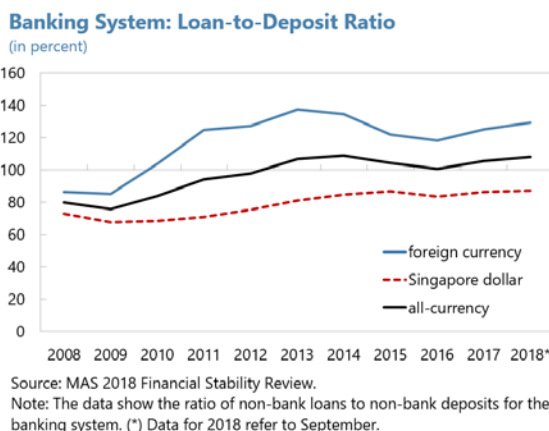


Table 6. Singapore: U.S. Dollar Liquidity Shortfalls at D-SIBs 1/

	All D-SIBs	Domestic D-SIBs	Foreign D-SIBs
USD LCR (In percent) 2/	48	40	74
HQLA needed for 100% LCR (In billions of Singapore dollars)	88.3	40.1	48.2
<i>In percent of GDP</i>	20	9	11
HQLA needed to meet same requirements as all-currency LCR (In billions of Singapore dollars) 3/	53.0	40.1	13.1
<i>In percent of GDP</i>	12	9	3

Sources: MAS; and IMF staff calculations.

Notes:

1/ This table shows the additional high-quality liquid assets that would be needed to meet hypothetical requirements for projected one-month liquidity in USD.

2/ Average of USD LCRs at the entity level, weighted by total assets. If we use the country-group level of consolidation for those banks that report it, we obtain a USD LCR of 38 percent for all D-SIBs.

3/ This assumes an LCR requirement of 100% for domestic banks and 50% for foreign banks. The requirements are imposed at the same level of consolidation as those for the all-currency LCR.

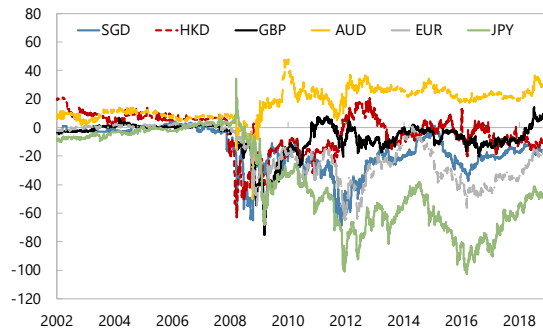
13. A well-functioning swap market is important for the financial system. Local banks obtain their U.S. dollar funding from corporate deposits, medium-term notes, commercial paper and certificates of deposit (given their AA ratings and the AAA rating of the sovereign) and channel their structural excess in Singapore dollars to foreign banks in the swap market. Foreign subsidiaries and branches attract U.S. dollar corporate deposits from multinational corporations that are often clients of the parent bank in many jurisdictions. The cost of borrowing U.S. dollars in the international swap market has been higher than direct funding in the U.S. dollar interbank market (negative cross-currency basis for most currencies) and increases for longer maturities (Figure 7). Importantly, the premium for borrowing U.S. dollars in the swap market is volatile and widens during funding stress episodes. In addition to the variation in the funding premium (i.e., the cross-currency basis), bid-ask spreads also tend to widen in stress episodes. The analysis in Box 1 suggests dislocations in the U.S. dollar funding market could be a source of downside risks for Singapore's major banks, even if causality is not established.

Figure 7. Dollar Funding Market

Funding costs in the FX swap market are volatile

5-Year Cross Currency Basis

(Basis points)

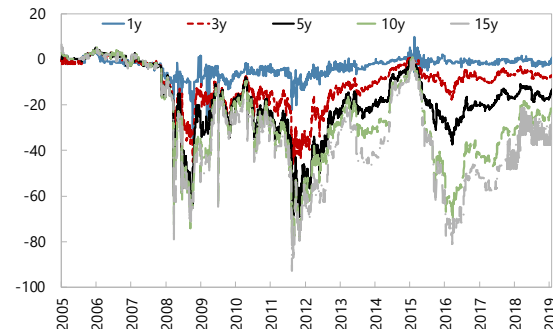


Sources: Bloomberg; Datastream; and IMF staff calculations.

Funding is more expensive at longer maturities

SGD-USD Cross Currency Basis by Maturity

(Basis points)

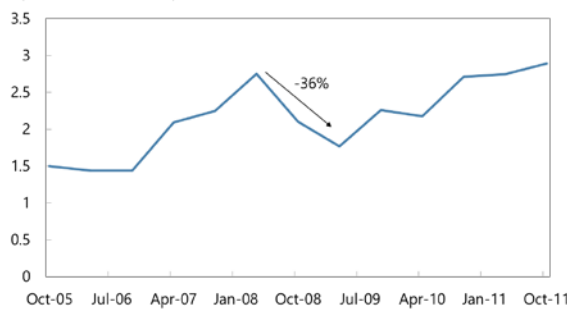


Source: Bloomberg

Transaction volumes declined after the financial crisis

FX Swap Market Monthly Volume

(Trillions of U.S. dollars)

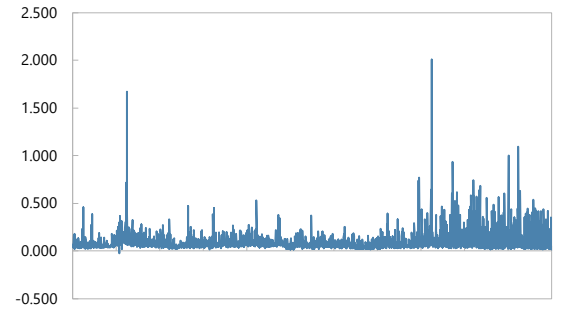


Source: Singapore Foreign Exchange Market Committee.
Note: The chart shows the monthly trading volume in FX swaps in Singapore. The fall of 36 percent occurs between April 2008 and April 2009.

... and FX swap market liquidity has decreased.

Bid-Ask Spreads of USD-SGD Swaps

(Percent of Ask Price)

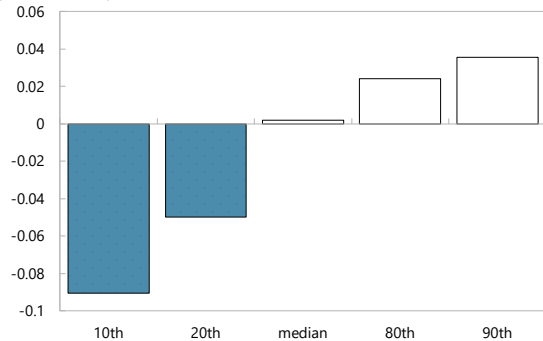


Source: MAS.

Swap market dislocations are associated with current...

Effect of Negative Cross-Currency Basis on Contemporaneous Bank Equity Return at Different Quantiles

(Unit: coefficient)

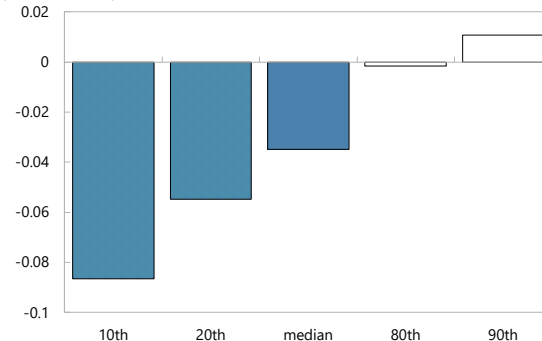


Sources: Bloomberg; Kenneth R. French's website; and IMF staff calculations.

... and future tail risk of banks.

Effect of Negative Cross-Currency Basis on Near-Term Bank Equity Returns at Different Quantiles

(Unit: coefficient)



Notes: The left (right) chart shows the relationship between the deviation from CIP-negative basis and the contemporaneous (one-week ahead) bank equity return at different quantiles. Equity returns are the residual return excluding the effects of Fama-French (ex-Japan) factors. Demeaned (annually) five-year cross-currency basis is used. Sample is from 2010 to 2018 at the daily frequency. The bars are the average of coefficients for three Singaporean banks where solid bars represent statistical significance at 5 percent.

Box 1. Dollar Funding at Risk

Deviations from covered interest parity (CIP) are common in foreign exchange and cross-currency swap markets since the global financial crisis.^{1,2} Violations of CIP come from supply and demand imbalances between currency pairs related to hedging and funding activities in combination with tighter limits to arbitrage due to regulations since the global financial crisis. Deviations from CIP show in the cross-currency basis—the amount by which the interest paid to borrow one currency by swapping it against another differs from the cost of directly borrowing this currency in the cash market—which proxies stress in the FX swap market (Figure 7).

Dislocations in FX derivative markets can disrupt bank business activities and signal risk to bank value. Quantile regressions show that the SGD/USD cross-currency basis is associated with the lower tail of the distribution of bank equity returns. A more negative five-year SGD/USD cross-currency basis is associated with a lower value of the left tail of equity returns of Singaporean banks (Figure 7).³ Moreover, the basis is also predictive about near-term (five days ahead) downside risk to the value of bank equity. This indicates that FX derivative market dislocations can forecast high near-term bank return volatility and higher downside risk to bank value.

Stress conditions in FX derivative markets can provide useful insights on bank riskiness, although interpreting causality is not straightforward. Although stress in the FX derivatives market may signal higher funding costs for banks, it is possible that the measured dollar funding stress indicator is influenced by liquidity and other market factors.

1/ CIP is a no-arbitrage condition that holds that the interest rate differential between currencies in the money markets should equal the differential between the forward and spot exchange rates.

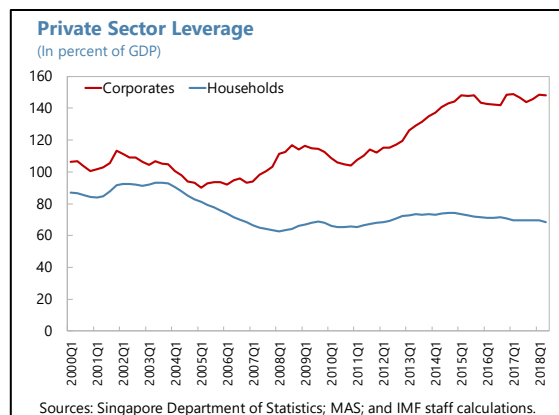
2/ Banks in Singapore are active in the FX swap market rather than the cross-currency basis swap market. Arbitrage conditions ensure that borrowing costs in these two markets move together. This Box uses data on CIP deviations from cross-currency basis swap prices because they are easier to obtain.

3/ Bank value is measured by bank equity returns. Stress in the dollar funding market is proxied by the cross-currency basis.

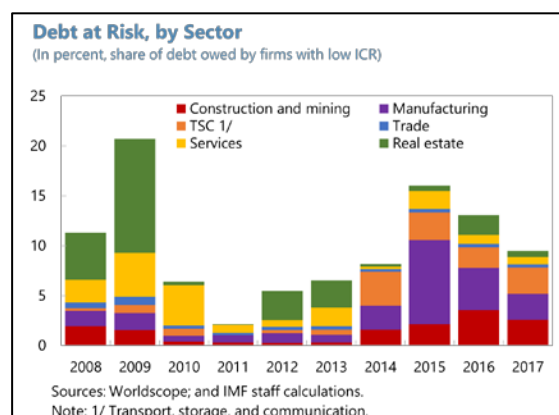
14. Insurance companies have strong buffers over minimum capital requirements, but some insurers are exposed to the risk of falling asset prices. Regulatory capital amounted to 247 percent of risk-based capital requirements in 2018. Profits have been strong but were weighed down by falling asset prices in 2018 (Table 5). The larger direct life insurers are notably exposed to equities and corporate bonds, making them vulnerable to falling equity prices and widening credit spreads. Competition in the general insurance sector has driven down its profits recently. Some three-quarters of the regulatory capital of the four largest insurers comes from accumulated profits that are yet to be shared with policyholders.

15. The household and corporate sectors are important transmission and amplification channels for shocks to the financial system. These sectors and their potential vulnerabilities will be assessed on page 28, but key points are:

- Households have a strong financial position. Total household assets are 446 percent of GDP and debt has stabilized around 70 percent of GDP. The average debt-to-income ratio is low at 2.1. Liquid financial assets are twice the size of total household debt. Still, households are sensitive to house price fluctuations as 44 percent of household assets are residential property and to interest rate changes as half of outstanding housing loans are at variable rates. Furthermore, the overall strong asset position of households could mask significant disparities across income deciles.



- Corporate leverage is high, but debt-at-risk has improved and appears manageable. Corporate debt rose markedly from 104 percent of GDP in 2010 to 148 percent of GDP in 2015Q3 but has been stable since. Profitability has weakened since the global financial crisis until 2016 and caused the Interest Coverage Ratio (ICR) (i.e., earnings before interest and taxes divided by interest expense) to fall from 12 to below four. However, both leverage and profitability, thus debt service capacity, have stabilized in recent quarters on the back of the cyclical upswing in growth. The share of debt-at-risk (the share of debt owed by firms with ICR below one) has improved since 2015 (text figure). Currently, notwithstanding the earlier mentioned lingering weakness in the construction and transportation sectors, debt-at-risk appears manageable. Corporates also have substantial cash buffers with a median cash-to-debt ratio of 50 percent.



16. Still, Singapore’s overall strong macroeconomic fundamentals, healthy public-sector balance sheets, and substantial official foreign exchange reserves greatly mitigate potential vulnerabilities. Large current account surpluses (close to 18 percent of GDP in 2018) have led to a net international investment position equal to 223 percent of GDP. Similarly, decades of fiscal surpluses have contributed to robust public finances and an accumulation of considerable government assets managed by the two sovereign wealth funds—Temasek Holdings (Private) Limited and GIC Private Limited. Further, the MAS’ foreign exchange reserves (equal to about 79 percent of GDP at end-2018) provide another buffer to mitigate the impact of macroeconomic and financial shocks, if needed.

B. Assessment of Systemic Risk

17. The FSAP examined the resilience of households, corporates, banks, and insurers from a systemic risk perspective. The approach to systemic risk assessment is summarized in Figure 8. The assessment uses two external shocks scenarios that, at the start of the FSAP, appeared most relevant to Singapore and which are described in the Risk Assessment Matrix (RAM; Table 7) and in Box 2. The stress test of households covered all recent mortgage borrowers, including those that are particularly susceptible to negative shocks, whereas the corporates stress test covered all firms listed on the Singapore stock exchange. For banks, the exercise covered the seven D-SIB groups (a total of 10 banks, including branches and subsidiaries), which account for about 75 percent of the resident bank loans to firms and households. For insurers, the exercise focused on the four largest insurers by asset size, which represent 80 percent of the assets of the sector. The top-down solvency tests were cross-checked against the MAS' top-down solvency tests and financial institutions' bottom-up stress tests and complemented with sensitivity analyses for the D-SIBs and attribution analyses for the insurers to highlight specific risks (Appendix III). The next section also explores cyber-risk scenarios.

Box 2. Stress Test of Banks and Insurers

The solvency stress tests are based on two “severe but plausible” scenarios. Staff at the MAS and the IMF designed two scenarios for the solvency (banks and insurers), household, and corporate stress tests (Table 8). Each scenario starts with external shocks whose effects are amplified by existing vulnerabilities: legacy loans to transportation firms, weak foreign currency liquidity, households' sensitivity to property prices, and high corporate leverage.

- **Adverse scenario 1** features large-scale global financial market turmoil, precipitating falling asset prices, which then propagate to the real economy. Equity and house prices drop by 40 percent, and short-term interest rates rise by 250 basis points in the first two years.
- **Adverse scenario 2** involves a major slowdown and macrofinancial stress in China which affects Singapore directly, and indirectly via extensive links to ASEAN. Under this unprecedented scenario, the output gap opens to -12.3 percent.

The liquidity stress tests assessed the liquidity positions of banks and insurers relative to minimum regulatory requirements. These tests included a cashflow-based analysis and an LCR test, and they used customized scenarios to better capture short-term dynamics.

Singapore: Output Gap

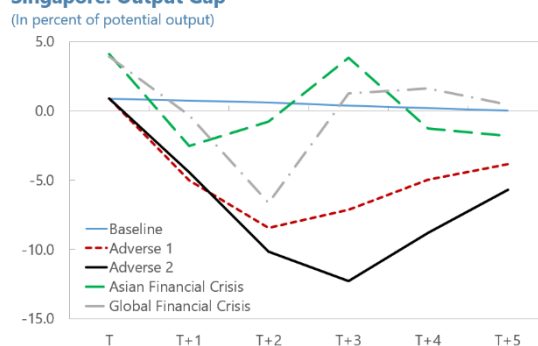


Figure 8. FSAP Systemic Risk Assessment Framework

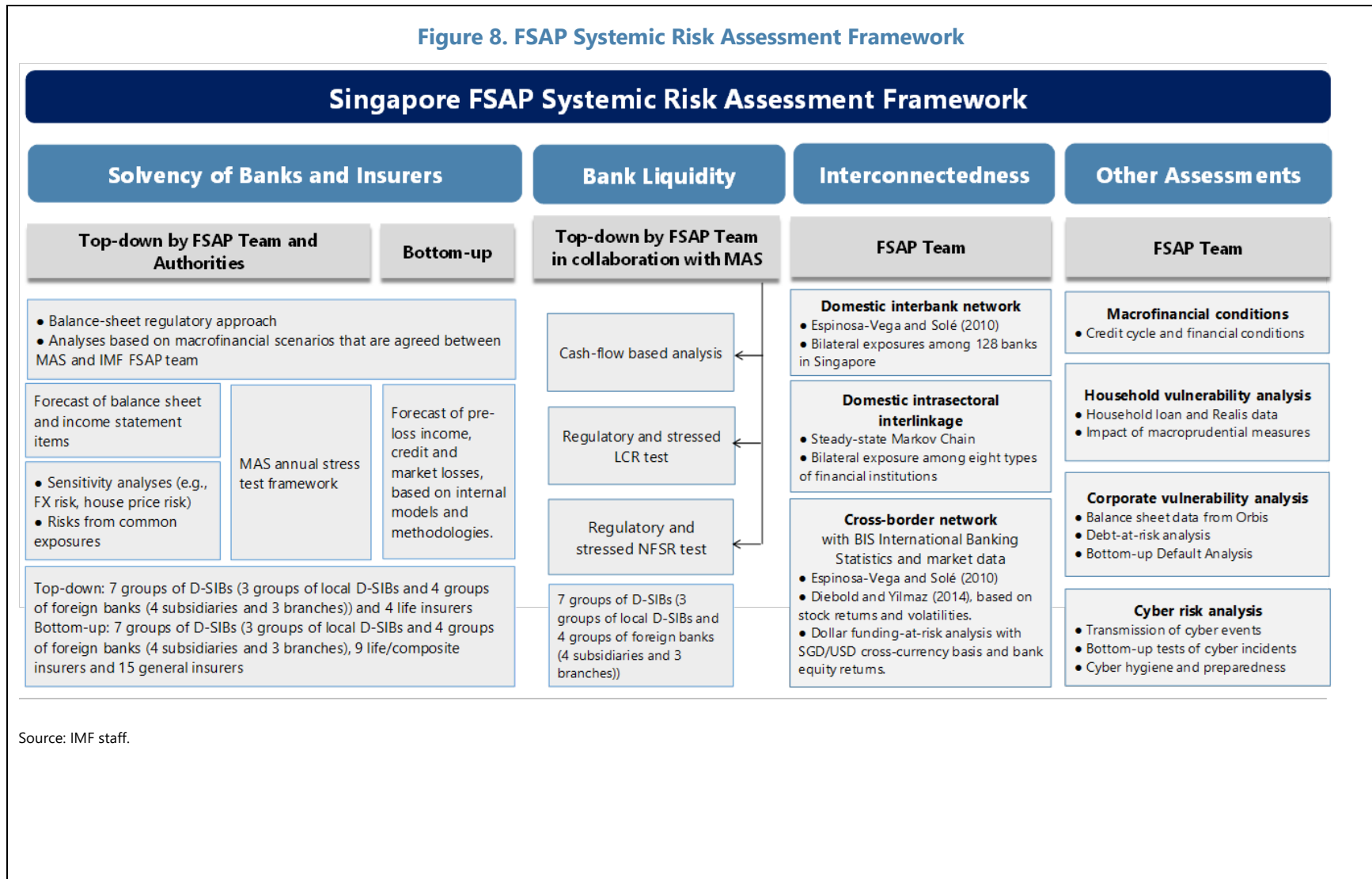


Table 7. Singapore: Risk Assessment Matrix

Source of Risk	Transmission Channels	Relative likelihood	Potential impact
Tighter global financial conditions and retreat from cross-border integration	An abrupt change in global risk appetite (e.g., due to higher-than-expected inflation in the U.S.) could lead to sharp increases in interest rates, tightening of financial conditions, and reduction of cross-border capital flows. Higher debt service costs and a sharp decline in economic activity could increase private sector's delinquency and deteriorate banks' capital. Heightened financial volatility and refinancing costs would also affect financial institutions through market risk and liquidity risk with tighter dollar funding conditions. A decline in financial sector activity—an important driver of the economy—could slow growth further through feedback channels.	Medium/High	High
Weaker-than-expected global growth, especially China	Singapore's position as a financial center and a trading hub would imply large spillovers from global lower growth. Especially, a significant slowdown in China would have both direct effects on Singapore and indirect impacts via a sharp slowdown in the region and a severe decline in commodity prices. Financial stress in China would lead to rising NPLs and a decline in investor sentiment, pullback of funding from the region, deteriorating further the quality of regional exposures of banks in Singapore. High corporate and household leverage and property price corrections could exacerbate a slowdown in economic activity, leading to a deep recession with substantial credit risk.	Medium	Medium/High
Cyber-attacks	Given Singapore's role as a financial hub, cyber-attacks on interconnected financial systems that trigger systemic financial instability or widely disrupt socio-economic activities could significantly impact the financial sector—an important driver of growth. Liquidity and operational risk would be the main channels.	Medium	Medium/High

Note: This table shows the shocks that will be used for the analysis of the resilience of financial institutions.

Table 8. Singapore: Stress Test Scenarios

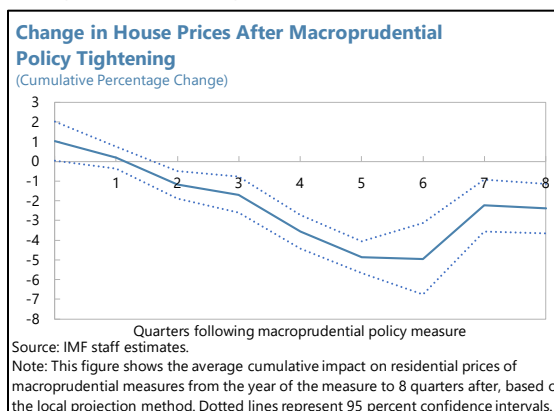
	2018 ^P	Stress Horizon				
		2019	2020	2021	2022	2023
Real GDP growth rate (In percent)						
Baseline scenario	2.9	2.7	2.7	2.6	2.6	2.6
Adverse scenario 1	2.9	-3.1	-0.8	4.3	5.2	4.1
Adverse scenario 2	2.9	-2.5	-3.3	0.5	6.8	6.4
Output gap (In percent of potential output)						
Baseline scenario	0.9	0.7	0.6	0.4	0.2	0.0
Adverse scenario 1	0.9	-5.0	-8.4	-7.1	-5.0	-3.8
Adverse scenario 2	0.9	-4.4	-10.2	-12.3	-8.8	-5.7
Real GDP (2018 = 100)						
Baseline scenario	100.0	102.7	105.6	108.4	111.2	114.1
Adverse scenario 1	100.0	96.9	96.1	100.2	105.5	109.7
Adverse scenario 2	100.0	97.5	94.3	94.7	101.2	107.6
Unemployment rate (In percent)						
Baseline scenario	2.9	2.9	2.9	2.9	2.9	2.9
Adverse scenario 1	2.9	3.5	5.8	6.2	4.9	3.9
Adverse scenario 2	2.9	3.2	5.8	8.9	8.8	6.5
Interest rate: 3-month SIBOR						
Baseline scenario	1.8	2.3	2.8	2.6	2.6	2.6
Adverse scenario 1	1.8	3.8	4.3	3.6	2.8	2.3
Adverse scenario 2	1.8	2.8	3.8	4.3	4.3	4.3
Property prices (Change in percent)						
Baseline scenario	8.0	0.0	0.0	0.0	0.0	0.0
Adverse scenario 1	8.0	-30.0	-15.0	5.0	5.0	5.0
Adverse scenario 2	8.0	-20.0	-25.0	0.0	3.0	5.0
Exchange rate (SGD/USD, Change in percent)						
Baseline scenario	2.0	2.0	1.0	0.0	-1.0	0.0
Adverse scenario 1	2.0	20.0	5.0	-10.0	-10.0	-5.0
Adverse scenario 2	2.0	10.0	10.0	5.0	-10.0	-10.0
Commodity prices (Change in percent)						
Baseline scenario	31.4	-2.7	-5.9	-4.0	-2.8	-1.9
Adverse scenario 1	31.4	-40.0	-5.0	20.0	20.0	5.0
Adverse scenario 2	31.4	-20.0	-20.0	-5.0	20.0	20.0
Equity prices (Change in percent)						
Baseline scenario	1.0	3.0	2.0	2.0	2.0	2.0
Adverse scenario 1	1.0	-35.0	-5.0	20.0	15.0	6.7
Adverse scenario 2	1.0	-20.0	-15.0	-5.0	20.0	15.0

Sources: MAS; and IMF staff.

Household and Corporate Sectors

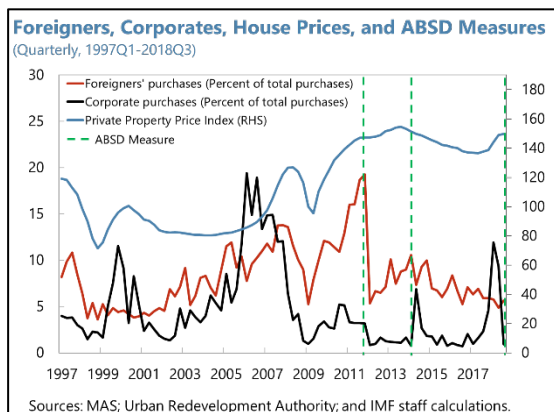
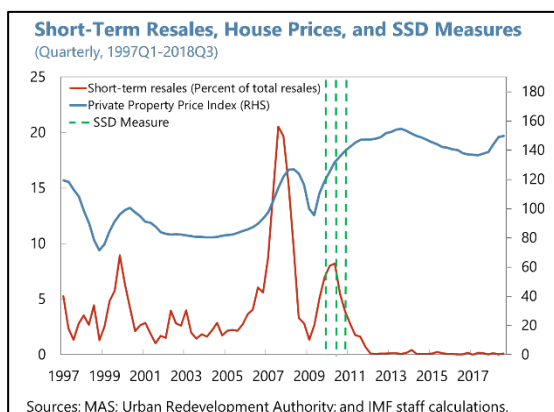
18. Households remain resilient under stress, although a small segment could face

repayment difficulties. A simulation of the mortgage service ratio conducted by the MAS, in close collaboration with the FSAP team, shows that most households, especially public housing owners, maintain strong debt service capacity under an adverse scenario. Nevertheless, a small segment of highly-leveraged, low-income (less than 10 percent of new borrowers in 2018), and younger owners of private housing would face repayment difficulties under the scenario.



19. This resilience is underpinned by active use of property market measures to contain risks.

Singapore is an attractive real estate market for foreign investors searching for yield. Demand by foreigners is a significant driver of residential property prices in Singapore and is likely to remain so in a global low interest rate environment. In theory, property market-related measures increase the resilience of households and financial institutions against shocks by moderating the procyclicality of credit and residential price developments. By reducing the likelihood of a large price correction, property market-related measures can thereby reduce the probability of default and, more importantly, the loss given default faced by lenders. In Singapore, the effects of these measures on private residential prices are estimated to have translated, for each measure on average, into a decrease in the level of residential prices of 5 percent at the peak.² Furthermore, the implementation of stamp duties (the Seller's Stamp Duty and the Additional Buyer's Stamp Duty) has been followed by a sharp reduction of speculative activity (proxied by short-term resales) and of foreigners' purchases, avoiding large residential property price fluctuations that pose systemic



² These effects are estimated with the local projection method and a three-dimensional panel dataset of quarterly residential price indices for 2007-18 and by type of property and region (Core Central Region, Rest of Central Region, Outside Central Region). The study controls for all past and future macroprudential policy measure events, fundamental factors through rent indices, and fixed effects. Macroprudential measures considered in the analysis are the Seller's Stamp Duty and the Additional Buyer's Stamp Duty for the private market, and limits on the mortgage servicing ratio, the loan tenure, and the LTV ratio for the Housing and Development Board resale market.

financial risks. Credit-related measures—such as limits on Total Debt Servicing Ratio and LTV ratios—also improved the quality of borrowers (e.g., by contributing to lower LTVs and debt servicing ratios for new mortgage loans), on top of containing excessive developments in residential prices and household debt.

20. As for corporates, their debt-at-risk would rise significantly under the two scenarios, but natural foreign currency hedges and large cash reserves are important buffers. Severe interest and currency shocks, and most of all the earnings shock, would have a sizable impact on firms' balance sheet (before considering mitigating factors) and significantly raise the debt-at-risk level beyond the levels seen in the global financial crisis, weighing on banks and insurers. However, the adverse effects are mitigated by natural foreign currency hedges and ample cash reserves.

Banking Sector

21. The D-SIBs would experience significant credit losses but nevertheless remain resilient under the two adverse scenarios (Figure 9).

Consistent with the analysis of households' and corporate sector resilience, NPL ratios would rise sharply as the scenarios unfold, compounded by a sharp house price decline and exchange rate depreciation. Credit losses would amount to 2.6 percent and 4.1 percent of risk-weighted assets in scenario 1 and 2. Still, thanks to the strong starting point—large capital buffers, good asset quality, strong profitability, low NPLs—the D-SIBs (here and in the next paragraph excluding the foreign branches since they are not subject to capital requirements) would all maintain risk-based capital ratios above the regulatory minima. Leverage ratios show similar resilience, suggesting that the calculation of risk-weighted assets of local D-SIBs is suitably conservative. The authorities' top-down and D-SIBs' bottom-up stress tests revealed similar resilience.

22. A complementary sensitivity analysis shows that D-SIBs have manageable concentration risk thanks to their diversified loan portfolios. While concentration risk is relatively higher in one foreign D-SIB, all D-SIBs have enough capital buffers to withstand a simultaneous default of the top-10 largest borrowers.

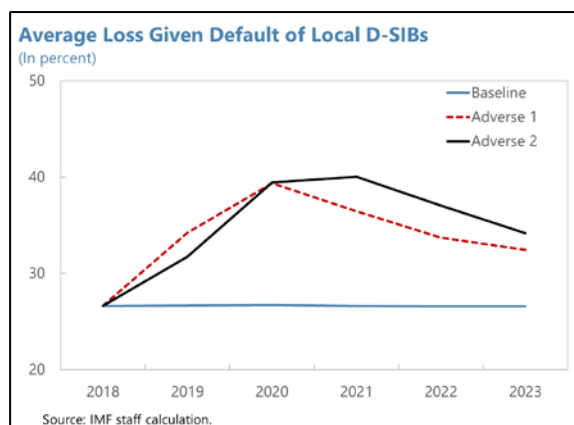
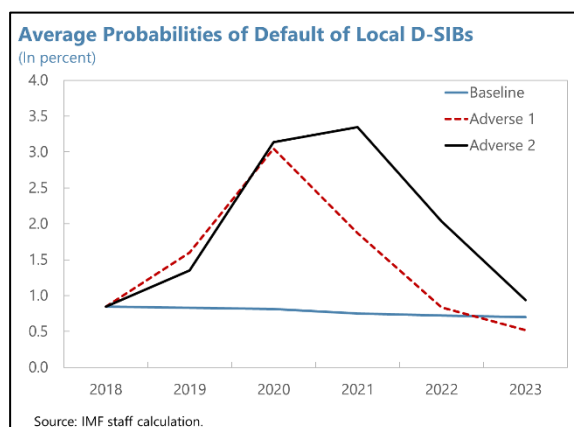
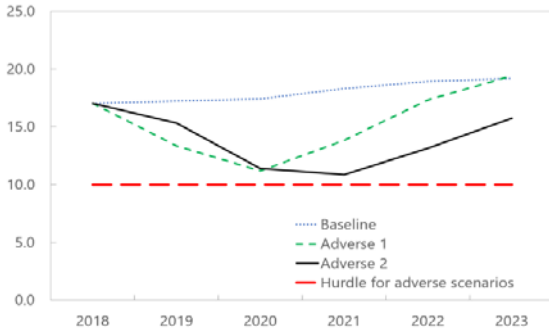


Figure 9. Bank Solvency Stress Test Results

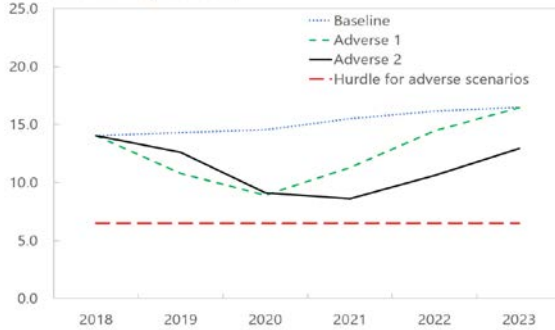
D-SIBs' large capital buffers absorb the scenario impact.

Total Capital Adequacy Ratio
(In percent of risk-weighted assets)



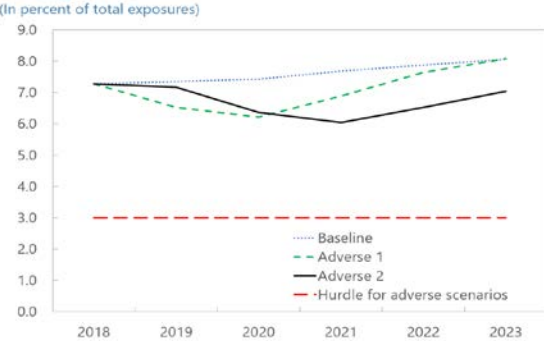
Resilience is seen in common equity tier 1 ratios...

CET 1 Capital Adequacy Ratio
(In percent of risk-weighted assets)



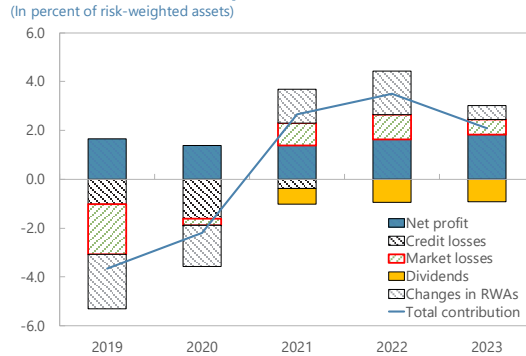
...and in leverage ratios, reflecting conservatism in the calculation of risk-weighted assets.

Leverage Ratio
(In percent of total exposures)



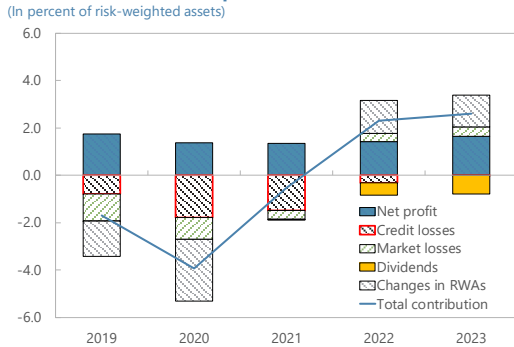
Market losses are the biggest driver of losses in adverse scenario 1...

Contribution to Total Capital Ratio: Adverse Scenario 1
(In percent of risk-weighted assets)



...while credit losses drive losses in adverse scenario 2.

Contribution to Total Capital Ratio: Adverse Scenario 2
(In percent of risk-weighted assets)



Risk-weighted assets grow significantly with the increase in default rates in adverse scenario 2.

Contribution to Changes in Total Capital Adequacy Ratio during 2019-21 in Adverse Scenario 2
(In percent of risk-weighted assets)



Source: IMF staff calculations.

23. Stress tests confirm that D-SIBs' liquidity is adequate overall but is vulnerable to shortfalls in foreign currency funding. The cashflow-based stress test show that D-SIBs have broadly adequate liquidity in all currencies and in Singapore dollars, but point to vulnerabilities in specific banks and at longer maturities. The LCR-based stress tests show that demand

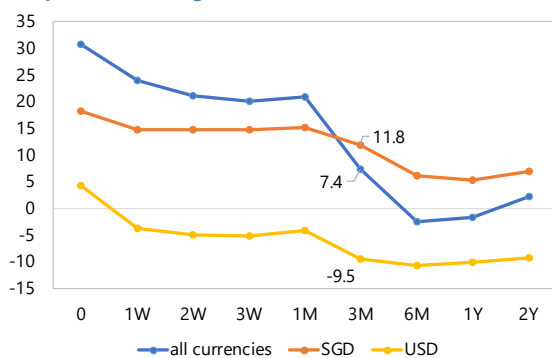
for liquid assets would increase significantly after a stress scenario, as banks need to return to compliance with LCR requirements in the medium term. The cashflow-based stress test confirms that U.S. dollar liquidity is a source of vulnerability. In this test, several D-SIBs would have insufficient liquid U.S. dollars assets to withstand one-week and three-month stresses. These failures lead to system-wide shortfalls equal to 8-10 percent of GDP in the short run and 11 percent of GDP after the first three months under a longer scenario (Figure 10). The importance of these results is reinforced by the previous findings that domestic interconnectedness is low—hence the transmission of domestic liquidity shocks is potentially low—while cross-border links are important—for which foreign currency liquidity is key.

Figure 10. Cashflow-based Stress Test Results

(In percent of GDP)

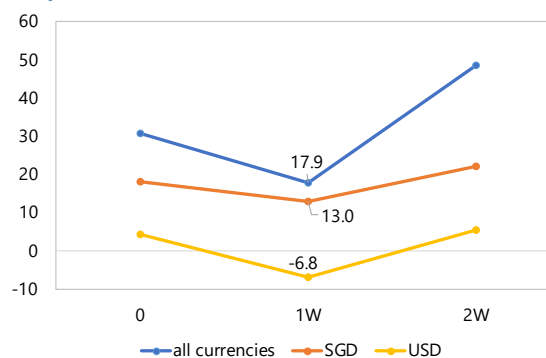
Liquid assets of the banking system deteriorate continuously under the long-term adverse scenario...

Liquid assets: long-term scenario



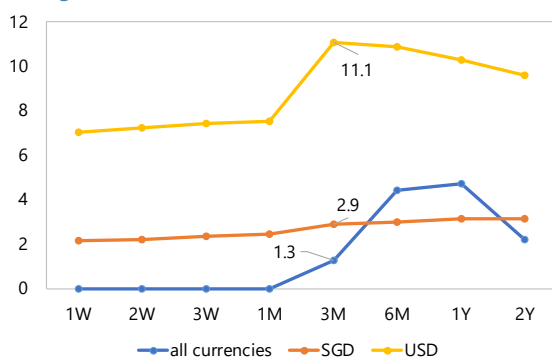
... but rebound quickly under the short-term adverse scenario.

Liquid assets: short-term scenario



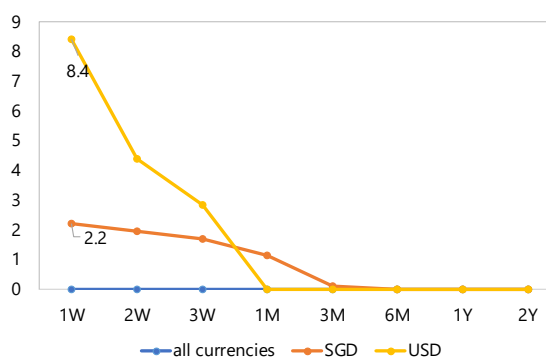
In the long-term adverse scenario, liquid asset shortfalls of individual banks are large in foreign currency but manageable in domestic currency.

Long-term stress scenario



The short-term adverse scenario produces a similar pattern.

Short-term stress scenario



Source: IMF staff calculations.

Notes: W denotes weeks, M denotes months and Y denotes years. The top two charts show the results of the cashflow-based stress tests applied to the aggregate data of all D-SIBs. Liquid assets represent the remaining value of liquid assets after receiving stressed contractual cash inflows and paying stressed contractual cash outflows, where the stress assumptions account for contract renewal. Negative liquidity denotes a shortfall. The bottom two charts show the results of the cashflow-based stress tests applied to data for each D-SIB individuals. Shortfalls are the sum, across all D-SIBs at their highest level of consolidation, of the amount by which cash outflows exceed the sum of liquid assets and cash inflows.

Insurance Sector

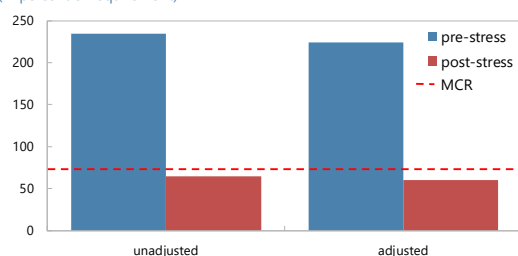
24. Insurers do not seem to be a source of systemic risk, although the solvency position of specific direct life insurers is vulnerable to falls in asset prices. Insurers have significant capital buffers in excess of minimum requirements. Nevertheless, two out of the four largest direct life/composite insurers breached minimum capital adequacy requirements in the top-down stress tests, and four out of the five smaller direct life/composite insurers also breached minimum capital adequacy requirements in the bottom-up stress tests (Figure 11). The losses in asset value for the direct life insurers are mainly driven by their substantial holdings of equities and corporate bonds. The liability values are also relatively less sensitive to market conditions under the current capital framework, resulting in insurers being impacted negatively under a rising yield stress scenario. However, combined post-stress capital shortfalls at the four largest insurers amount to just 1.3 percent of GDP.

25. The stress tests of general insurers show limited exposures to market and extreme flooding risks. All fifteen direct general insurers remain well-capitalized under both adverse scenarios. A separate bottom-up stress test (motivated by climate change) showed that extreme flooding in Singapore would have limited effect on risk-based capital adequacy ratios, after reinsurance recoveries.

Figure 11. Insurer Solvency Stress Test Results

Capital buffers of large insurers are eroded under the adverse scenario.

Big 4 Insurers' CAR
(In percent of requirement)

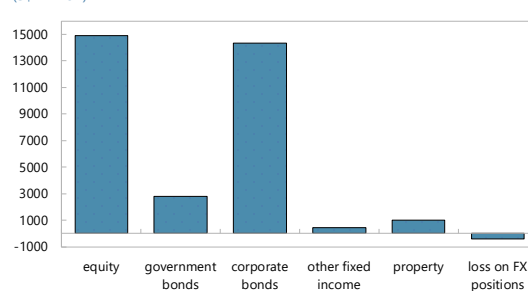


Source: IMF staff calculations.

Notes: The capital adequacy ratio is defined as available capital over required capital. This chart shows the aggregate available capital for the four largest direct life insurers over their required capital. For each insurer, the unadjusted capital ratio aggregates all activities, including participating policy activity, while the adjusted capital ratio excludes participating policy activity. The MCR denotes the minimum capital requirement of 100 percent.

Losses are primarily driven by falls in the prices of equity and corporate bond assets.

Big 4 Insurers' asset losses
(S\$ million)



Source: IMF staff calculations.

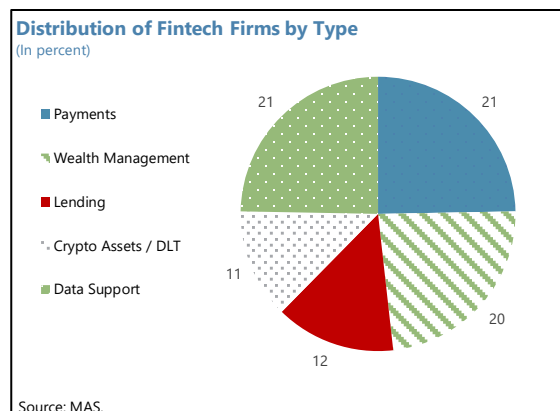
Notes: The solid blue bars represent in losses in asset values under the stress scenario. A negative loss represents a gain.

...BEING RESHAPED BY FINANCIAL INNOVATION

A. An Evolving Financial Landscape

26. Financial innovation holds the promise of having a far-reaching impact on Singapore's financial services sector.

The government of Singapore has an ambitious plan—the “Smart Nation Initiative”—to digitalize and transform the economy into a global technological innovation hub. In the financial services area, the MAS, since a little over three years ago, began efforts to promote fintech via innovative initiatives such as regulatory sandboxes, financial grants (the MAS has committed about US\$170 million for this purpose), training, and events (for example, with an annual fintech festival). Technology adoption in the financial sector can further expand financial services and lower the cost of financial intermediation, which has remained steady between 1.5 and 2 percent.



27. Most fintech activity in Singapore is geared to serving markets outside of Singapore or helping incumbents deliver more cost-effective financial services as opposed to disrupting existing business models.

Discussions with market participants suggest business segments relating to wealth management, trade finance, and payments could be particularly prone to disruption. In a hypothetical scenario where banks lose all the income from transaction and payment services and wealth management due to competition from fintech firms, the D-SIBs would experience 2 percentage points of capital impairment over the stress test horizon which is sizeable but manageable.

28. There are already several crypto-exchanges trading payment tokens in Singapore and their number may increase following the enactment of the new Payment Services Act (PS Act) in February 2019.

Some are also likely to expand their activities to securities tokens and crypto-derivatives. Still, financial institutions in Singapore have shown a conservative approach to crypto-asset investments and crypto-asset investments by Singaporean investors are relatively limited.

29. It will likely take time until adoption of fintech in Singapore becomes a factor that contributes to systemic financial risk. Furthermore, the MAS has the powers and flexibility to react quickly if needed to preserve stability, consumer protection, and financial integrity. At this time, the main risks to Singapore's financial sector potentially emanating from fintech appear to be the following:

- Operational and technology-related risks. As incumbent financial institutions are quickly moving toward digitalization and modernizing their front, middle, and back-end IT architectures, they are increasingly relying on new third-party service providers. Other sources of risk are banks' slow and rigid legacy systems.
- Financial integrity risks and reputational risk to the MAS. The expansion of use and trading of crypto-assets can create reputational and financial integrity risks. Until the enactment of the PS Act, crypto-assets—or digital tokens as they are referred to in Singapore—have been unregulated, except for securities tokens. The MAS has focused on warning investors about the risks of digital token investments and addressing money laundering and terrorist financing (ML/TF) risks. Still, financial stability risks from all types of tokens appear limited.
- Increased risk taking by incumbent firms. In principle, financial institutions' risk appetite could be expected to change over time in response to increased competition in existing business lines or to uncertainty surrounding the benefits of financial innovation.

B. Cyber Risk

30. The increasing digitalization of the financial system brought on by fintech has also raised the risk of cyber-attacks. The FSAP explored the importance of cyber-risk by surveying and interviewing banks and insurers, examining data, and conducting an event study analysis of the impact of past cyber events worldwide on banks' stock prices. So far, successful cyber-attacks in the Singapore financial sector have not caused significant financial losses. As part of the bottom-up stress tests, the MAS surveyed 18 banks and 17 direct general/composite insurers regarding their exposures to cyber-attacks. The FSAP team also discussed cybersecurity frameworks with the seven D-SIBs and the four largest insurers.

31. Banks identify the greatest cyber-related risks to be theft of money and disruption of normal operations, but they expect the associated losses to be manageable. Banks' losses were expected not to exceed about half of quarterly profits, before taking any management actions. Banks employ layers of security measures, including access controls, encryption, backups of systems and data, which are regularly tested and supported by continuous monitoring. Still, banks' responses suggest that some do not fully consider the negative impact arising from loss of confidence on the bank and the spillover effects from contagion within the financial system.

32. Direct insurers also expect the claims relating to cyber coverage to be manageable. Direct general insurers estimated the claims that they would incur if their ten largest clients of affirmative cyber coverage and their 10 largest clients of Property & Casualty insurance were victims of cyberattacks. Claims arising from these exposures amount to SGD 1.8 billion, which are shared between the direct insurers and their reinsurers and may be offset against a release of technical

reserves. The net losses reduce the aggregate capital adequacy ratio of these insurers by only 3 and 2 percentage points for affirmative and silent cyber coverage, respectively.³

POLICY FRAMEWORKS TO ENSURE A RESILIENT FINANCIAL SYSTEM

A. Financial Oversight

Overview

33. The strong oversight framework has been further enhanced in recent years, and many of the improvements correspond to the 2013 FSAP recommendations (Appendix I). The 2013 FSAP found the oversight framework to be “among the best globally,” a finding this FSAP confirmed. Since then, notably, the MAS has clarified, through amendments to the MAS Act, that in the event of conflicts between its prudential supervision and development objectives, the former prevails. This is important as the MAS is now playing an active role in promoting as well as supervising and regulating fintech developments.

Banking Sector

34. As mentioned on page 16, capital and liquidity requirements have been strengthened in line with Basel III. Furthermore, the MAS conducts regular and granular stress tests of bank solvency and liquidity. Finally, the MAS collects and monitors consistent data that are reasonably indifferent in their coverage to the legal form of the reporting bank and continues to actively engage home and host supervisors and parent bank management within the context of a risk-based supervisory framework.

35. In view of the vulnerability of D-SIBs foreign exchange liquidity to stress conditions, the MAS should seek to strengthen their U.S. dollar liquidity in a timely manner. As noted on page 19, the LCR in U.S. dollars is low at about 50 percent for D-SIBs and even lower for the domestic D-SIBs. The cashflow stress tests confirms the vulnerabilities in foreign currency liquidity. Given the importance of dollar funding and liquidity, banks should undertake more self-insurance against liquidity shocks by holding more high-quality liquid assets in U.S. dollars. The FSAP team discussed with the MAS several ways that this could be achieved. The MAS has chosen to use the supervisory process to encourage banks to improve their foreign currency liquidity positions. This approach seems feasible, given that it has been successful in reducing banks’ reliance on the FX swap market for funding normal U.S. dollar lending activity. That said, other jurisdictions have found it useful to introduce minimum requirements for foreign currency LCRs. The MAS should keep this option open if improvement in the monitored U.S. dollar LCR is not achieved through

³ Affirmative cyber coverage refers to any insurance policy that explicitly covers cyber risk in the policy wording. Silent cyber coverage refers to any insurance policy that could lead to a claim due to a cyber-attack and where ‘cyber’ is not mentioned in the policy wording (e.g., fire insurance, where a fire could be triggered by a cyber-attack).

the supervisory process. Any actions should be undertaken gradually to avoid disrupting banking or foreign exchange activity.

Financial Market Infrastructures

36. Singapore's financial market infrastructures (FMIs) have continued to operate safely and efficiently since they were assessed in the FSAP of 2013. The MAS has taken important steps to address the 2013 FSAP recommendations relating to capital market FMIs. Actions have been implemented or are in progress for the two central counterparties. In December 2018, the privately-operated securities settlement system moved its Singapore dollar settlements for equities and debt securities to settle at the MAS. Two additional central counterparties and one trade repository have also entered the FMI landscape. The MAS has signed a supervisory cooperation on crisis management arrangements with the U.S. authorities.

37. The safety of the payment system has been reinforced with legal and regulatory reforms. The MAS is prudently aiming for higher standards than the minimum set out in the Committee on Payment and Settlement Systems (CPSS)/ International Organization of Securities Commissions (IOSCO) Principles for Financial Market Infrastructures (PFMI). The Payment and Settlement Systems (Finality and Netting) Act was amended in 2018 to enhance insolvency protection, designation criteria, and administrative powers of the MAS. The PS Act was signed into law in February 2019 to address new activities and risks, following major changes in the payments landscape. Foreign exchange settlement risks in the financial landscape have been addressed following international supervisory guidance issued in 2013, with the MAS' supervisory expectations requiring banks to include the management of such risks in their counterparty risk management framework.

38. However, the part of the MAS that supervises the payment system seems stretched and should receive more resources. The PFMI assessment of the MAS responsibilities found that resources are not commensurate with the broad scope of its supervisory responsibilities and considering also the evolving payments landscape (Appendix II). Therefore, the MAS should increase resources for oversight and supervision of the payment systems. Additional resources would also be important to support the detailed annual assessment of MEPS+ and other payment systems. The assessment of MEPS+ against the PFMI finds that most principles are observed but identifies opportunities for further improvement relative to international best practices, namely on the principle on operational risk which is broadly observed (Appendix II).

B. Fintech

Outsourcing and Reputational Risk

39. The MAS has so far managed to strike a good balance in its dual role of promoting innovation and preserving financial safety and soundness. Overall, the MAS has taken a prudent and proactive approach to fintech. This is apparent in the way the regulatory sandbox was established and in changes to regulations to ensure they account for fintech developments.

For example, the MAS has published guidelines on digital advice and standards for third party risk management. Internally, the MAS has experimented with emerging technologies such as distributed ledger technology and data analytics. One area where a rebalancing seems required relates to outsourcing. For example, the MAS' updated outsourcing guidelines no longer require financial institutions to pre-notify the MAS even when they outsource critical functions.

40. That said, the potential for reputational risk from the regulatory sandbox will need to continue to be monitored and contained. The MAS is among several authorities globally to design and implement a regulatory sandbox. The sandbox is new, and the MAS has noted its benefits in facilitating innovation in a controlled environment. Importantly, the MAS ensures that participants in the regulatory sandbox apply full Anti-Money Laundering and Combating the Financing of Terrorism (AML/CFT) requirements. More broadly, while safeguards applied by the MAS limit the potential impact on the financial system resulting from a failure of any entity, heightened supervisory intensity may be needed during each stage of the sandbox period to contain reputational risk to the MAS. To mitigate potential reputational risk, the MAS should, within a risk-based framework, place emphasis on verification of compliance with risk management and other minimum standards (overlaid with a judgement of the residual risks posed) during the experimentation phase in the sandbox.

41. In addition, some aspects of operational risks deserve heightened supervisory intensity. The MAS recognizes the significance of information technology risk that is becoming more prominent as evidenced by (i) the additional guidance issued on outsourcing and technology risk management, and (ii) the organizational change that created the "Technology Risk and Payments Department." To complement the emphasis on operational risk, the mission recommends the following:

- Conduct more thematic reviews of operational risk heavy activities across the entire banking sector with a view to benchmarking best practices and communicating this benchmarking publicly. Doing this would be to the benefit of the industry and to the benefit of consistency of communication by supervisors on the same risk across different significant activities;
- Develop a full picture of the supervised firms and their Information and Communications Technology systems by mapping financial and technology connections across the sector to help identify potential systemic risks from interconnectedness and concentrations in third party service providers; and
- Formalize and clarify that the MAS may require pre-notification of material outsourcing arrangements where the MAS is not satisfied that a bank has managed its outsourcing risk adequately. Although the MAS has the supervisory powers and tools to impose additional conditions on banks that fail to establish or maintain appropriate systems and processes to address outsourcing-related risks, the absence of pre-notification of material outsourcing may not result in timely supervisory response.

Crypto-Assets

42. The scope of activities and global nature of Singaporean crypto-exchanges can create reputational risks to the MAS. The MAS' powers over crypto-services already cover securities tokens. Although the new PS Act enhances the MAS' powers over crypto-exchanges trading digital payment tokens, it focuses on risks to financial integrity and does not provide the MAS with the same type of prudential, investor protection, or market integrity powers as currently applied to crypto-exchanges trading securities tokens. Many crypto-exchanges operate through a global network of affiliated entities and are quick to change their structures to react to regulatory developments. The group entities typically share the same technology and any hack, failure or other incident in the systems used by the Singapore-based exchanges may create a reputational risk to the MAS despite it regulating only the Singapore-based entity primarily for AML/CFT purposes. The MAS plans to continue to educate and caution the public on the risks of digital tokens and the rationale for limiting its regulatory ambit to AML/CFT over digital token players during its public engagements.

43. Expanding crypto-activities call for close monitoring and willingness to expand regulation promptly, if warranted. The MAS has an exceptionally wide ability to extend its regulatory reach to other tokens through regulations. While the limited financial stability risks do not yet require using this power, it would be important that the MAS:

- Further enhances its investor education efforts to highlight risks to investors arising from differing regulatory frameworks for various types of digital token.
- Prepares to apply a cross-organizational supervisory approach over the expanding crypto-exchange sector to effectively address risks specific to the sector.
- Stands ready to expand its regulatory reach promptly, if warranted by market and industry developments in digital token services.

44. Singapore's AML/CFT approach to digital tokens is broadly in line with the current (and still evolving) Financial Action Task Force (FATF) standard but nevertheless requires further adjustments. The authorities are to be commended for their efforts to mitigate the ML/TF risks related to digital tokens. The enactment of the PS Act is a welcome development as it brings digital payment token service providers that were not already captured by the existing AML/CFT framework into the MAS' regulatory fold. Going forward, the MAS is encouraged to pursue efforts to bring custodian wallet service providers within its AML/CFT purview, ensure that the AML/CFT framework also applies to corporate digital token service providers created in Singapore, and issue the implementing regulations, notices, and guidelines under the PS Act. Singapore is also encouraged to ensure that the risk-based approach to AML/CFT regulation of providers of services related to digital tokens relies on a sound risk assessment, continue to follow the developments of the FATF standard related to Virtual Asset Service Providers and, if necessary, adjust the AML/CFT framework to the outcome of the FATF discussions.

C. Cyber Risk

Overview

45. The MAS is at the forefront of international efforts to reinforce cyber resiliency and to develop related international guidance. The MAS has led efforts to develop international guidance on cyber resiliency relating to payments and market infrastructures (e.g., the MAS co-chaired the CPMI/IOSCO Working Group on Cyber Resilience) and has moved swiftly to strengthen the resiliency of Singapore's systems. The 2018 Cybersecurity Act is important for promoting cyber security, and all banks are taking steps to strengthen their computer systems. The MAS has appointed a member in its Board-level Risk Committee who has specialist expertise and experience in technology and cyber risk management, and a Chief Cyber Security Officer to its senior management team to advise on strengthening the cyber resiliency of the MAS and the financial sector. A Cyber Resiliency Framework for the MAS-operated Critical Information Infrastructures (CIIs) has been established and the MAS established a Cyber Security Advisory Panel which includes international cyber security thought leaders. Still, as stated earlier, all financial institutions in Singapore noted concern about cyber threats. Mitigating and staying ahead of the risks in this rapidly evolving area will remain an analytical and policy challenge for policy makers and regulators in Singapore and worldwide.

46. The authorities are proactively developing an institutional framework for cybersecurity in the financial sector. The Cybersecurity Act of 2018 imposes responsibilities on the owners of computer systems that are designated as critical information infrastructures and defines rules for the licensing of cybersecurity service providers. The MAS is responsible for overseeing the cybersecurity of the financial sector. It is consulting with financial firms on a set of minimum regulatory requirements for cyber hygiene. The MAS employs information technology experts to conduct on-site inspections of financial institutions' cybersecurity practices and is training supervisors to include cybersecurity elements in their regular monitoring of individual financial institutions.

Surveillance of Cyber-Risk

47. To strengthen further its surveillance of cyber-risk, the MAS could develop a cyber network map. The MAS has been monitoring interconnectedness via financial exposures and cyber-interdependences in the financial system separately. An integrated monitoring of financial and Information and Communications Technology connections among firms (including financial market infrastructures and third-party service providers) could be useful for the MAS to identify interconnectedness, potential risk concentrations and common dependencies.

Financial Market Infrastructures—MEPS+

48. The MAS is encouraged to further enhance the cyber resiliency of the central bank and MEPS+. As elaborated in Appendix II, the mission has identified opportunities for improvement in view of rapid technological changes, evolving risks, and comparisons with international best practices, as follows.

- The role of the Chief Cyber Security Officer—a role held concurrently by the Executive Director of the Technology Risk and Payments Department (TRPD)—should be clarified. The clarification of the role and reporting line should ensure the independence of the TRPD. As the Chief Cyber Security Officer role, responsibilities, and resource implications continues to evolve, the MAS may consider if a full-time position is warranted.
- The MAS should continue to strengthen its management of cyber-related operational risk by enhancing enterprise-level cyber resiliency with mandatory information security awareness training and course completion for all MAS staff on a regular basis.

D. Macprudential Policy

The Framework

49. The MAS has a strong framework for macroprudential policy and has been proactive in using property-related tools. The MAS' proactive use of macroprudential policy demonstrates its ability and willingness to act to suppress emerging threats to financial stability. So far, macroprudential policy has focused on the property market given its importance for financial stability. The framework is also effective in ensuring appropriate cooperation and coordination with other institutions. It contains a clear mandate and well-defined objectives and the MAS has a dedicated financial stability unit with strong analytical capacity. The MAS also uses a range of communication tools that supports accountability.

50. The MAS has enhanced its cooperation with foreign supervisors to ensure effective implementation of macroprudential policies. The MAS has signed several memoranda of understanding with foreign counterparts for information sharing and cooperation, which enhanced the use of macroprudential tools. Furthermore, the MAS holds regular bilateral meetings with regional central bank counterparts to exchange views on macroprudential issues and participates in several international and regional fora with a focus on financial stability issues. Since some macroprudential risks are more cross-border in nature and some policy tools require cooperation to be effective, the MAS has reciprocity arrangements with other countries. This is important given the many foreign banks in Singapore and the importance of cross-border lending.

51. Coordination at the domestic level is facilitated by the concentration of responsibilities over financial stability in the MAS. Being the financial supervisor gives the MAS control and power over prudential tools which it may deploy as necessary in the pursuit of financial stability. An interagency taskforce on the property market serves as a platform for regular sharing of data and surveillance insights across the Ministry of Finance, the MAS, and the Ministry of National Development. The concentration of responsibilities of macroprudential policy and of financial supervision in the MAS ensures it has access to all relevant data. Policy coordination in crisis times is furthermore facilitated insofar as the management of financial crises may require policy action far beyond the relaxation of macroprudential tools, including monetary easing and emergency liquidity assistance by the central bank.

Systemic Risk Monitoring

52. The MAS has a sophisticated framework for systemic risk monitoring and oversight which could still be improved by closing data gaps. The MAS has improved the oversight of credit risk at banks through multi-year on-site inspection initiatives, guidance on credit underwriting and credit review, and the roll out of analytical tools to compare and evaluate more granular data collected from banks. The MAS also parses partial information on the relevant economic sectors from multiple sources. However, further data collection in the following areas would help the MAS' surveillance: (i) a more complete set of sectoral financial accounts—a complex undertaking for a country with extensive cross-border linkages like Singapore; (ii) domestic interlinkages; (iii) detailed information on the stock of property-related loans to the non-financial private sector at the borrower-level over time; (iv) household assets by income, linked to household debt; and (v) insurers' exposures to collective investment schemes, liability cashflow projection, and net open foreign exchange positions. The MAS should also consider alternative approaches to estimating the credit gap, recognizing changes in credit cycles, which will support timely and appropriate macroprudential policy actions.

E. Crisis Management and Resolution, and Safety Nets

53. The framework for crisis management and resolution has been strengthened since the 2013 FSAP and is broadly adequate. The MAS is the designated resolution authority for the financial sector. In 2017, the passage of amendments to the MAS Act strengthened the resolution framework and resolution tools. It introduced enhanced resolution powers and strengthened the framework for recovery and resolution of D-SIBs. These powers are for the most part consistent with international best practices as outlined in the Financial Stability Boards Key Attributes for Effective Resolution of Financial Institutions. Furthermore, the MAS conducts both individual and inter-institutional exercises to prepare itself for crisis management. The MAS, as the home regulator to three D-SIBs and host regulator for another four D-SIBs, is committed to cross-border cooperation crisis management and resolution. Although the MAS has never had to provide emergency liquidity assistance, it has the powers and has established the policies and mechanisms needed to provide back-stop liquidity.

54. There is scope to enhance some aspects of the resolution framework. For example, to align more closely with international best practices, the MAS should extend bail-in power to cover also unsecured senior creditors. Furthermore, the resolution functions at the MAS are divided broadly between supervisory units and the newly created Resolution Unit that replaced the previous ad hoc working group. However, given that resolution and resolution planning are highly specialized activities, it would be appropriate for the Resolution Unit to have a dedicated core staff that, over time, could take on an expanded role in resolution. Finally, although the resolution tools are well designed, the resolution plans still need to be operationalized by clarifying the procedures, sequencing, and timelines.

55. The funding arrangements for resolution aim at guaranteeing that any public sector support is temporary and eventually repaid by the industry. The decision not to extend bail-in to unsecured senior creditors exposes the public sector to potentially significant financing risks and

should be reversed. In the meantime, the current funding arrangements whereby the resolution fund is financed initially with public resources would be strengthened with clearer guidance from the MAS on the conditions and the pace of recovery of public funds. Moreover, the Resolution Fund can provide temporary liquidity to banks in resolution. Restructured entities should have access to central bank liquidity facilities as quickly as possible.

F. Financial Integrity

56. The FATF and the Asia Pacific Group on Money Laundering undertook a joint assessment of Singapore in 2016 which pointed to several strengths and some vulnerabilities.

The Mutual Evaluation Report (MER) found AML/CFT efforts in Singapore to be highly coordinated and sophisticated with a strong focus on enforcement activities. However, it considered that Singapore could improve its understanding of transnational money laundering and terrorist financing (ML/TF) threats and how specific vulnerabilities could be exploited, especially those related to the size and exposure of Singapore's private banking and its growing asset management industry. The MER also noted that beneficial ownership information may not be available on a timely basis for all types of entities and arrangements in Singapore.

57. Singapore should continue efforts to monitor and better understand the ML/TF risks associated with certain sectors or persons.

Since the assessment, a number of developments have occurred. In March 2017, Singapore formed a Risk and Typologies Inter-agency Group (RTIG) to identify new and emerging ML/TF risks and to coordinate efforts to address those risks. The RTIG is complemented by a government-industry partnership formed to discuss transnational finance risks and has identified the potential misuse of certain types of legal entities and arrangements, such as shell companies established by non-residents based overseas, as an area of focus. The RTIG is also in the process of completing a risk assessment of virtual currencies. Further, Singapore has improved the supervision of designated non-financial businesses and professions that may hold ownership information on legal entities and arrangements, including by enhancing risk-based supervision of company service providers. Enhanced supervisory measures include checking that proper customer identification and verification is carried out and records maintained. As of March 2017, companies and limited liability partnerships are required to maintain registers of their beneficial owners. Further, as of July 2017, all outstanding bearer shares that had not been converted to nominal shares were cancelled. Going forward, the priority actions for Singapore should be the continuation of efforts to better understand and mitigate the transnational ML/TF risks it faces and the specific risks associated with legal persons and arrangements that may be formed or administered in Singapore. Singapore should also continue to closely monitor the trust and company services sector.

Appendix I. Status of Key Recommendations of 2013 FSAP

No.	Recommendations in 2013 Financial System Stability Assessment (FSSA)	Status Update
1.	Increased attention to onsite inspections of banks' credit risk.	Implemented
2.	Monitor LCR ratios for significant foreign currencies.	Implemented
3.	Mitigate legal risks to CCPs from conflicts of law across jurisdictions.	Implemented
4.	The CCPs to explore with members the possibility of widening their collateral pool and examine the feasibility of receiving Singapore government securities as collateral to improve access to central bank liquidity in times of stress.	Implemented
5.	Consider subjecting loans for owner-occupied housing to a limit to be set by the MAS.	Not implemented
6.	Encourage over-extended households to reduce their leverage.	Implemented
7.	Stand ready to adjust macroprudential measures in the housing market in line with changes in market conditions.	Implemented
8.	Further strengthen banks' capital framework, with implementation of the countercyclical capital buffer in line with the Basel III timelines.	Implemented
9.	Further develop SGX recovery plans, identifying additional scenarios.	Implemented
10.	Upgrade the collateral that covers credit exposures related to the link with the Chicago Mercantile Exchange (CME).	Not implemented
11.	Formalize bilateral cooperative crisis management agreements for FMIs.	Implemented
12.	Collect more granular data on household balance sheets, drawing on surveys and strengthened credit bureau practices.	Implemented

No.	Recommendations in 2013 FSSA (continued)	Status Update
13.	Authorize the Singapore Deposit Insurance Corporation (SDIC) to provide support, on a least-cost basis, for the transfer of deposit liabilities to a bridge bank or healthy institution.	Implemented
14.	Ensure that the banking industry adequately contributes to the costs of bank failures.	Implemented
15.	Further facilitate cross-border cooperation in bank resolution.	Implemented
16.	Consider changes to the structure of the MAS Board to strengthen operational independence in financial supervision.	Not implemented
17.	Ensure that the MAS' mandate for prudential supervision is not compromised by its developmental mandate.	Implemented
18.	Review and strengthen the resolution framework to enhance the MAS' operational independence in bank resolution.	Not implemented

Appendix II. Report on the Observance of Standards and Codes: CPSS-IOSCO Principles for Financial Market Infrastructures— Summary Assessment

A. Introduction

1. **This report contains the assessment of Singapore’s systemically important payment system and authorities’ responsibilities against international standards.** The assessment was undertaken in the context of the IMF’s FSAP mission to Singapore from October 29 to November 14, 2018.¹
2. **The objective of the assessment was to identify potential risks that may affect financial stability. The scope of the assessment includes the MEPS+ and its authority, the Monetary Authority of Singapore (MAS).**² The MAS-operated FMIs includes the MEPS+, which functions as an interbank funds transfer system, and a central securities depository and a securities settlement system for government securities and MAS Bills. The assessment focuses on the inter-bank funds transfer functions of MEPS+. MEPS+ is assessed using 18 of the 24 principles that are generally applicable for payment systems under the PFMI. The MAS’ regulatory, supervisory, and oversight responsibilities are assessed against Responsibilities A to E of the PFMI.
3. **The methodology for the assessments is based on the PFMI Disclosure Framework and Assessment Methodology.**³ Important sources of information included the self-assessment report and disclosure framework of MEPS+ completed by the operators of MEPS+, self-assessment report of MAS responsibilities prepared by the overseers and supervisors of MEPS+, responses to the Questionnaire on FMIs in Singapore, and relevant laws and regulations. The assessor had thorough discussions with MAS staff and private sector representatives.

B. Main Findings

4. **Singapore’s financial market infrastructures (FMIs) have continued to operate safely and efficiently since they were assessed in the FSAP of 2013.** The MAS has taken important steps to address the recommendations made for capital market FMIs. Remedial actions were implemented or are in progress for the two central counterparties. The privately-operated securities settlement system has moved its SGD money settlements for equities and debt securities to settle at the MAS in December 2018. Two additional central counterparties and one trade repository have also entered

¹ The assessor was Tanai Khiaonarong.

² The assessment follows the definition and analytical approach established in the PFMI, which considers FMIs as multilateral systems inclusive of their participants and operator.

³ The methodology could be used by external assessors to draw comparisons at the international level to identify best practices. In addition, the questions under the key considerations for each principle in the PFMI are not intended to serve as a checklist or to be exhaustive. Assessors, at their discretion, could pose additional or different questions as needed, in particular to address the different levels of complexity of the FMI.

the FMI landscape. The MAS has signed a supervisory cooperation on crisis management arrangements with the U.S. authorities.

5. The payment system was further protected with legal and regulatory reforms. The Payment and Settlement Systems (Finality and Netting) Act was amended in 2018 to enhance insolvency protection, designation criteria, and administrative powers of the MAS. A Payment Services Bill to address new activities and risks, following major changes in the payments landscape, was proposed in 2017 and is expected to be introduced to Parliament in late-2018. Foreign exchange settlement risks in the financial landscape were addressed following international supervisory guidance issued in 2013, with MAS supervisory expectations requiring banks to include the management of such risks in their counterparty risk management framework.

6. The MAS has led efforts to develop international guidance on the cyber resilience for FMIs and moved swiftly to strengthen Singapore's governance and resiliency of the payment system. The MAS co-chaired the Committee on Payments and Market Infrastructures (CPMI)/International Organization of Securities Commissions (IOSCO) Working Group on Cyber Resilience, which prepared the international guidance. The MAS has appointed a member in its Board-level Risk Committee who has specialist expertise and experience in technology and cyber risk management, and also a Chief Cyber Security Officer to its senior management team to advise on strengthening the cyber resiliency of the MAS and the financial sector. A Cyber Resiliency Framework for MAS-operated Critical Information Infrastructures (CIIs) has been established. Efforts are ongoing to manage potential operational risks that could stem from cyber risks, and they include expanding surveillance coverage, reinforcing protection capabilities, reducing time to recover, and developing cyber competencies. The MAS established a Cyber Security Advisory Panel, including international cyber security thought leaders.

7. The MAS' pioneering role in cyber resiliency is also demonstrated in its practices, which are higher than minimum requirements and help strengthen the safety of FMIs. Given that Singapore is a modern financial center with a systemically important financial system, the MAS is right in aiming for higher standards than the minimum set out in the Committee on Payment and Settlement Systems (CPSS)/IOSCO Principles for Financial Market Infrastructures (PFMI). And it is particularly important to do so considering the evolving financial landscape, new technologies, and potential risks since the issuance of the international standards in 2012. The MAS' potential to aim for higher standards in many other areas of the PFMI are also evident in the assessment results for the MEPS+ inter-bank funds transfer sub-system and MAS responsibilities.

8. The assessment of MEPS+ finds that most of the principles are observed, but also identifies opportunities for further improvement relative to international best practices. MEPS+ observes 17 principles and broadly observes one principle, which is on operational risk. Six principles were not applicable. To achieve full observance for operational risk, enhancements to the cyber resiliency of the central bank and MEPS+ would need to be substantially implemented. While MEPS+ has observed most of the minimum standards of the PFMI, the mission has identified opportunities for improvement in view of rapid technological changes, evolving risks, and comparisons with international best practices that the authorities may want to consider:

- **Governance (Principle 2).** As the Chief Cyber Security Officer is a new and important role which is held concurrently by the Executive Director of the Technology Risk and Payments Department (TRPD), which is the overseer and supervisor of MEPS+, the clarification of the role and reporting line should ensure the independence of the TRPD. The objective would be to prevent perceived or potential conflicts of interest between the oversight and operational responsibilities for MEPS+. The TRPD head is a member of the Management Financial Supervision Committee, which is the governing oversight body of MEPS+. The Chief Cyber Security Officer, whose appointment is currently held by the TRPD head, is also a member of the Management Critical Information Infrastructure Committee, which is responsible for the operations of MEPS+. As the Chief Cyber Security Officer role, responsibilities, and resource implications continues to evolve, the MAS may consider if a full-time position is warranted.
- **Comprehensive risk management framework (Principle 3).** In the near to medium term, FMIs might adopt distributed ledger technology to handle different asset classes such as for cash, securities and foreign exchange. The MAS should analyze and identify the potential risks for MEPS+ guided by the CPMI analytical framework for distributed ledger technology in payment, clearing and settlement. This framework considers risk implications such as legal basis, governance, settlement finality, financial risk, and operational risk.
- **Operational risk (Principle 17).** With the worldwide heightening of cyber risks, the MAS should: (i) enhance enterprise-level cyber resiliency with mandatory information security awareness training and course completion for all MAS staff on a regular basis; (ii) apply ratings in the annual self-attestations submitted by MEPS+ critical service providers to support the continuation of critical services for MEPS+ and ensure that the external audit is completed against acceptable national or international standards; and (iii) monitor the compliance of MEPS+ participants with the mandatory controls of the Society for Worldwide Interbank Financial Telecommunication (SWIFT) Customer Security Program, and ensure that self-attestations are audited.
- **Disclosure of rules, key procedures and market data (Principle 23).** To further enhance transparency and thus foster public understanding and confidence in the payment system, the MAS should consider public disclosure of additional information on material developments and quantitative indicators such as MEPS+ system availability, average daily liquidity, and throughput time in the MEPS+ disclosure framework. This is particularly important with operational incidences associated with MEPS+, FMI interdependencies, and MEPS+ critical service providers.

9. The assessment of MAS responsibilities finds that most responsibilities are also observed. Responsibility B on powers and resources is assessed as having broad observance because of resource constraints relative to the broad scope of responsibilities and in light of the evolving payments landscape. Potential opportunities for improvement relative to international best practices are as follows.

- **Regulatory, supervisory, and oversight powers and resources (Responsibility B).** In view of its broad mandate and increased responsibilities, the MAS should increase resources for the payment systems oversight and supervision unit of the TRPD. The unit is responsible for the oversight and supervision of MEPS+, five privately-operated designated payment systems, and credit bureaus. The unit also participates in the cooperative oversight of a cross-border payment system and SWIFT. The unit has a limited number of staff working on payment systems oversight and supervision. Sufficient resources would support the detailed annual assessment of MEPS+ and other payment systems, which could evolve in systemic importance.
- **Disclosure of policies with respect to FMIs (Responsibility C).** To further enhance transparency in its oversight and supervisory responsibilities, the MAS should consider: (i) enhancing the independent review of MEPS+ with an annual assessment report with ratings prepared by the TRPD, endorsed by the Management Financial Supervision Committee, and publicly disclosed; and (ii) publishing an annual report on FMI and payments for Singapore, including the policies, assessment results, and risk analysis for the MEPS+.
- **Application of the PFMI (Responsibility D).** To clarify the application of the PFMI, the MAS should consider: (i) revising the Monograph on Supervision of Financial Market Infrastructures to describe the standards used for designated system-wide important payment systems and the associated risks assessed relative to the PFMI; and (ii) assessing on an annual basis the need to apply the PFMI to system-wide important payment systems with respect to horizon-scanning and changes in their risk profiles (such as value limit increases, cross-border features).

C. Summary Assessment of MEPS+

Principle	Comments
Legal basis	The legal basis is sound with further enhancements made for insolvency protection, designation criteria, and administrative powers for the MAS.
Governance	Governance arrangements are clear and transparent and should continue to ensure the independence of the oversight and supervisory functions for MEPS+.
Framework for the comprehensive management of risks	MEPS+ has a sound risk management framework where operational, credit, liquidity and legal risks have been identified, but should include potential Distributed Ledger Technology (DLT)-related risks.

Principle	Comments
Credit risk	The MAS does not face credit risk as the operator of MEPS+. As the central bank, the MAS mitigates its exposure to credit risk by requiring participants to provide collateral against borrowing from MEPS+ participants.
Collateral	Collateral with low risks are accepted to manage credit exposures from participants and are subject to valuation and conservative haircuts.
Margin	Not applicable.
Liquidity risk	The MAS does not face liquidity risk as the operator of MEPS+.
Settlement finality	Settlement finality is clear and certain in MEPS+.
Money settlements	Payments in MEPS+ settle in SGD only on a real-time gross settlement basis in central bank money.
Physical deliveries	Not applicable.
Central securities depositories	Not applicable.
Exchange-of-value settlement systems	Principal risks arising from the settlement of securities transactions are eliminated through delivery versus payment capabilities in MEPS+.
Participant-default rules and procedures	MEPS+ has clearly defined rules and procedures to manage a default by a participant and it has an annual contingency drill and testing of its default procedures.
Segregation and portability	Not applicable.
General business risk	The MAS manages the general business risks of operating MEPS+ based on the enterprise-wide budgeting and accounting processes.
Custody and investment risks	As the operator of MEPS+, the MAS does not use commercial custodian services for its own or participants' assets (cash, SGS and MAS Bills).
Operational risk	The MAS monitors and manages MEPS+ operational risks based on international and national standards as well as MAS-issued guidelines and notices on financial institutions.

Principle	Comments
Access and participation requirements	MEPS+ access and participation requirements include publicly disclosed risk-based criteria, which permit fair and open access.
Tiered participation arrangements	The MAS monitors and manages the material risks to the FMI arising from tiered participation arrangements in MEPS+.
FMI links	Not applicable.
Efficiency and effectiveness	MEPS+ efficiency and effectiveness are measured by the extent to which the operational standards and targets are met.
Communication procedures and standards	MEPS+ uses internationally accepted communication procedures and standards.
Disclosure of rules, key procedures, and market data	MEPS+ operating rules and procedures are documented in the MEPS+ Service Agreement and the Operations and Contingency Manual, which are made public.
Disclosure of market data by trade repositories	Not applicable.

D. Summary Assessment of Authorities' Responsibilities

Responsibility	Comments
Regulation, supervision, and oversight of FMIs	MEPS+ is subject to appropriate and effective regulation, supervision, and oversight by the MAS.
Regulatory, supervisory, and oversight powers and resources	The MAS is the sole authority in Singapore responsible for the regulation, supervision and oversight of all the payment systems in the country. There appears to be insufficient resources for discharging oversight and supervisory responsibilities for MEPS+ relative to the current and future scope of responsibilities of the TRPD.
Disclosure of policies with respect to FMIs	The MAS' approach to supervision of FMIs is described in the publicly available Monograph on the Supervision of FMIs in Singapore. The MAS should consider further enhancing transparency in its oversight and supervisory responsibilities.

Responsibility	Comments
Application of the principles for FMIs	The MAS adopts the PFMI in its supervision of systemically important payment systems and should consider clarification on its application of the PFMI.
Cooperation with other authorities	CLS is the only SIPS which is subject to cooperative oversight and has participation from the MAS. The MAS, as a sector lead, works with the Cyber Security Agency of Singapore to strengthen the cyber resilience of the Critical Information Infrastructures in the banking and finance sector.

E. Recommended Actions for MEPS+

Principle	Comments
Governance	Clarify the role and reporting line for the Chief Cyber Security Officer with a view to ensure the separation of MEPS+ oversight and operational responsibilities.
Framework for the comprehensive management of risks	Analyze and identify the potential implications for safety for MEPS+ against the CPMI analytical framework for distributed ledger technology in payment, clearing and settlement.
Operational risk	<p>Enhance enterprise-level cyber resiliency with mandatory information security awareness training and course completion for all MAS staff on a regular basis.</p> <p>Apply ratings in the annual self-attestations submitted by MEPS+ critical service providers to support the continuation of critical services for MEPS+ and ensure that external audit is completed against acceptable national or international standards.</p> <p>Monitor the compliance of MEPS+ participants with the mandatory controls of the SWIFT Customer Security Program, and ensure self-attestations are audited.</p>
Disclosure of rules, key procedures, and market data	Disclose additional information on material developments and quantitative indicators on system availability, average daily liquidity, and throughput time in the MEPS+ disclosure framework.

F. Recommended Actions for Authorities' Responsibilities

Responsibility	Comments
Regulatory, supervisory, and oversight powers and resources	Increase resources for the payment systems and oversight unit of the TRPD, which is responsible for the oversight and supervision of MEPS+, designated payment systems, CLS, credit bureaus, and major MEPS+ participants.
Disclosure of policies with respect to FMIs	Enhance the independent review of MEPS+ with an annual assessment report with ratings prepared by the TRPD, endorsed by the MFSC, and publicly disclosed. Enhance the transparency of MAS FMI responsibilities, including MEPS+, by publishing an annual report on FMI and payments for Singapore, which could include analysis of associated risks for MEPS+.
Application of the principles for FMIs	Revise the Monograph on Supervision of FMIs to describe the standards used for designated system-wide important payment systems and the associated risks which are assessed relative to the PFMI. Assess on an annual basis the need to apply the PFMI to system-wide important payment systems, based on horizon-scanning and changes in their risk profiles (value limit increase, cross-border features) and systemic importance.

G. Authorities' Response to the Assessment

10. MAS welcomes the IMF's assessment of Singapore's systemically important payment system and authorities' responsibilities against the PFMI and wishes to express its appreciation to the IMF and its assessors for the constructive dialogue and assessment.

Governance (Principle 2)

11. MAS notes IMF's observation that the CCSO is a member of the CIIC, and the CCSO role is concurrently held by the Executive Director of TRPD, which is the overseer and supervisor of MEPS+. At the time of appointment of CCSO in October 2017, Executive Director of TRPD was assessed to be the most qualified person for the CCSO role. MAS is of the view that there is no material conflict of interest as CCSO advises CIIC on adequacy and appropriateness of MEPS+'s

cyber security arrangements and is not responsible for MEPS+ operations. Nonetheless, MAS will review the need for greater clarity of the CCSO role to more fully achieve the separation of operational and oversight responsibilities over MEPS+.

Comprehensive risk management framework (Principle 3)

12. MAS agrees with IMF’s observation on the potential adoption of DLT by FMI in the near to medium term, and its potential risks to MEPS+. MAS will review and analyze the potential implications of DLT on the safety of MEPS+ against the CPMI analytical framework for distributed ledger technology in payment, clearing and settlement before it makes the decision, to either adopt DLT for MEPS+ or interface DLT-based systems with MEPS+.

Operational Risk (Principle 17)

13. MAS notes IMF’s observation on MAS’ ongoing efforts to manage potential operational risks that could stem from cyber risks, and these efforts include expanding surveillance coverage, reinforcing protection capabilities, reducing time to recover, and developing cyber competencies. The assessors have also observed that there are a few areas for improvement in MAS’ information and cyber security training to staff, oversight of MEPS+ critical service providers and monitoring of MEPS+ participants’ end-point security.

14. On enhancing enterprise-level information security, MAS agrees that it is critical for all MAS staff to be cyber vigilant. MAS staff are apprised of latest developments in information security risks through regular advisories. All staff are also required to complete a mandatory information security e-learning module and pass the accompanying assessment test. This mandatory e-learning module will be continually updated to reflect the evolving information security threat and risk landscape. Additional initiatives will be explored to enhance enterprise-level cyber vigilance of all staff, including the conduct of more frequent phishing exercises.

15. On oversight of MEPS+ critical service providers, MAS agrees with IMF’s recommendation to apply ratings in the annual self-attestations submitted by the MEPS+ critical service providers that support the continuation of critical services for MEPS+. All external audits will be completed against acceptable national or international standards.

16. On MEPS+ participants’ end-point security, MAS agrees with IMF’s recommendation to monitor the compliance of MEPS+ participants with the mandatory controls of the SWIFT Customer Security Program and ensure that the participants’ self-attestations are audited.

Disclosure of rules, key procedures and market data (Principle 23)

17. MAS notes IMF’s observation that MEPS+ has met the disclosure requirements in Principle 23. MAS also notes that the assessors had drawn comparisons to international best practices on the extent of disclosure. To further enhance transparency and foster public understanding and confidence in MEPS+, MAS will review IMF’s recommendation on the disclosure of additional information on material developments and quantitative indicators on system availability,

average daily liquidity, and throughput time in the MEPS+ PFMI Disclosure that is published on the MAS website.

Regulatory, Supervisory, and Oversight Powers and Resources (Responsibility B)

18. In light of the evolving payments landscape, MAS agrees that it is timely to review the resource requirements for the supervision of payment systems.

Disclosure of Policies with Respect to FMIs (Responsibility C)

19. Responsibility C does not require overseers of payment systems to publicly disclose the results of their independent assessment of the systems or publish a consolidated report on FMI. Nonetheless, MAS acknowledges that the publication of the overseer's assessment of MEPS+ will enhance accountability to the public given that MEPS+ is also operated by MAS. MAS will discuss the frequency of disclosure, the forum to endorse the report and the form in which such information would be best presented. On the publication of a consolidated report, MAS publicly discloses important developments on FMIs supervised by us on a regular basis through various means, such as press releases, speeches and public documents. MAS is of the view that the current approach is adequate for the transparency of MAS' responsibilities over FMIs.

Application of the Principles for FMIs (Responsibility D)

20. MAS agrees with IMF's recommendation to revise the Monograph on Supervision of FMIs to describe the standards used for designated system-wide important payment systems and the associated risks which are assessed relative to the PFMI. MAS will also annually assess the need to apply the PFMI to system-wide important payment system.

Appendix III. Stress Testing Matrix (STeM)

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
Banking Sector: Solvency Stress Test				
1. Institutional Perimeter	Institutions included	<ul style="list-style-type: none"> All seven D-SIBs (10 banks). 	<ul style="list-style-type: none"> All seven D-SIBs (10 banks). 	<ul style="list-style-type: none"> All seven D-SIBs (10 banks).
	Market share	<ul style="list-style-type: none"> 75 percent of total loans to private residents. 	<ul style="list-style-type: none"> 75 percent of total loans to private residents. 	<ul style="list-style-type: none"> 75 percent of total loans to private residents.
	Data and starting position	<ul style="list-style-type: none"> Bank proprietary data. Starting position: 2018Q2 and projected to end-2018 under the baseline scenario. Bank consolidated level data for banks having their headquarters in Singapore and unconsolidated data for foreign bank subsidiaries and branches. 	<ul style="list-style-type: none"> Supervisory data (balance sheet and income statements). Starting position: 2018Q2 and projected to end-2018 under the baseline scenario. Bank consolidated level data for banks having their headquarters in Singapore and unconsolidated data for foreign bank subsidiaries and branches. 	<ul style="list-style-type: none"> Supervisory data (balance sheet and income statements). Starting position: 2018Q2 and projected to end-2018 under the baseline scenario. Bank consolidated level data for banks having their headquarters in Singapore and unconsolidated data for foreign bank subsidiaries and branches.
2. Methodology	Overall framework	<ul style="list-style-type: none"> Balance sheet approach Banks' own internal stress testing methodology. 	<ul style="list-style-type: none"> Balance sheet approach. Satellite models and stress testing methodology developed by the MAS. 	<ul style="list-style-type: none"> Balance sheet approach. Satellite models and stress testing methodology developed by the FSAP team.

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
	Satellite models for macro-financial linkages	<ul style="list-style-type: none"> Banks' own internal models to translate macrofinancial conditions into pre-loss net income, credit and market losses, and regulatory capital. Three local banks use both standardized approach and internal ratings-based approach to measure the credit risk of their loan portfolios, while foreign D-SIBs use only the standardized approach. For example, the average EAD for residential mortgages under the internal ratings-based approach as a proportion of total credit EAD / exposures for residential mortgage is 88 percent among three local banking groups. 	<ul style="list-style-type: none"> MAS' satellite model to estimate PD and LGD dynamics and credit losses SFRS109 framework to calculate loan loss provisioning needs. Market losses from bottom-up submission. Method to integrate credit and funding losses from interbank cross-exposures into the solvency stress test. Method to calculate risk-weighted assets. Model to estimate pre-loss net income as a sum of net interest income and non-interest income. No accrued income on NPL loans. 	<ul style="list-style-type: none"> FSAP team's own model for credit losses from banks' lending portfolios. SFRS109 framework to calculate loan loss provisioning needs. Method to calculate market losses from holdings of debt instruments (sovereign and other issuers). Haircuts are calculated based on a modified duration approach. Method to integrate credit and funding losses from interbank cross-exposures into the solvency stress test. Method to calculate risk-weighted assets. Model to estimate pre-loss net income as a sum of net interest income and non-interest income. No accrued income on NPL loans.
	Stress test horizon	<ul style="list-style-type: none"> 3-years (2019-2021). 	<ul style="list-style-type: none"> 5-years (2019-2023). 	
	Assumption	<ul style="list-style-type: none"> Banks' own internal stress testing methodology. 	<ul style="list-style-type: none"> Passive balance sheet assumption: (i) the balance sheet growth is identical to the overall credit growth, which is linked to nominal GDP growth; (ii) the balance sheet composition remains constant throughout the stress test horizon; (iii) banks build capital only through retained earnings; and (iv) maturing capital instruments are not renewed. Banks can pay dividends only if net income after taxes are positive. 	
3. Type of analyses	Scenario analysis	<ul style="list-style-type: none"> Three macrofinancial scenarios, agreed with the authorities. The scenarios include domestic macrofinancial variables (e.g., GDP, inflation, interest rates, unemployment rate, exchange rate, equity and house prices), and global variables (global GDP, interest rates, and commodity prices). All the scenarios are generated in collaboration between the MAS and the IMF FSAP team, using MAS' Monetary Model of Singapore and IMF's Global Macrofinancial Model. Baseline scenario based on the July 2018 WEO projections. Two adverse scenarios reflect macrofinancial risks in the Risk Assessment Matrix. All 		

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
		<p>of them are triggered by external factors but amplified by domestic vulnerabilities.</p> <ul style="list-style-type: none"> - Scenario 1. Large-scale global financial market turmoil. - Scenario 2. Protracted recession centered on a major slowdown in China and trade tensions. <ul style="list-style-type: none"> • Under the two adverse scenarios, the Singaporean economy sets to suffer a recession, with the output gap being -8.4 percent and -12.3 percent and the cumulative decline of real GDP growth being 1.7 and 2.3 standard deviations over the first two and three years, respectively. These shocks are unprecedentedly in Singapore. • The SGD/USD bilateral exchange rate would depreciate by 20 percent in 2019 under the adverse scenario 1, equal to 3.7 standard deviation of the annual exchange rate movement (y-o-y). 		
	Sensitivity analysis	N.A.	<ul style="list-style-type: none"> • Sensitivity analyses will also be conducted in the top-down exercises. • They evaluate impacts of different risk factors on NPL and capital ratios: <ul style="list-style-type: none"> - GDP and unemployment - Property prices - Commodity prices - Exchange rates - Interest rates 	<ul style="list-style-type: none"> • Sensitivity analyses will also be conducted in the top-down exercises. • They evaluate impacts of four different single risk factors on the existing capital buffers: <ul style="list-style-type: none"> - Exchange rate risk - Interest rate risk - Hypothetical decline of non-interest income due to FinTech development - Concentration risk from default of largest private borrowers
4. Risks and Buffers	Risks	<ul style="list-style-type: none"> • Credit loss captures all exposures in on-balance sheet's loan portfolios and off-balance sheet credit commitments. • Market loss from valuation adjustments of banks' holding of debt securities and exchange rate risk on the net open foreign exchange positions. 		<ul style="list-style-type: none"> • Credit loss captures all exposures in on-balance sheet's loan portfolios and off-balance sheet credit commitments. • Market loss from valuation adjustments of banks' holding of debt securities and exchange rate risk on the net open foreign exchange positions. • Credit and funding losses from interbank cross-exposures.
	Buffers	<ul style="list-style-type: none"> • Existing capital buffers. • Internal capital generation from net income after taxes. 		

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
		<ul style="list-style-type: none"> No. 		
5. Regulatory Standards	Regulatory Standards	<ul style="list-style-type: none"> National new capital injection regulatory framework: MAS Notice 637 and 612. Fully loaded Basel III. 		
6. Reporting Format for Results	Output presentation	<ul style="list-style-type: none"> System-wide capital shortfalls from macroprudential perspectives. Hurdle rates <ul style="list-style-type: none"> Baseline scenario: the sum of regulatory minimum (CET1, Tier1, and total capital), D-SIB surcharge, capital conservation buffer, and countercyclical capital buffer. Adverse scenarios: the sum of regulatory minimum and D-SIB surcharge. 		
Banking Sector: Liquidity Stress Test				
		Top-down by the authorities and FSAP team jointly		
1. Institutional Perimeter	Institutions included	N.A.	<ul style="list-style-type: none"> All seven D-SIBs (10 banks) 	
	Market share	N.A.	<ul style="list-style-type: none"> 76 percent of total deposits of private residents. 	
	Data and Starting position	N.A.	<ul style="list-style-type: none"> Starting position: 2018Q2. Robustness will be investigated using data for 2018Q3. Supervisory data. Bank consolidated level data for banks having their headquarters in Singapore and unconsolidated data (i.e., Singapore operations only) for foreign bank subsidiaries and branches. 	
2. Methodology	Overall framework	N.A.	<ul style="list-style-type: none"> Stress test of the LCR, by applying higher rates of cash outflow, lower rates of cash inflow, and haircuts to liquid asset values. This simulates the liquidity position, as measured by the LCR, in a stress scenario. The all-currency and Singapore dollar LCRs will be stressed. 	<ul style="list-style-type: none"> The FSAP liquidity stress test comprises two types of tests: (i) LCR-based stress test and (ii) cashflow-based test. The LCR-based test will be aligned with that of the authorities, using the authorities' calculation software. The cashflow-based test projects the bank's liquid asset position under stress conditions of up to six months, based on the contractual maturity profile of assets and liabilities. The cashflow-based test will be applied to liquid assets in all currencies, Singapore dollars and

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
				U.S. dollars separately. <ul style="list-style-type: none"> The NSFR and U.S. dollar LCR will be inspected, without being stressed. There is no minimum requirement for the U.S. dollar LCR.
3. Type of analyses	Scenario analysis	N.A.	<ul style="list-style-type: none"> The LCR-based stress tests consider retail and wholesale scenarios separately. They are designed to be similar to those used in other FSAPs but are elaborated to emphasize features and potential vulnerabilities of the Singapore context. They include delays in cash inflows from derivatives and margin calls on derivatives. They explicitly model the effects of a depreciation of the Singapore dollar on the all-currency LCR. These scenarios are agreed with the authorities. The cashflow-based stress tests consider 1-week and 6-month stress scenarios. The parameters of the scenarios are calibrated with reference to the first year of Scenario 1 in the bank solvency stress tests, international experience of bank liquidity stress episodes and past FSAP practices. Run-off rates on deposits are calibrated to a two-standard deviation fall in historical supervisory data on deposit balances. Run-off and roll-off rates on FX swaps are also calibrated to a two-standard deviation scenario, but since trade volumes in FX swaps are not observed, liquidity in the FX swap market is proxied by bid-ask spreads on FX forwards. 	
4. Risks and Buffers	Risks	N.A.	<ul style="list-style-type: none"> Contraction in the supply of funding to the bank (so-called "funding liquidity stress") Increased demand by the bank's clients for renewal of maturing loan contracts Reduced ability of the bank's clients to repay the bank on time Falling asset prices, possibly due to fire sales (so-called "market liquidity stress"). For the LCR-based test, some depreciation of the Singapore dollar is included. 	
	Buffers	N.A.	<ul style="list-style-type: none"> The buffer in the LCR-based test is the excess value of high-quality liquid assets over the regulatory requirement (which varies by currency and bank type). High quality liquid assets are as defined in the domestic implementation of the LCR. The buffer in the cashflow-based test is the value of liquid assets (so-called "counterbalancing capacity"). This buffer includes notes and coins, deposits at the 	

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
			<p>central bank, deposits at commercial banks, and securities. Securities may be monetized before their maturity.</p> <ul style="list-style-type: none"> The cashflow-based test is agnostic about the use of standing facilities or markets to monetize high quality assets, but it precludes the use of emergency liquidity facilities or liquid assets backing reserve requirements. 	
5. Regulatory Standards	Regulatory standards	N.A.	<ul style="list-style-type: none"> National regulatory framework. The LCR is defined as in MAS Notice 649. The hurdle is set at a Singapore dollar LCR of 100 percent for all banks, an all-currency LCR of 100 percent for local banks, and an all-currency LCR of 50 percent for foreign banks. The hurdle for the cashflow-based test is zero Singapore dollars. 	
6. Reporting Format for Results	Output presentation	N.A.	<ul style="list-style-type: none"> The authorities will use the results to inform their supervisory process and share headline results in the industry sharing sessions and Financial Stability Review. 	<ul style="list-style-type: none"> System-wide LCR and liquid asset shortfalls under the LCR stress scenarios System-wide liquid asset value under the cashflow-based stress scenarios.
Insurance Sector: Solvency Stress Test				
1. Institutional Perimeter	Institutions included	<ul style="list-style-type: none"> 9 largest direct life insurers and 15 largest general insurers 	<ul style="list-style-type: none"> The 4 largest direct life insurers 	<ul style="list-style-type: none"> The 4 largest life/composite insurers
	Market share	<ul style="list-style-type: none"> At least 80 percent of total assets (life insurers) At least 80 percent of gross written premiums (general insurers) 	<ul style="list-style-type: none"> 80 percent of total assets 	<ul style="list-style-type: none"> 80 percent of total assets
	Data and starting position	<ul style="list-style-type: none"> Starting position: 2018Q2 Each insurer's own data 	<ul style="list-style-type: none"> Starting position: 2018Q2 Supervisory data Only life insurance activities of these insurers will be included Within life insurance, for interest rate shocks on liability, the liability cash flows for investment-linked business, non-participating term life and non-participating accident and health are 	<ul style="list-style-type: none"> Starting position: 2018Q2 Supervisory data Only life insurance activities of these insurers will be included Within life insurance, for interest rate shocks on liability, the liability cash flows for investment-linked business, non-participating term life and non-participating accident and health are

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
			excluded (7 percent of liability for guaranteed cash flows including provision for adverse deviation in the sector).	excluded (7 percent of liability for guaranteed cash flows including provision for adverse deviation in the sector).
2. Methodology	Overall framework	<ul style="list-style-type: none"> • Projection of the regulatory capital position under several scenarios • Each insurer's own internal methodology 	<ul style="list-style-type: none"> • Projection of the regulatory capital position under a severe yet plausible macroeconomic stress scenario • The capital position will be modelled by revaluing assets and liabilities under the scenario • Static balance sheet approach, where the impact of the entire scenario is evaluated in one step 	<ul style="list-style-type: none"> • Projection of the regulatory capital position under a severe yet plausible macroeconomic stress scenario • The capital position will be modelled by revaluing assets and liabilities under the scenario • Static balance sheet approach, where the impact of the entire scenario is evaluated in one step • A satellite model will be used to estimate the impact on government bond prices by maturity, for those currencies where yield curves are not agreed under the bank solvency scenario
3. Type of analyses	Scenario analysis	<ul style="list-style-type: none"> • There will be macroeconomic and non-macroeconomic scenarios. The macroeconomic scenarios have horizons of 2.5 years and the non-macroeconomic scenarios have horizons of one year. • There will be three macroeconomic scenarios, matching the baseline and two adverse scenarios used under the bank solvency stress tests above. • One climate-related scenario tests the impact on general insurers of 	<ul style="list-style-type: none"> • There will be one adverse scenario only. • The scenario will have a two-year horizon, based on the combined impact of 2019 and 2020 under "Scenario 1" of the agreed bank solvency scenarios. • Risk-free discount rates under the adverse scenario will follow the Singapore regulatory regime, where longer-term discount rates are based on the average of historical Singapore Government bond yields 	<ul style="list-style-type: none"> • There will be one adverse scenario only. • The scenario will have a two-year horizon, based on the combined impact of 2019 and 2020 under "Scenario 1" of the agreed bank solvency scenarios. • Risk-free discount rates under the adverse scenario will follow the Singapore regulatory regime, where longer-term discount rates are based on the average of historical Singapore Government bond yields

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
		<p>severe but plausible rainfall.</p> <ul style="list-style-type: none"> • A cyber risk scenario tests the impact on general insurers of claims on direct (affirmative) and indirect (silent) cyber insurance policies. 	<p>(since inception) and hence are less sensitive to interest rate movements.</p>	<p>(since inception) and hence are less sensitive to interest rate movements.</p>
4. Risks and Buffers	Risks	<ul style="list-style-type: none"> • Falls in asset prices, possibly due to fire sales ("market risk") • Catastrophe risk • Cyber risk 	<ul style="list-style-type: none"> • Falls in asset prices, possibly due to fire sales ("market risk") will be modelled in more detail than in the bank solvency stress tests 	<ul style="list-style-type: none"> • Falls in asset prices, possibly due to fire sales ("market risk") will be modelled in more detail than in the bank solvency stress tests • Default by largest counterparties
	Buffers	<ul style="list-style-type: none"> • Buffers are as specified in the top-down analyses to the right. • In addition, insurers may recognize future profits as (e.g., coupon income from corporate bond holdings during the stressed period) buffers. • Insurers also model the effects of their recovery plans on their regulatory capital positions. 	<ul style="list-style-type: none"> • The buffers are regulatory capital in excess of regulatory capital requirements. • The fall in asset values will result in an automatic relaxation of capital requirements for market risk. • Falls in liability values, due to rising sovereign yields, will also improve the solvency position. 	<ul style="list-style-type: none"> • The buffers are regulatory capital in excess of regulatory capital requirements. • The fall in asset values will result in an automatic relaxation of capital requirements for market risk • Falls in liability values, due to rising sovereign yields, will also improve the solvency position.
5. Regulatory Standards	Regulatory standards	<ul style="list-style-type: none"> • Current RBC regulations ("RBC 1"). • Insurers specify hurdle rates according to their internal targets, which are higher than the minimum regulatory requirement. • Insurers' own regulatory requirements include industry-wide and firm-specific requirements. 	<ul style="list-style-type: none"> • Current RBC regulations ("RBC 1"). • The stress tests will use a hurdle Capital Adequacy Ratio based on confidential, insurer-specific capital requirements. 	<ul style="list-style-type: none"> • Current RBC regulations ("RBC 1"). • The stress tests will use a hurdle Capital Adequacy Ratio of 100 percent. • In addition, a higher Capital Adequacy Ratio will be considered, based on an indicative and confidential capital surcharge for high-impact insurers. However, such quantitative results will not be published, to maintain confidentiality.
6. Reporting Format for	Output presentation	<ul style="list-style-type: none"> • The FSAP team will have access to a summary of 	<ul style="list-style-type: none"> • Sector-wide regulatory capital position and 	<ul style="list-style-type: none"> • Sector-wide regulatory capital position and

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
Results		insurers' stress test results. <ul style="list-style-type: none"> • Attribution analysis will assist in identifying the drivers of risk • As much sector-wide detail as possible will be disclosed, while preserving insurer—supervisor confidentiality. 	capital shortfall.	capital shortfall.
Financial System: Interconnectedness Analysis				
1. Institutional Perimeter	Institutions included	N.A.		<ul style="list-style-type: none"> • Interbank network: all banking groups (119). • Common exposure: All seven D-SIBs. • Intra-financial network: 8 groups of financial institutions. • Cross-border bank network: the banking system of selected countries.
	Data and Starting position	N.A.		<ul style="list-style-type: none"> • Starting position: 2018Q2 • Supervisory and market data. • Scope of consolidation <ul style="list-style-type: none"> – Interbank and common exposure: individual banks. – Intra-financial: groups of financial institutions. – Cross-border: banking system.
2. Methodology	Overall framework	N.A.		<ul style="list-style-type: none"> • Interbank: Espinosa-Vega and Solé (2010). • Common exposure: balance sheet approach. • Intra-financial network: Steady-state Markov Chain probability. • Cross-border network: Espinosa-Vega and Solé (2010) and Diebold and Yilmaz (2015).

Domain		Assumptions		
		Bottom-up by financial institutions	Top-down by authorities	Top-down by FSAP Team
3. Risks and Buffers	Risks	N.A.		<ul style="list-style-type: none"> • Credit and funding losses related to interbank exposures, intra-financial exposures, and cross-border banking exposures. • Default of large common borrowers in the banking system. • Fire-sale of assets following sizeable withdrawals of deposits.
	Buffers	N.A.		<ul style="list-style-type: none"> • Interbank network: banks' own capital and liquidity buffers. • Cross-border bank network: capital buffers of a banking system.
4. Reporting Format for Results	Output presentation	N.A.		<ul style="list-style-type: none"> • Interbank network: a network chart, index of vulnerabilities. • Common exposure: system-wide capital shortfalls. • Intra-financial network: bilateral exposure matrices, a chart of steady state Markov Chain probability, • Cross-border network: index of vulnerabilities and contagion, a heatmap of bank distress, and spillover charts.