

**ASIAN CONSULTATIVE COUNCIL
of the
BANK FOR INTERNATIONAL SETTLEMENTS**

Foreign exchange markets in Asia-Pacific

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Executive summary

In response to a call for interest circulated in March 2021, 12 Asian Consultative Council (ACC) member central banks formed the Study Group on Foreign Exchange (FX) Markets in Asia-Pacific in April 2021. The group discussed (i) how to strengthen FX market monitoring; (ii) how to develop deep and efficient FX markets and encourage widespread use of FX hedging; and (iii) how to dampen the impact of FX volatility on domestic financial markets. The report provides key observations and policy takeaways in four areas. Some takeaways are relevant particularly for emerging market economy (EME) central banks but less so for advanced economy (AE) central banks in the Asia-Pacific region.

Overview of regional FX markets. Asian EME currencies increased their share in global FX turnover from 2013 to 2022, but the share remains below that of Asia-Pacific AE currencies. Rapidly growing non-deliverable forward (NDF) markets for some EME currencies indicate segmentation between onshore and offshore markets. Finally, FX markets play a bigger role in central bank operations in EMEs than in AEs, with EMEs conducting FX interventions mainly aimed at supporting market functioning and financial stability.

FX market monitoring and surveillance. Most central banks use FX market monitoring and surveillance to help inform the use of policy instruments, particularly FX intervention and liquidity provision. Improved data availability and digitalisation have increased the frequency, coverage and quality of FX market monitoring. Some central banks are also adopting big data and machine learning techniques in their FX market monitoring activities.

Challenges in FX market monitoring include data availability (especially on transactions by non-residents or in offshore markets), the analysis of big data, the translation of data into useful information, and sharing the monitoring output among different stakeholders. Hence, within central banks, there may be room to improve cross-departmental cooperation in FX market monitoring and risk analysis. Greater scope for cooperation among central banks may also exist. As offshore markets lie outside the operational remit of the respective central bank, they are more difficult to monitor but can be the locus of price discovery or currency volatility. Given the rapid electrification of FX spot and derivatives markets, central banks may opt to invest more in big data analysis and monitoring of electronic trading of NDFs.

FX hedging markets and their development. The use of FX derivatives has grown in Asian EMEs, but still lags that of AEs and regional financial centres. Furthermore, central banks generally have limited information on FX hedging policies of market participants, especially those of non-residents, and the exact purpose for which FX derivatives are used. Regional currencies proved considerably more resilient during the 2020 Covid-19 financial market turbulence than in the 2013 taper tantrum, due partly to the swift and coordinated response by central banks, and partly to the structural FX market reforms in recent years.

In order to help balance future demand for and supply of FX hedging instruments, a more flexible approach to FX hedging requirements for non-bank financial institutions (NBFIs) may be useful, such as allowing “over-” and “under-hedging” vis-à-vis the underlying exposure. EME financial authorities may also consider broadening the range of FX risk management tools available to market participants beyond FX derivatives. At the same time, the authorities could mitigate the build-up of systemic risks by pre-emptively introducing or tightening FX-related macroprudential measures during normal times.

Broader considerations for FX market structure and capital flows. The intermediation capacity of local FX markets needs to keep pace with local asset market development. If the pace at which local FX markets deepen does not keep up with the growth rate of gross capital flows over time, then FX markets can amplify market stress at times when capital inflows/outflows are volatile. In this context, the soundness of intermediaries involved in FX transactions is a particularly important factor in mitigating financial vulnerability and transmission of stress.

When FX markets cannot smoothly absorb shocks to capital flows, EME central banks may need to deploy policy tools to limit FX volatility and safeguard macroeconomic and financial stability. At the same time, there are limits to how far central banks can deploy policy tools to provide FX liquidity and mitigate capital flow shocks. Therefore, while pursuing capital account liberalisation, EME central banks may need to introduce temporary capital flow management measures when other tools do not work well. Finally, they should assure access to global or regional financial safety nets to deal with severe market stress.

1. Introduction

The foreign exchange (FX) market is a core market for central banks. The structure of local and offshore FX markets has a profound influence on capital flows to the economy, and it is these FX markets that transmit the effects of monetary and financial conditions in other jurisdictions to the home economy. The Asia-Pacific region is home to three of the top five FX trading hubs, while emerging market economy (EME) central banks in the region maintain an active presence in FX markets both as regulators and through their own FX operations.

This report takes stock of recent developments in FX markets in Asia-Pacific with the aim of identifying areas in which regional central banks can strengthen market monitoring, develop deep and efficient FX markets and encourage the widespread use of FX hedging to dampen the impact of unwarranted FX and capital flow volatility on domestic financial markets. In doing so, it focuses on a particular aspect of FX markets within the broader inquiry into how monetary policy frameworks in Asia have responded to volatile exchange rates and capital flows, as addressed by the ACC Working Group's previous report on "Capital flows, exchange rates and policy frameworks in emerging Asia" (BIS (2020)). The report is also related to the previous work by the Markets Committee (MC) that explored aspects of structural changes in FX markets with immediate relevance for central banks' monitoring approaches (BIS (2018)).

The analysis draws, first, on a survey by study group members of central banks in the Asia-Pacific region about their local FX market features, the broad aspects of central bank engagement in local FX markets, central bank monitoring of FX markets, and the characteristics of local FX hedging markets. Second, the report makes use of the Triennial Central Bank Survey of Foreign Exchange and Over-the-counter (OTC) Derivatives Markets and other official sector sources, such as the IMF Coordinated Portfolio Investment Survey and the BIS locational banking statistics. Third, the report also draws on data from commercial sources, including Bloomberg and Refinitiv. Fourth, it makes extensive use of country case studies and other information supplied by member central banks.

The report offers the following key findings. Looking at the regional market trends, EME Asian currencies increased their share in global FX turnover over the past decade, although the market share of these currencies typically remains below that of advanced economy (AE) currencies in the region. Growth in offshore FX trading relative to cross-border trading by domestic dealers with non-residents is particularly noticeable for currencies with rapidly growing non-deliverable forward (NDF) markets. This indicates possible segmentation between onshore and offshore markets for some currencies. FX markets play a bigger role in EME central bank operations compared with their AE peers. At the same time, central bank participation in the FX market as a share of total FX market activity is reportedly on a declining trend. The fact that central bank activity is infrequent, and is focused on financial stability and market functioning, suggests that FX markets in the region have developed significantly in recent years toward supporting well-functioning domestic financial markets.

FX market monitoring and surveillance are used by central banks mostly to inform the use of policy instruments, such as FX intervention and liquidity provision. These instruments can be deployed to help achieve macroeconomic, domestic financial and external stability objectives. The frequency, coverage and quality of FX market monitoring and surveillance have increased against the backdrop of improved data availability and digitalisation. Some central banks are also beginning to introduce big data and machine learning techniques into their FX market monitoring activities. Also, in contrast to the findings in BIS (2018), which had a global coverage with a greater focus on AEs, lower frequency monitoring by central banks in Asia-Pacific is conducted more often by the financial stability area than by the economics/research departments. This reflects the greater involvement of EME central banks in Asia-Pacific in local FX markets for policy implementation and as regulators. The challenges for Asia-Pacific central banks in their FX market monitoring include data availability (especially in relation to transactions by non-residents or in offshore markets), the analysis of big data, the translation of data into useful information, and sharing the

output of the FX market surveillance among different stakeholders. Greater cooperation among central banks could also improve the effectiveness of FX market monitoring.

The study group also finds that the use of FX derivatives has grown in Asian EMEs, but still lags that of AEs and regional financial centres. Furthermore, member central banks generally have limited information on the FX hedging policies of market participants, especially those of non-residents, and the exact purpose for which FX derivatives are used. Outward portfolio investment by residents is also seen as lagging other drivers of FX turnover growth and shifts in hedging practices, suggesting further scope for promoting outward investment by residents. Concerning market resilience, regional currencies fared considerably better during the 2020 Covid-19 financial market turbulence than during the 2013 taper tantrum, due partly to the swift, and, in some cases, coordinated, response by central banks, and partly to the structural FX market reforms in recent years. The continuation of the current policy mix of market liberalisation and effective risk management by market participants should help further improve FX market resilience.

The report presents policy takeaways in the areas related to monitoring, FX hedging markets and capital flows. First, given that FX market monitoring is a key input for the use of a broad range of instruments to achieve central banks' objectives, there is scope for central banks to improve cross-departmental and cross-country cooperation in FX market monitoring and risk analysis. Also, central banks issuing currencies for which there exists a sizeable offshore NDF market may need to enhance their monitoring capabilities for that market. Second, to develop FX hedging markets, several EME central banks in the region have introduced new instruments, relaxed restrictions on FX transactions, and allowed foreign investors to actively manage their FX exposure. In future, a more flexible approach to FX hedging requirements by non-bank financial institutions (NBFIs) and/or broadening the range of FX risk management tools beyond FX derivatives may be beneficial in some cases. In addition, regional authorities may wish to mitigate the build-up of systemic risks by introducing FX-related macroprudential measures¹ ex ante during normal times. Third, the intermediation capacity of local FX markets needs to keep pace with local asset market development and the volume of capital flows. The soundness of intermediaries involved in FX transactions is a particularly important factor in mitigating financial vulnerabilities. When EME FX markets cannot smoothly absorb capital flow shocks, EME central banks may need to deploy policy tools to limit FX volatility and safeguard macroeconomic and financial stability.

The report is structured as follows. The next section provides an overview of regional FX markets and central banks' engagement with them. Section 3 documents how central banks monitor FX markets, including the role of FX market monitoring in informing the use of central bank instruments to achieve their policy goals, the sources of information and types of output, and challenges in FX market monitoring along with potential enhancements. Section 4 gives an overview of the FX hedging market landscape, compares FX market performance during select risk events, and lists key considerations for the further development of FX markets in emerging Asia. Section 5 discusses the links between FX markets, capital flows and domestic financial conditions. Section 6 concludes with several broad takeaways for policy.

¹ FX-related macroprudential measures are prudential, monetary and fiscal policy measures specifically calibrated to FX exposures or the FX liabilities of banks and non-bank financial institutions (NBFIs). Examples are FX-denominated liability-based reserve requirements; limits on currency mismatch, FX positions and FX-denominated loans; and FX liquidity requirements.

2. An overview of regional FX markets and central bank engagement

The trading volumes of the regional EME currencies have continued to grow, although they remain lower compared with the leading regional AE currencies. This section provides an overview of Asia-Pacific FX markets and how central banks engage in them. The analysis draws largely on the study group's survey ("the survey") of a select group of economies in the Asia-Pacific region and the statistics from the latest BIS Triennial Central Bank Survey of FX and OTC Derivatives Markets ("the Triennial"), together with other sources. In order to capture the structural trends, most statistical comparisons in this section focus on the period covering approximately one decade, ie between the 2013 and 2022 Triennial surveys.

Key messages:

EME Asian currencies increased their share in global FX turnover from 2013 to 2022, although their market share typically remains below that of AE currencies in the region.

Growth in offshore FX trading relative to cross-border trading by domestic dealers with non-residents is particularly noticeable for currencies with rapidly growing NDF markets. This indicates a possible segmentation between onshore and offshore markets for some currencies.

The need for regional central banks to intervene in FX markets is relatively low, particularly among AEs. The fact that market functioning and financial stability are the primary objectives for intervention, and that central bank activity remains infrequent, suggests that FX markets in the region have developed significantly in recent years toward supporting well-functioning domestic financial markets.

2.1 FX market features in select Asia-Pacific economics

The state of FX market development differs across the regional economies. Authorities in many economies have taken some initiatives to deepen and enhance the resilience of the onshore market by developing a stronger FX market ecosystem, relaxing regulations to encourage the use of hedging instruments by corporates and banks, and by improving data and the monitoring and surveillance system.

According to the Triennial, onshore FX trading volume in China more than tripled between 2013 and 2022, and more than doubled in Hong Kong SAR, Singapore and Indonesia (BIS (2022)). FX trading volume also rose by around a half in India, Korea and Malaysia. In terms of the percentage of GDP, FX transaction volumes in Malaysia and Thailand exceed those in Indonesia and the Philippines. Spot transactions dominate the Indonesian and Philippine markets, while FX swap and forward transactions account for a larger portion in the Malaysian and Thai FX markets.

Table 2.1 describes general FX market features, focusing mainly on the FX regime, of select Asia-Pacific economies. AEs have not made significant changes to their FX regime in recent decades, indicating their relative maturity, while EMEs have made significant changes. Of the 11 central banks that participated in the survey, five characterise their exchange rate regime as floating, another five as managed float, and one as a currency board. None of the central banks characterise their exchange rate regime as fixed.

A bird's eye view suggests that liquidity has improved for most EME currencies, although it is still less than that of AE peers. The share of trading volume in global FX turnover of currencies of a number of Asian EMEs increased between 2013 and 2022 (Graph 2.1.1, left-hand panel). Most notably, the share of the Chinese yuan more than tripled to 7%, and the Indian rupee and the Korean won also exhibited significant increases. The currencies of regional financial centres, the Hong Kong dollar and the Singapore dollar, also increased their market shares. Apart from the Chinese yuan, the market share of EME currencies remains considerably below that of the Australian dollar and the Japanese yen, with the latter being the third most traded currency globally. At the same time, both of these AE currencies have lost some of their market shares since 2013. Turning to a price-based metric of liquidity, the bid-ask spread of most EME

currencies have narrowed over this period (right-hand panel), pointing at an improvement in market liquidity. The degree of structural improvement in market liquidity may be understated for some currencies, because April 2022 is characterised by relatively high market volatility, which may have led to wider spreads than under relatively calm market conditions.

General FX market features in select Asia-Pacific economies

Table 2.1

Australia	Australia has had a floating exchange rate system in place since 1983. Prior to this, Australia shifted through several regimes, including a fixed exchange rate regime.
Hong Kong SAR	Hong Kong SAR uses an exchange rate system linked to the US dollar. As Hong Kong SAR is a small and open economy whose growth is driven by external factors, adopting a currency board helps reduce volatility of the exchange rate and external risks.
India	India's exchange rate policy has evolved over time in line with the gradual opening up of the economy as part of the broader strategy of macroeconomic reforms and liberalisation since the early 1990s. The exchange rate is determined in the interbank market and there is neither a band nor a peg that the RBI monitors.
Indonesia	Indonesia has implemented a free-floating exchange rate regime since August 1997, where the exchange rate is determined by supply and demand in the foreign exchange market. Exchange rate stability against other currencies is necessary to achieve and maintain price and financial system stability.
Korea	Korea adopted a free-floating exchange rate regime in 1997. The won's exchange rate is freely determined on the basis of supply and demand in the foreign exchange market.
Malaysia	Malaysia as a small and open economy has adopted a floating exchange rate regime since 2016. Prior to this, the ringgit was pegged to the US dollar following the 1997–98 Asian financial crisis and moved to a managed float exchange rate regime in July 2005.
New Zealand	In New Zealand, increased exchange rate volatility and inflation pressures led the central bank to move to a floating exchange rate regime from a fixed one in 1985.
Philippines	The Philippines adopted its floating exchange rate regime in 1970. The authorities believe that allowing market forces to determine the exchange rate provides benefits as a flexible peso acts as an automatic stabiliser to restore macroeconomic balance for a small open economy in the face of external shocks.
Singapore	Singapore's monetary policy is aimed at ensuring low and stable inflation. MAS uses the Singapore dollar nominal exchange rate (S\$NEER) as the intermediate target of monetary policy, because the exchange rate has a much stronger influence on inflation than the interest rate due to the very large share of the tradable sector in the economy. To implement its monetary policy stance, the MAS intervenes in the foreign exchange market, especially when there are significant short-term capital flows that would cause the S\$NEER to deviate from a level consistent with domestic price stability. The current regime has been operating since 1981.
Thailand	Thailand has adopted a managed floating exchange rate regime since July 1997. Previously, the Thai baht was pegged to a basket of currencies.

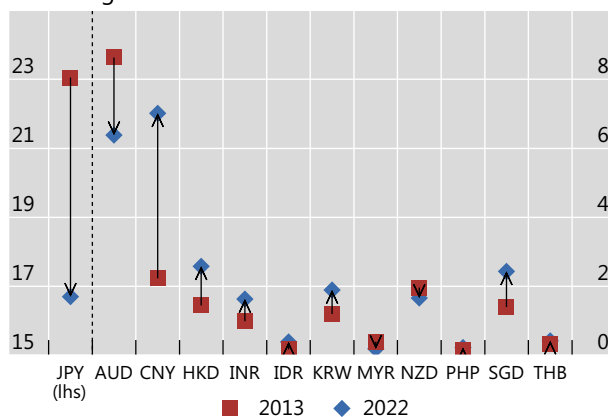
Source: BIS Study Group on FX Markets in Asia-Pacific.

Relative depth and liquidity of select Asia-Pacific currencies

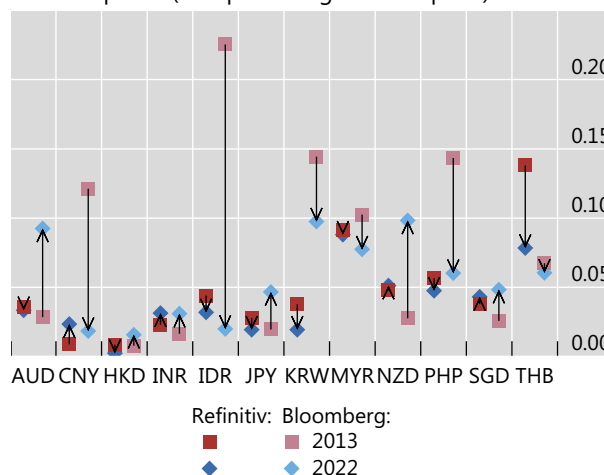
In per cent

Graph 2.1.1

Share in global FX turnover



Bid-ask spread (as a percentage of mid-price)



AUD = Australian dollar, CNY = Chinese yuan, HKD = Hong Kong dollar, INR = Indian rupee, IDR = Indonesian rupiah, JPY = Japanese yen, KRW = Korean won, MYR = Malaysian ringgit, NZD = New Zealand dollar, PHP = Philippine peso, SGD = Singapore dollar, THB = Thai baht.

Notes: Based on daily averages during the month of April each year; FX turnover numbers adjusted for inter-dealer double-counting. Historically available bid-ask spreads are only indicative and can vary substantially depending on the data source.

Sources: BIS Triennial Central Bank Survey; Bloomberg; Refinitiv DataScope; BIS calculations.

Despite the steady progress in FX market development, most EMEs in the region still have some form of FX and capital controls, such as requiring non-resident FX transactions to be backed by underlying investment. Hence, foreign investors tend to participate less in local EME FX markets than in those of financial centres or AEs in the region. Although there is no common standard for assessing capital account liberalisation, academics and experts usually make use of publicly available information to compile indices for this purpose. Widely used indices for assessing progress in capital account liberalisation include the Chinn-Ito index, the Quinn index and the Schindler index, among others. According to a *de jure* measure of capital account openness based on the Chinn-Ito index,² from a historic perspective, since 1970 all country groups have made significant progress in capital account liberalisation and financial market openness, and AEs particularly so (Graph 2.1.2, left-hand panel). At the same time, since 2008, the index readings for EMEs have shown a slight dip, which could probably be explained by the renewed capital flow restriction measures in some EMEs after the 2007–08 Great Financial Crisis (GFC).

It needs to be emphasised that Chinn-Ito index is a relative quantitative scale for a country's capital account convertibility and financial market openness, but it offers no measure for whether the country's progress is advanced or lagging relative to the level that can be judged as optimal according to objective criteria. As pointed out by the IMF's *Institutional View on Capital Flows*, capital account liberalisation should be in line with a country's economic fundamentals and level of development. Premature capital account liberalisation may lead to an accumulation of vulnerabilities and trigger a crisis. Therefore, China's and India's low scores indicate only that these countries currently apply more restrictions to cross-border capital flows (Graph 2.1.2, right-hand panel), which might be necessary and appropriate.

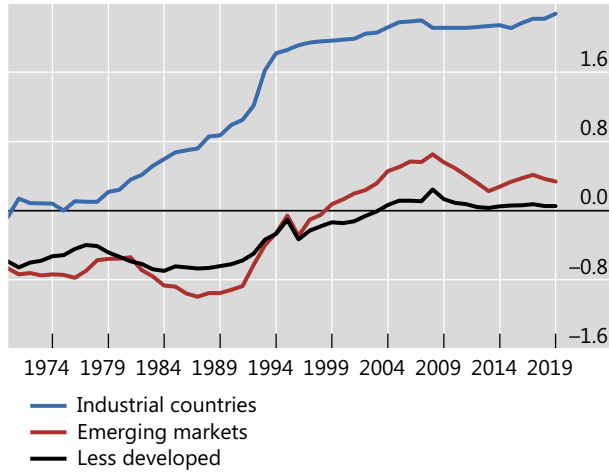
² The Chinn-Ito index (Chinn and Ito (2006)) is based on the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER). It uses principal component analysis (PCA) to produce an index based on such factors as regulatory controls over current and capital account transactions, the existence of multiple exchange rates and any requirement to surrender export proceeds. Given that the Chinn-Ito index is based on *de jure* measures of capital account openness, it may not be able to capture perfectly a country's significant *de facto* progress in liberalising various forms of capital flows.

Capital account openness

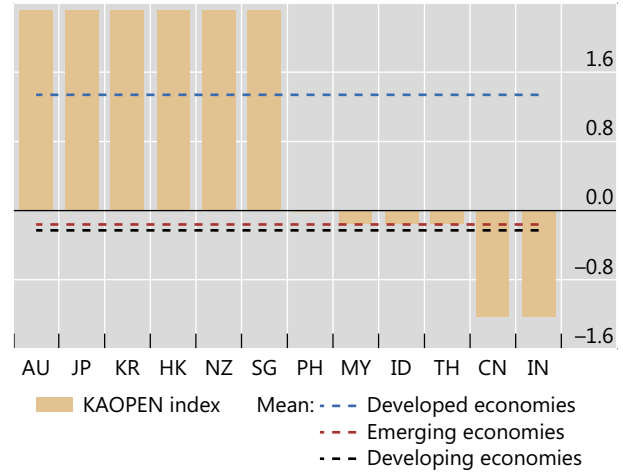
In per cent

Graph 2.1.2

Chinn-Ito capital account openness index since 1970



Chin-Ito capital account openness index in 2019



AU = Australia, CN = China, HK = Hong Kong SAR, IN = India, ID = Indonesia, JP = Japan, KR = Korea, MY = Malaysia, NZ = New Zealand, PH = the Philippines, SG = Singapore, TH = Thailand.

Notes: Time series shown in the left-hand panel are provided directly by the authors of the capital account openness (KAOPEN) Index and calculated on a different country sample compared with the right-hand panel.

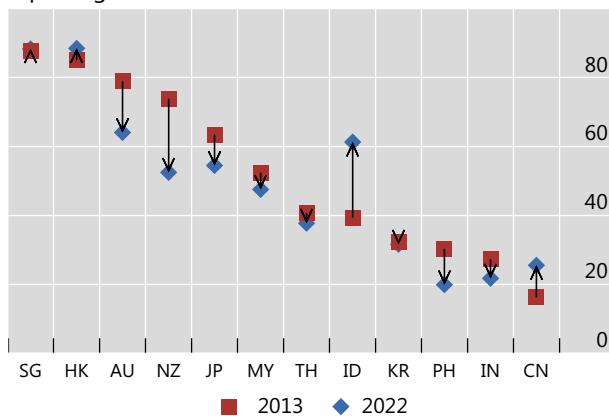
Source: Chinn and Ito (2006) KAOPEN Index, updated, http://web.pdx.edu/~ito/Readme_kaopen2019.pdf.

Non-resident participation in local FX markets and offshore trading

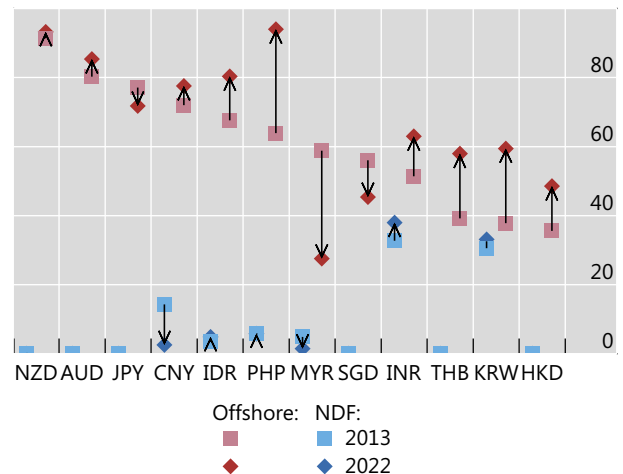
In per cent

Graph 2.1.3

Share of non-resident/cross-border counterparties to reporting FX dealers



Offshore and NDF share in total turnover



AU = Australia, CN = China, HK = Hong Kong SAR, IN = India, ID = Indonesia, JP = Japan, KR = Korea, MY = Malaysia, NZ = New Zealand, PH = the Philippines, SG = Singapore, TH = Thailand.

Source: BIS Triennial Central Bank Survey.

Given their full current and capital account convertibility, FX dealers located in regional financial centres and AEs boast a higher share of trading with cross-border counterparties than those located in EMEs. Cross-border counterparties account for close to 90% of daily FX turnover in both Hong Kong SAR and Singapore, roughly unchanged over the past decade (Graph 2.1.3, left-hand panel). The cross-border

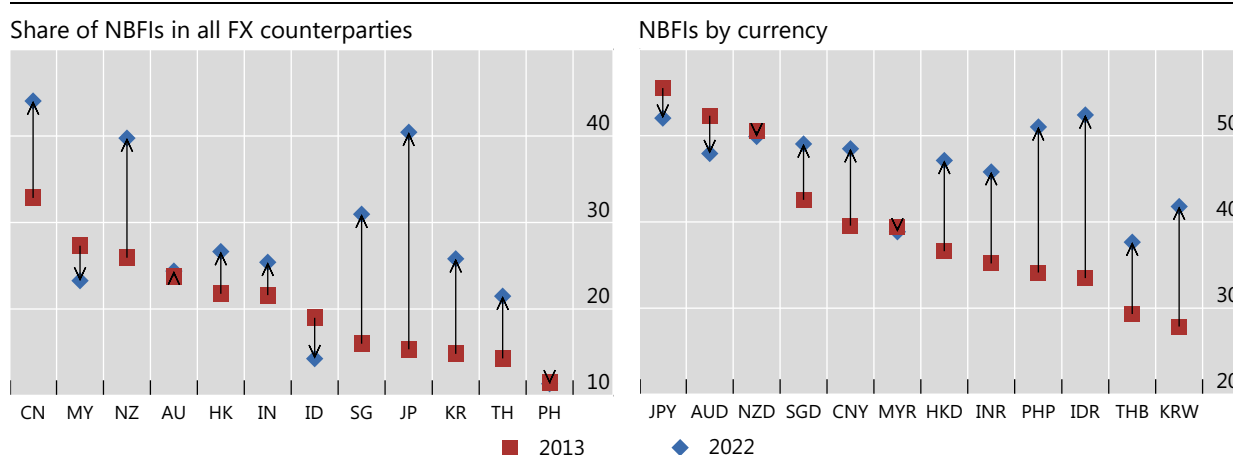
share ranges from about 50 to 60% in AEs globally, but has declined in Australia, Japan and New Zealand. Cross-border counterparties accounted for a lower share of turnover with FX dealers in Asian EMEs in 2022 than in 2013. By contrast, the share of cross-border participation has increased in China's and Indonesia's FX markets between 2013 and 2022.

The geography of where a regional currency trades suggests a way of gauging its degree of internationalisation. The offshore share indicates the fraction of total turnover intermediated by dealers located outside the currency-issuing jurisdiction. For regional AE currencies, the offshore share was approximately 80–90% in 2013, although for the Japanese yen (JPY) it has declined marginally since then (Graph 2.1.3, right-hand panel). The offshore share for the Chinese yuan in the right-hand panel, which includes both onshore CNY and offshore CNH, is also high, owing to CNH trading. The most significant development, however, is the sizeable increase in the offshore share of trading in the Indonesian rupiah (IDR), the Philippine peso (PHP), the Indian rupee (INR), the Thai baht (THB) and the Korean won (KRW), with the IDR and PHP offshore share much close to that of AE currencies in the region. By contrast, the offshore share of trading in the Malaysian ringgit (MYR) has declined significantly, owing in part to recent regulatory initiatives that encourage trading by non-residents in the Malaysian onshore FX market.

Share of non-bank financial institutions (NBFIs) in FX dealers' customer base

In per cent

Graph 2.1.4



AU = Australia, CN = China, HK = Hong Kong SAR, IN = India, ID = Indonesia, JP = Japan, KR = Korea, MY = Malaysia, NZ = New Zealand, PH = the Philippines, SG = Singapore, TH = Thailand.

AUD = Australian dollar, CNY = Chinese yuan, HKD = Hong Kong dollar, INR = Indian rupee, IDR = Indonesian rupiah, JPY = Japanese yen, KRW = Korean won, MYR = Malaysian ringgit, NZD = New Zealand dollar, PHP = Philippine peso, SGD = Singapore dollar, THB = Thai baht.

Source: BIS Triennial Central Bank Survey.

The growth in offshore FX trading relative to domestic dealer trading with non-residents is particularly noticeable for some currencies with rapidly growing NDF markets. To the extent that NDF markets tend to emerge for currencies that are not easily deliverable offshore, a sizeable NDF market would suggest market segmentation between onshore and offshore FX markets due to FX controls or capital controls. Of the six currencies with an NDF market, only two, INR and KRW, boast any sizeable share (Graph 2.1.3, right-hand panel, blue markers). Overall, trading in NDFs almost doubled globally between 2013 and 2022, owing to greater electrification of NDF markets, the onboarding of these instruments on the main electronic trading platforms of EBS and Refinitiv, and a significant rise in the central clearing of NDF trades (HKMA (2018); Schrimpf and Sushko (2019)).

Finally, consistent with the greater financialisation of FX trading and the increasing sophistication of FX dealers' customers, the share of NBFIs increased in most jurisdictions. On a locational basis, the share of NBFIs in the FX dealers' customer base is highest in onshore China's FX market, where it exhibited a

significant increase in recent years (Graph 2.1.4, left-hand panel). NBFIs participation also increased significantly in onshore FX markets of several other jurisdictions. On a currency-by-currency basis, EME currencies tended to have lower NBFIs shares in the dealers’ customer base a decade ago, but for a number of them trading with NBFIs has since increased dramatically, most notably for IDR, INR, KRW, PHP and THB (right-hand panel). Generally, the NBFIs share is higher when evaluated by currency rather than by local FX market jurisdiction, suggesting that there is still some catching up to do for local FX markets in the region.

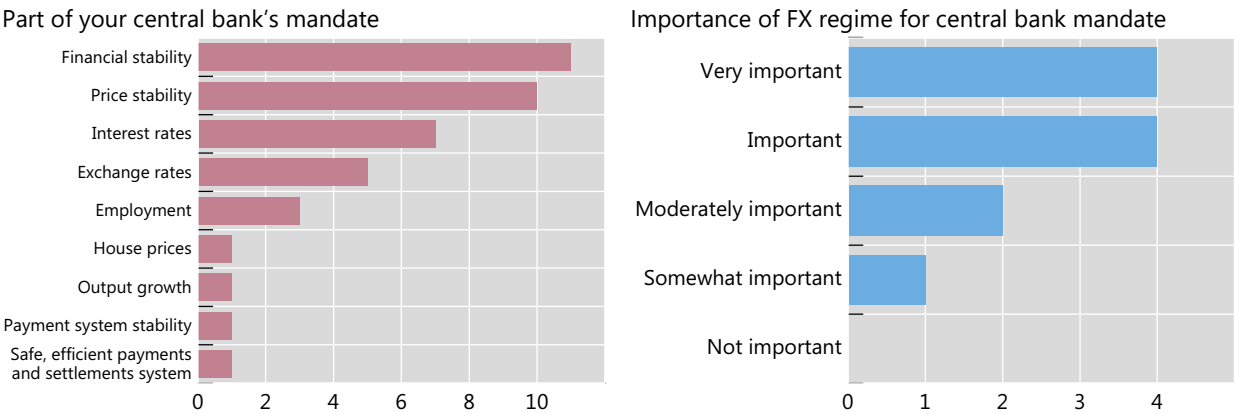
2.2 Central bank involvement and participation in the FX market

Central banks in the Asia-Pacific region generally place a high importance on FX markets, even if exchange rate stability is not in their mandates. In the survey of 11 member central banks, only five have exchange rates in their mandate. However, the FX regime is “important” or “very important” for the central bank mandate in eight out of the 11 jurisdictions (Graph 2.2.1).

FX markets and the central bank mandate

Number of respondents

Graph 2.2.1



Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

Central banks in Asia-Pacific closely monitor FX markets to help inform how and when they engage in these markets. Most central banks intervene in FX markets infrequently, less than once a month (Graph 2.2.2, left-hand panel). Supporting market functioning and financial stability was the most common reason for FX intervention, with 10 out of 11 responses indicating this as the main objective of FX intervention (right-hand panel). Only one central bank uses FX intervention to target an exchange rate level.³ Most respondents also indicated that central bank activity as a share of total FX turnover had been decreasing in their respective jurisdictions.

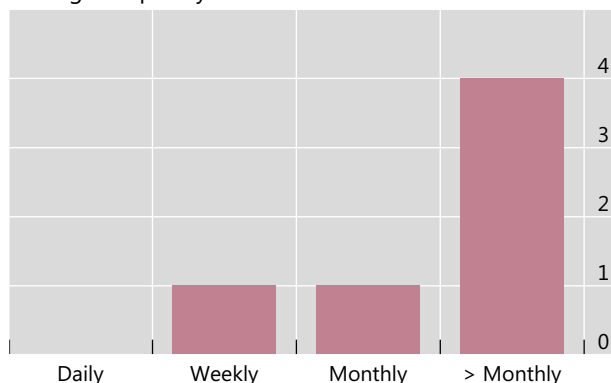
³ BIS (2022), which provides an overview of central bank FX intervention practices, also concludes that the most important intermediate objectives of FX intervention for EME central banks are keeping exchange rate volatility in check and providing liquidity to thin markets. By contrast, some AE central banks do consider influencing the exchange rate as the main intermediate objective to help them achieve price stability.

Frequency and objective of FX intervention

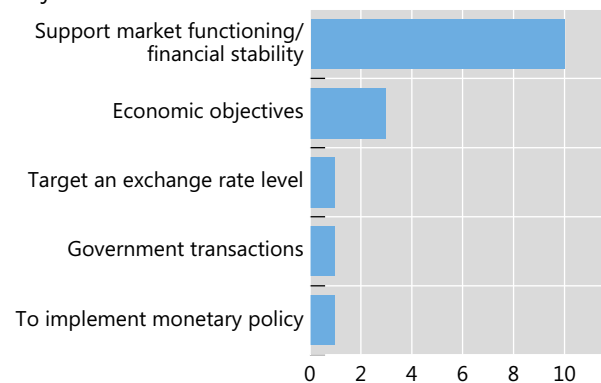
Number of respondents

Graph 2.2.2

Average frequency of FX interventions



Objectives of FX intervention



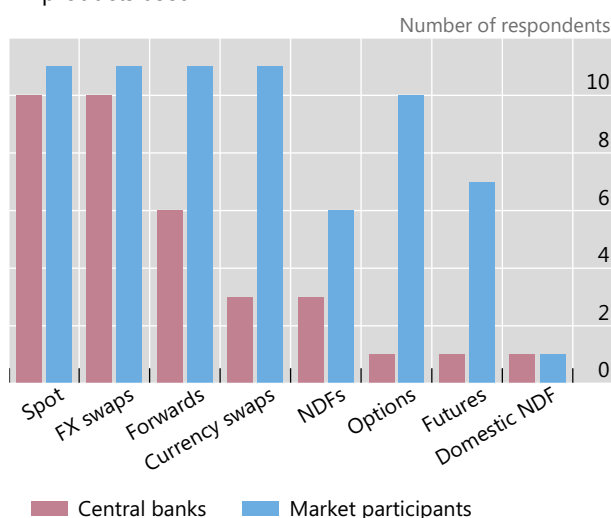
Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

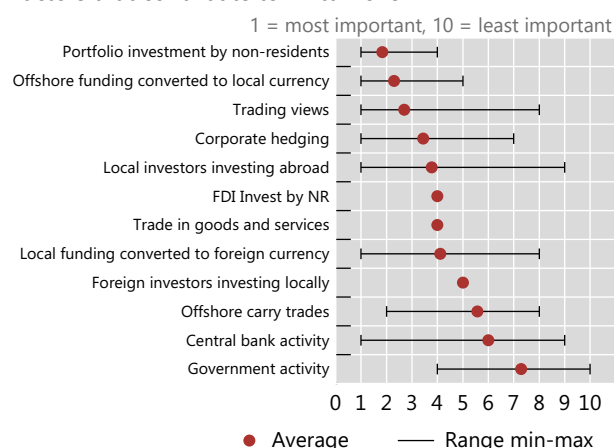
Local FX market features

Graph 2.2.3

FX products used



Factors that contribute to FX turnover



Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

Market participants actively transact in spot, forwards, swaps and options in all responding jurisdictions, and in NDFs in about half of the jurisdictions. By contrast, central banks are active mainly in the spot and FX swap markets, followed by forwards (Graph 2.2.3, left-hand panel). Among 12 potential factors that can contribute to FX turnover, the 11 Asia-Pacific central banks view portfolio investment by non-residents as the most important one, followed by offshore funding converted to local currency, trading views, corporate hedging and local investors investing in foreign assets (right-hand panel).

In summary, central banks in Asia-Pacific closely monitor FX markets. However, the need for central banks to intervene in FX markets is relatively light, particularly among AEs. The fact that market functioning and financial stability are the primary objectives for intervention, and that central bank activity is infrequent, suggests that FX markets in the region have developed significantly in recent years toward supporting well-functioning financial markets.

3. FX market monitoring by central banks

This section provides a high-level summary of how FX market monitoring fits into central bank objectives and describes the organisational arrangements for monitoring FX markets, based on study group members' responses to the survey. The section also outlines current challenges for FX market monitoring and potential solutions under consideration by the members.

Key messages:

Central banks use FX market monitoring and surveillance mainly to inform the use of instruments, such as FX intervention and liquidity provision. These instruments can be deployed to help achieve macroeconomic, domestic financial and external stability objectives.

The frequency, coverage and quality of FX market monitoring and surveillance has increased, thanks to improved data availability and digitalisation. Some central banks are also beginning to introduce big data and machine learning techniques into their FX market monitoring activities.

Challenges in FX market monitoring include data availability (especially on transactions by non-residents or in offshore markets), analysis of big data, translation of data into useful information, and sharing the output of the FX market surveillance among different stakeholders. Greater cooperation among central banks could also improve the effectiveness of FX market monitoring.

3.1 Multifaceted role of FX market monitoring in central bank activities

Central banks use FX market monitoring to inform the use of different policy instruments, such as FX intervention and liquidity provision, changes to policy rates, macroprudential measures and capital flow management measures (CFMs). These instruments, in turn, help central banks achieve their policy objectives of macroeconomic, domestic financial and external stability. Based on the mapping of policy objectives and instruments used in BIS (2020), we can consider how FX monitoring supports the broader policy frameworks of central banks in the region.

Policy instruments. Table 3.1 illustrates that FX monitoring is most commonly seen as informing FX intervention and liquidity provision activities in both foreign and local currency. While many central banks in the region with floating exchange rate regimes allow their exchange rates to be flexible and market-determined, and thus they may not use FX-related instruments listed in Table 3.1 in normal times, they still monitor FX markets to help identify excessive FX volatility and/or market dysfunction because they retain the discretion to intervene if necessary. FX monitoring helps regional central banks decide whether the use of FX intervention or liquidity provision instruments might be necessary in response to such stress events. Monitoring and analysis of FX markets also provide information to policymakers who make decisions about a broader set of instruments, such as policy interest rates and macroprudential measures.

Graph 3.1.1 allows three additional takeaways to be deduced concerning the links between FX market monitoring and central bank policy instruments. First, all policy instruments have a part to play in achieving all three sets of policy objectives: external stability, domestic financial stability and macroeconomic stability. Second, FX market monitoring informs the use of policy instruments, such as FX intervention, which, again, central banks in the region use to achieve not only external stability but also domestic financial and, to a lesser extent, macroeconomic stability objectives. Third, most central banks responding to the survey also find FX monitoring useful in informing the use of liquidity provision instruments for the purpose of maintaining domestic financial stability.

FX market monitoring supports policy instruments used to achieve policy objectives Table 3.1

Objectives and instruments	HK	ID	IN	KR	MY	PH	SG	TH	AU	NZ
External stability (including exchange rate stability and capital flow issues)										
Capital flow management measures		✓	✓			✓	✓	✓		
FX intervention	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Intervention in bond and money markets			✓						✓	✓
Macroprudential measures		✓	✓	✓		✓				
Policy interest rates		✓	✓						✓	✓
Capital account liberalisation ¹			✓			✓	✓	✓		
Liquidity provision						✓	✓		✓	
Domestic financial stability										
Capital flow management measures		✓	✓			✓	✓			
FX intervention		✓	✓		✓	✓	✓		✓	✓
Intervention in bond and money markets			✓						✓	✓
Macroprudential measures	✓	✓	✓	✓		✓		✓		
Policy interest rates		✓	✓	✓				✓	✓	✓
Capital account liberalisation ¹			✓			✓	✓			
Liquidity provision		✓	✓			✓	✓	✓	✓	✓
Macroeconomic stability (including price stability)										
Capital flow management measures			✓			✓	✓			
FX intervention		✓	✓			✓	✓		✓	✓
Intervention in bond and money markets			✓						✓	✓
Macroprudential measures	✓	✓	✓			✓				
Policy interest rates		✓	✓	✓		✓		✓	✓	✓
Capital account liberalisation ¹			✓			✓	✓			
Liquidity provision		✓	✓			✓	✓		✓	

¹ Excluding (cyclical) capital flow management measures.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific. This table is based on the framework used by the ACC Working Group in "Capital flows, exchange rates and policy frameworks in emerging Asia" (see BIS (2020)).

Core central bank functions. FX market monitoring also supports many core central bank functions (Graph 3.1.2). In particular, central banks in the region highlight that FX monitoring is most commonly used to support the functions of foreign reserve management, FX policy implementation and intervention, market intelligence and financial stability. In line with BIS (2018), this report distinguishes along the lines of the frequency-function nexus between *near real-time monitoring* and *medium-term monitoring*.⁴ To reflect this distinction, the survey separated the monitoring of core functions into higher-frequency (near real-time or daily) and lower-frequency (weekly, monthly or event-driven). Higher-frequency monitoring was most often used to support foreign reserve management, implementation of exchange rate policy or FX intervention and market intelligence gathering, followed by financial stability monitoring (Graph 3.1.2). Thus, for near real-time monitoring, the survey results are consistent with the practice of central banks on the BIS Markets Committee, including major AEs (see BIS (2018)). In contrast,

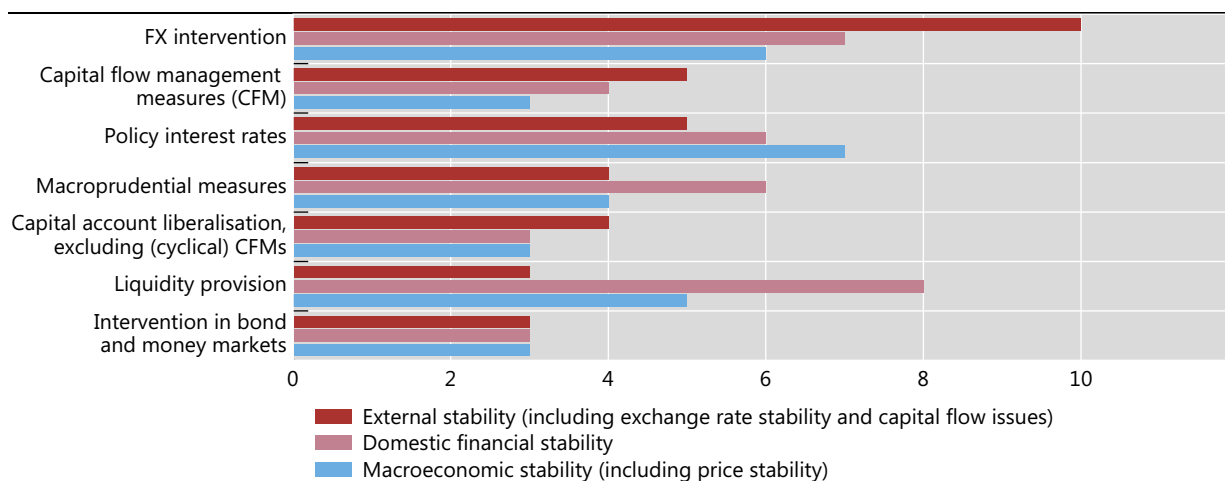
⁴ According to BIS (2018), *near real-time monitoring* of market conditions and market drivers supports core central bank functions such as policy implementation. Near real-time monitoring of market impact and transaction costs, in turn, also supports the foreign exchange reserve management function of central banks. *Medium-term monitoring* concerns the structural trends in fast-paced markets. Finally, ex post event analysis supports financial stability monitoring functions of central banks, as well as broader market intelligence.

monitoring related to financial stability objectives is more often conducted at a lower frequency (weekly, monthly or event-driven). The use of FX monitoring to support financial stability functions by a large number of respondents is not surprising given that a number of central banks in the region have previously highlighted that the financial channels of the exchange rate have important financial stability implications and have become more prominent over time (see BIS (2020)).

Policy instruments that draw on FX market monitoring, and their objectives

Number of respondents

Graph 3.1.1



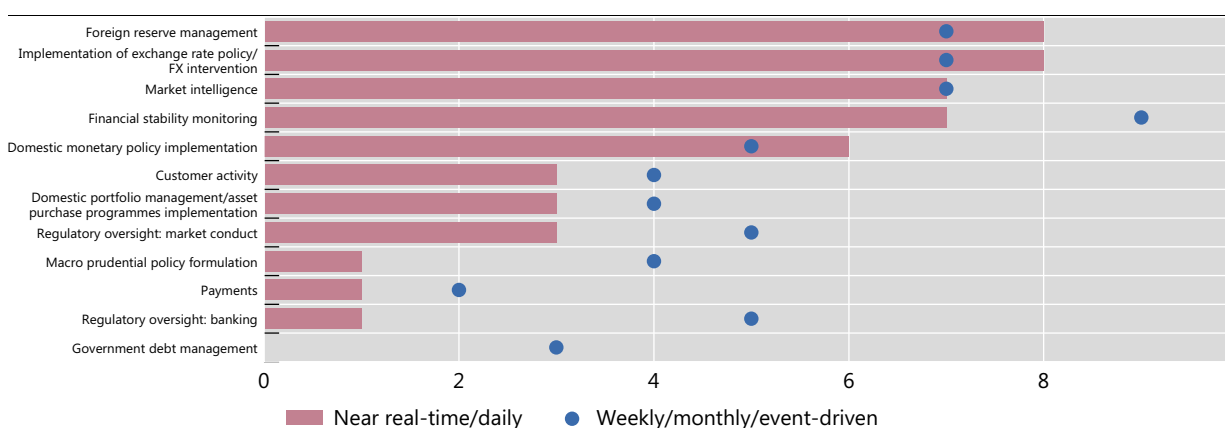
Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

FX markets monitoring for central bank core functions

Number of respondents

Graph 3.1.2



Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

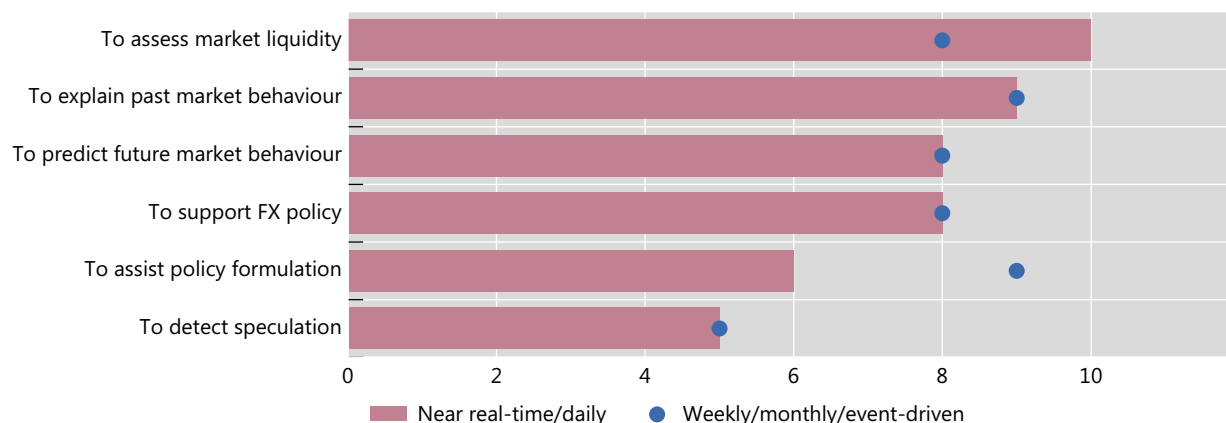
Operational objectives. Most central banks that took part in the survey use high- and low-frequency monitoring to meet the operational objectives of assessing market liquidity, explaining past market behaviour, predicting future market behaviour and supporting FX policy (Graph 3.1.3). Lower-frequency monitoring is more commonly used to explain past market behaviour and to assist in policy formulation (blue dots), where the latter can include regulatory oversight functions (eg banking and

market conduct) and regulation of FX transactions (eg requirements for underlying documentation for FX forward transactions or overnight position limits on non-resident entities). In turn, higher-frequency monitoring is more commonly used to assess market liquidity conditions as well as to explain past market behaviour (red bars). Some central banks also employ FX monitoring at both higher and lower frequency to detect speculative activities.

Operational objectives of FX market surveillance and monitoring

Number of respondents

Graph 3.1.3



Note: 11 central banks participated in the survey conducted by the study group.

Source: BIS-ACC Study Group on FX Markets: central bank survey.

3.2 How do Asia-Pacific central banks conduct monitoring of FX markets?

FX market monitoring and surveillance are conducted mainly by the market operations, financial stability and economics/research departments. High-frequency monitoring is typically conducted by the market operations department, while lower-frequency monitoring is typically the domain of financial stability and economics/research departments.

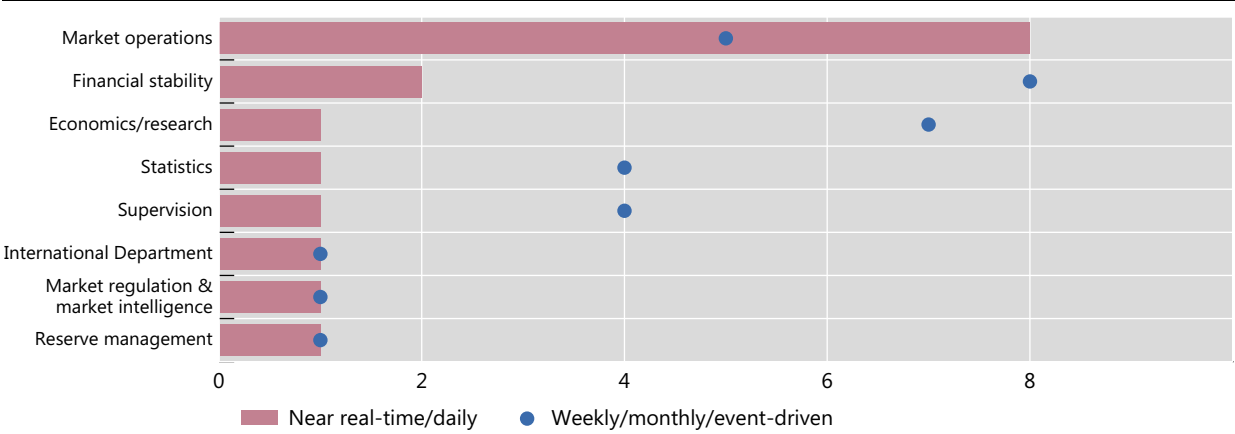
Consistent with central bank practices in other regions (BIS (2018)), market operations departments are mainly responsible for conducting near real-time monitoring among Asia-Pacific central banks (Graph 3.2.1). However, in contrast to other regions, and major AEs in particular, lower-frequency monitoring by central banks in Asia-Pacific is conducted more often by the financial stability area rather than economics/research departments. This reflects the greater involvement of EME central banks in Asia-Pacific in local FX markets for the purposes of policy implementation and as regulators.

Spot and FX swaps are by far the most monitored instruments, while data on options and NDFs are least monitored among the different instruments. This is consistent with FX swaps, followed by spot, accounting for the highest share of FX turnover by instrument, as reported in the Triennial Survey (BIS (2019)). At the same time, there is considerable dispersion in responses, indicating that monitoring of options and NDFs is important for some central banks, but not for others. This is because, for those currencies which are not easily convertible in offshore trading, participants in offshore markets rely on non-deliverable instruments, such as options and NDFs, for hedging or for expressing their views on future currency movements. In fact, although limited to very few currencies, Asia-Pacific currencies account for the largest share of NDF trading globally (Patel and Xia (2019)), with the NDF market seen as a possible source of excessive currency volatility and a monitoring challenge for some central banks (see eg Reserve Bank of India (2019)). For all instruments, measures such as bid-ask spreads, FX trading volume, market depth and liquidity are widely monitored to help understand if these markets are functioning well. This is

consistent with the previous responses from central banks in the region reporting that they monitored FX liquidity mainly with a view to promoting orderly market functioning (BIS (2020)).

Frequency of monitoring by department

Number of respondents Graph 3.2.1



Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

For jurisdictions issuing currencies that have a relatively deep offshore market, the surveillance of most offshore instruments is conducted by the market operations department. Monitoring typically takes place on a daily basis, although a few central banks also monitor NDFs in near real-time.

In recent years, data and systems used for FX surveillance and monitoring have improved. Several central banks noted an increasing use of high-frequency data to inform analysis while one respondent has incorporated trade repository data for monetary and financial stability surveillance reports. System improvements already being undertaken by some central banks include (i) changing the structure of data collection from banks to reduce administrative burden and increase efficiency; (ii) developing an internal reporting system to monitor interbank transactions on a real-time basis and to capture transactions between banks and their clients; and (iii) developing an automated system to detect market manipulation.

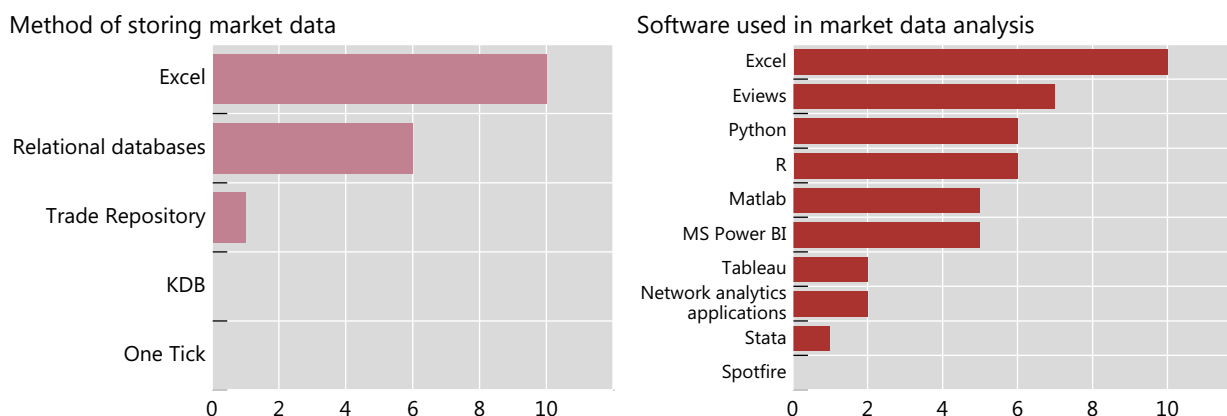
3.3 Sources of information for FX market monitoring and its output

Central banks collect and monitor FX market information from a broad range of sources. The most common sources are external providers such as Bloomberg and Refinitiv and market intelligence from participants and financial institutions; data from external providers are generally collected and monitored at high frequencies (tick-by-tick or intraday), while market intelligence is generally gathered on a daily basis. Most central banks also conduct event-driven or monthly surveys. Around half of the respondents collected and monitored net open positions reported by financial institutions or data from trade repositories.

Methods for market data storage and analysis

Number of respondents

Graph 3.3.1



Note: 11 central banks participated in the survey conducted by the study group.

Source: BIS-ACC Study Group on FX Markets: central bank survey.

The most prevalent method of storing and analysing FX-related data remains Microsoft Excel despite improvements in technology over recent years (Graph 3.3.1). Around half of the respondents also store data in relational databases,⁵ and use other software such as Eviews, Python and R for data analysis.⁶

There has been a trend towards monitoring more data sources and higher-frequency data in recent years, necessitating big data management and analysis. According to Cornelli et al (2022), interest in big data appears higher among central banks in Asia than in other jurisdictions, including at the senior level in policy-related areas. For instance, in 2015 Bank Indonesia began to develop a monitoring system for the local currency government bond market using big data/machine learning. And, in 2021 Bank Indonesia started studying machine learning to forecast the rupiah's exchange rate on a daily basis (Box 3.1). The Bank of Thailand, too, has invested in big data analytics coupled with machine learning techniques to support FX market monitoring and surveillance, including tools used to monitor the functioning of the Thai FX market (Box 3.2).

The most common types of output from FX market monitoring are daily reports, automated dashboards and chartpacks. The main target audience for the daily reports and chartpacks is senior management, followed by the department responsible for FX monitoring; automated dashboards are produced mainly for the departments responsible for monitoring FX markets. Only one respondent shares these outputs organisation-wide.

3.4 Challenges for FX market monitoring and potential enhancements

Challenges for FX market monitoring include data availability (especially in relation to transactions by non-residents or in offshore markets), the analysis of big data, and the translation of data into useful information. Central banks are considering the optimal way to address these challenges and have implemented or are looking to implement a number of measures in response.

⁵ A relational database is a collection of data items with pre-defined relationships between them. Many relational database systems have an option of using the Structured Query Language (SQL) for querying and maintaining the database.

⁶ KDB and One Tick refer to specialised systems for storing and analysing very high-frequency (tick level) market data.

Data availability for monitoring transactions by non-residents in offshore markets (both NDF and non-NDF) is a challenge for a number of the survey respondents. This is because data availability is limited to regulated entities and there is no centralised platform that captures all NDF or other offshore transactions. Some central banks make use only of the available NDF data provided by commercial data vendors in order to, at least, approximate the overall NDF trading activity. The lack of information on offshore trades makes it difficult to identify the ultimate beneficiary counterparty, understand large market flows and distinguish hedging from speculation. In response, regional central banks have (i) increased engagement with market participants to better understand these transactions; (ii) improved reporting practices to gain more insight into the ultimate beneficiary counterparty; (iii) relaxed regulation to incentivise onshore trading; and (iv) leveraged NDF data provided by commercial vendors to estimate total market developments.

Operational challenges in *analysing big data* include collecting and storing the increasing amount of data. One respondent also highlighted cost considerations for data subscriptions and storage. Central banks have responded by (i) optimising data collection (eg only collecting data as needed from banks); (ii) building agile data processing workflows to allow for flexibility; and (iii) building internal reference data to enable grouping of information and richer analysis. In addition, study group members noted organisational challenges within a central bank. One challenge concerns the sharing of results/output of FX market monitoring within the central bank. Specifically, the results of market surveillance are often not shared on an organisation-wide basis due to *confidentiality*.

Translating large data into useful information for the central bank policymaking process is also a challenge. In particular, one challenge concerns aligning FX monitoring output with what senior management find most helpful in informing their policy decisions. Some central banks have built or are looking to introduce automated dashboards to monitor markets in real time. Machine learning techniques are not yet widely used but several central banks are looking to develop this capability. Respondents likewise highlighted the importance of maintaining strong communication and engagement with market participants and financial institutions in providing context for the data.

To help address these challenges, central banks have also needed to consider *staffing* arrangements. Recruiting *external experts versus training staff internally* to master more sophisticated data management and analysis toolkits appears to be a live issue for some central banks. One central bank made organisational changes to enhance its monitoring of markets by consolidating market operations and market research into one department. Finally, collaboration with other central banks to facilitate the sharing of best practices and to achieve cost efficiencies was also suggested.

Capital flows and FX monitoring initiatives in Indonesia

The Indonesian economy depends on capital inflows to finance its current account deficit. Yet, portfolio inflows have become more volatile recently, partly due to higher global financial market uncertainty. In turn, Bank Indonesia is mandated with creating and maintaining the stability of the rupiah, as reflected in the rupiah exchange rate's stability against other currencies. Hence, initiatives to monitor exchange rates and capital flows (especially into the local currency government bond market) have become more relevant and important for supporting the monetary policy direction.

In 2015, Bank Indonesia began to develop a monitoring system for the local currency government bond market using big data and machine learning. First, the system started to capture and cluster investor data based on their behaviour. The challenges Bank Indonesia faced before the introduction of the system were (i) no standard names for investors; (ii) enormous data quantity and frequency; and (iii) manual data collection from various platforms. By using a big data method,¹ Bank Indonesia can more efficiently and accurately analyse investor behaviour and automatically process data. The second step was to model investor behaviour by combining fundamental and market variables that influence their decisions. The selection of the most suitable variables will be carried out by using a machine learning model. The third phase was to generate the daily projection of portfolio flows to local currency government bonds. This projection of daily portfolio flows based on the dynamics of global and domestic financial markets could be considered when Bank Indonesia formulates policy responses.

More recently in 2021, Bank Indonesia started studying machine learning techniques to forecast the rupiah's exchange rate against the US dollar on a daily basis. In particular, Bank Indonesia clusters the domestic and external sentiment that might have an impact on the rupiah's movements based on analysis developed by Henderson and Daoud (2021) (Table B.3.1). Early analysis showed that the rupiah's depreciation in mid-2021 was associated with the rising global risk-off sentiment and stronger US economic growth. However, this analysis provides only a "prompt indicator", and has no prediction power. To strengthen the analysis, Bank Indonesia is considering the quantification of granular data by using machine learning.

Sentiment grouping based on the impact on Indonesian financial markets

Table B.3.1

Factors		IDR exchange rate against USD	Local currency government bond yield	Equity Index
Domestic	Slower domestic growth	(-)	(-)	(-)
	Loose monetary policy	(-)	(-)	(+)
External	Global risk-off sentiment	(-)	(+)	(-)
	Stronger US growth	(-)	(+)	(+)

The model's construction will be based on the artificial neural network (ANN) technique. This technique is believed to be more flexible and more efficient because of its learning ability on unpredictable data. According to Nayab et al (2013), the exchange rate prediction model trained by using historical data can predict the movement of the exchange rate over the next 1,000 days with an accuracy rate of 98.85%. The data set used in the initial phase of development is divided into four main groups, namely market data, fundamental economic data, technical data, and FX daily transactions. The output that can be achieved by using machine learning includes (i) post analysis for the rupiah's movement; and (ii) a daily forecast for the rupiah's movement including monitoring of the FX transactions of market participants.

¹ In particular, by combining the methodologies of algorithm clustering, agglomerative hierarchical clustering and silhouette coefficient.

Thailand's experience in applying big data and machine learning in FX market monitoring

Over the past 10 years, the emergence of electronic FX trading infrastructure has brought greater data availability, which in turn has created opportunities to further enhance FX market monitoring capabilities. Because of this, the Bank of Thailand has invested in big data analytics, coupled with machine learning techniques, to support FX market monitoring and surveillance. In particular, the Bank of Thailand has developed monitoring and forecasting tools that allow its staff to closely monitor the functioning and dynamics of the Thai FX market, and provide timely input for policy formulation. Two of these tools are described below.

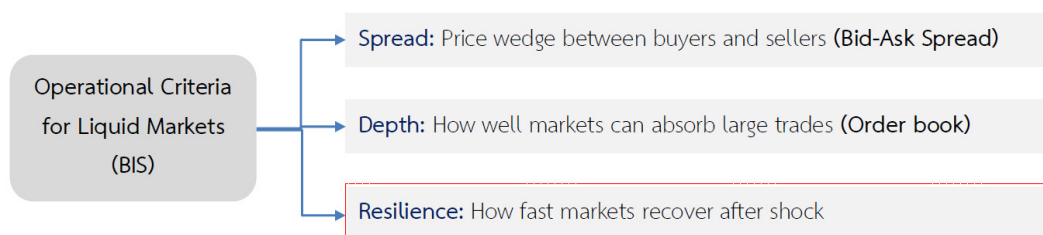
Tools

Tool 1: FX market monitoring.

The Bank of Thailand has recently adopted big data using tick-by-tick traded and quoted data from an FX electronic platform provider to monitor the microstructure of the Thai FX market through a series of indicators representing key metrics such as market depth (limit order book), market tightness (bid-ask spread), and market resilience (time to replenish liquidity). With this, the Bank of Thailand can assess from a bottom-up perspective how vulnerable the Thai FX market is to large external shocks or stresses at any given point in time. The monitoring tool serves as an early warning indicator for potentially abnormal FX movements induced by market illiquidity.

FX market monitoring indicators

Graph B.3.1



Sources: Borio (2004); Santoso et al (2010).

Tool 2: Price and flow forecasting.

The Bank of Thailand was able to utilise machine learning techniques to analyse data on FX transactions by residents to predict future FX flows. Essentially, the observed patterns of flows from residents' trading behaviour are interpreted using machine learning processes. As a result, we can assess aggregated flow data and identify potential periods of stress ahead of time.

In addition to domestic flows, several external factors affect the USD-THB exchange rate, such as other asset prices and global investor sentiment. Hence, adopting a machine learning technique to consider these factors and forecast exchange rates became instrumental in order to analyse short-term market players' behaviour that contributes to market volatility.

4. Developing the FX ecosystem and hedging markets

Key messages:

The use of FX derivatives has grown in Asian EMEs, but lags that of AEs and regional financial centres. Furthermore, central banks generally have only limited information on market participants' FX hedging policies and the exact purpose for which FX derivatives are used.

Concerning market resilience, regional currencies fared considerably better during the 2020 Covid-19 financial market turbulence than during the 2013 taper tantrum, partly due to the swift, and, in some cases, coordinated, response by central banks, and partly owing to the structural FX market reforms in recent years.

The continuation of the current policy mix of market liberalisation with effective risk management by market participants should help to improve FX market resilience.

4.1 FX hedging market landscape

Asia-Pacific economies are at different stages of their FX market evolution. The development of an FX ecosystem and hedging markets depends on the degree of market liberalisation and country-specific factors, such as financial market infrastructure, market size, the degree of capital market openness and foreign participation in the domestic capital market, international investment positions, institutional settings and the regulatory environment. In regional financial centres, such as Hong Kong SAR and Singapore, market infrastructure plays a key role in facilitating trading in regional currencies for current and capital account transactions. Specifically, fast-paced electronic trading in FX swaps and NDFs is executed with low transaction costs, relatively higher liquidity, and large transaction volumes (Washimi and Kadogawa (2020)).

For emerging Asian economies where onshore spot and FX hedging markets remain regulated to lessen the impact of volatile capital flows, several efforts have been under way to ease non-resident access to the onshore hedging market and help market participants to hedge more flexibly. However, despite their different stages of market development, Asia-Pacific EMEs and AEs alike all face some common concerns regarding FX volatility and US dollar liquidity (see Section 4.2).

More developed FX markets are generally characterised by a deep and liquid FX derivatives market and relatively easy access by non-residents to onshore FX hedging.⁷ In general, AEs and financial centres in the region tend to boast deeper FX derivatives markets than their EME peers (Graph 4.1.1). In both cases, financial customers rely on FX derivatives to a greater extent than do non-financial customers. At the same time, the median share of FX derivatives in dealers' trading with financial customers in Asian EMEs, both resident and non-resident, had been growing, exceeding 60% by 2019, but declined at the time of the 2022 Triennial survey (left-hand panel). By contrast, median hedging by Asian EME non-financial firms trended below 50% during the same period (right-hand panel, red line), as global trade slowed on weak global economic growth, a decline in the growth of global value chains, the sluggish pace of trade and investment liberalisation agreements and trade disputes.

The use of FX derivatives by financial counterparties trended upwards between 2011 and 2021, partly because outward portfolio investment by Asian EMEs was growing rapidly (Graph 4.1.2). Total outward portfolio investment of residents in India, Indonesia, Korea, Malaysia, the Philippines and Thailand exceeded \$1.1 trillion as of end-2021, about two thirds of which was in securities denominated in US

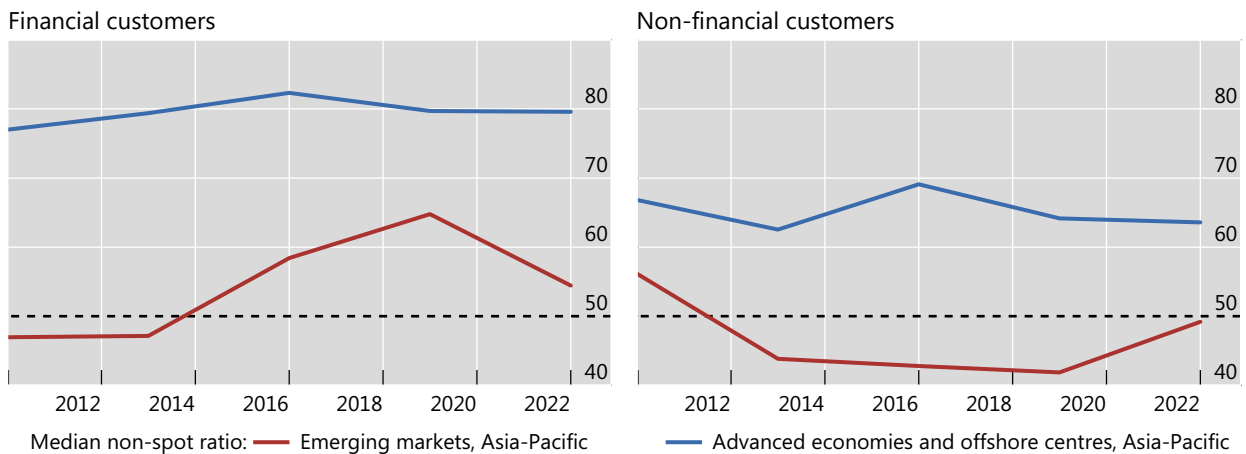
⁷ According to the BIS Triennial Survey, from 2013 to 2019 the relative depth of FX derivatives markets was on the rise or stable for all but one of the member jurisdictions, as indicated by the share of FX derivatives in total FX turnover. When viewed by currency rather than location, the share of FX derivatives tended to be higher (ie closer to the global average of major currencies), but the trends were more mixed.

dollars. However, since the beginning of 2022, the outward portfolio investment exhibited a decline against the background of volatile macroeconomic and financial developments. The total also masks considerable cross-country differences, with Korea, followed by Malaysia and Thailand, boasting sizeable external portfolio assets, whereas those of Indian residents are negligible.

Share of FX derivatives turnover (non-spot ratio) by customer type and economy

In per cent

Graph 4.1.1

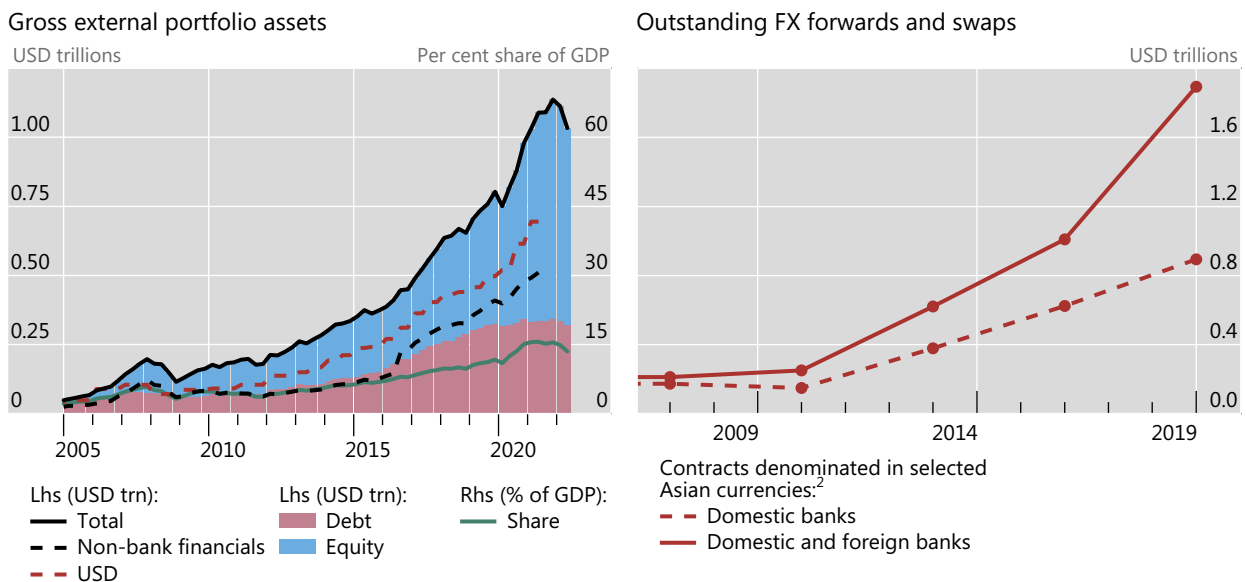


The non-spot ratio is calculated as the share of the average daily turnover of FX derivatives, namely FX swaps, forwards, currency swaps and OTC options in the average daily total FX turnover (ie of both FX spot and derivatives).

Source: BIS Triennial Central Bank Survey of Foreign Exchange and Over-the-counter Derivatives Markets.

External portfolio assets and outstanding FX hedges in select Asian economies¹

Graph 4.1.2



¹ India, Indonesia, Korea, Malaysia, the Philippines and Thailand. For the Philippines, portfolio investment by non-bank financials is not available. ² Reporting dealers' consolidated notional amount of contracts outstanding with non-dealer financial institutions. Contracts denominated in IDR, INR, KRW, MYR, PHP and THB. The selected countries report only in the Triennial Survey (dashed red line). The BIS uses the Triennial data to supplement the semiannual data to arrive at a more accurate estimate of the size of OTC derivatives markets for all periods (solid red line).

Sources: IMF, *Coordinated Portfolio Investment Survey*; CEIC; BIS OTC derivatives statistics; national data.

Overview of currency risk hedging instruments Table 4.1

	Onshore FX forward	Non-resident access to onshore FX hedging	Offshore market
China	Avg daily FX forward and swap volume: USD 70–90bn 6-month spread: 5–15 pips	Yes, under the QFII and RQFII rules (conform to actual needs), cross-border and CIBFXM mechanism. Foreign central banks and similar institutions can participate in various types of FX transaction in China's interbank foreign exchange market	Avg daily NDF volume: USD 1bn 1-month spread: 30–50 pips
Hong Kong SAR	Avg daily FX forward volume: USD 13–15bn 1–3 month spread: 0.5–1 pips 6–12 month spread: 1–3 pips	Yes	–
India	Avg daily FX forward volume: USD 4–5bn Spread: 1 pip	Yes, for underlying exposure above a nominal threshold	Avg daily NDF volume: USD 5–7bn bid/ask spread: 1–2 pips
Indonesia	Avg daily FX forward volume: USD 500m Spread: 10 pips Avg daily onshore NDF (DNDF) volume: USD 500–700m Spread: 5 pips	Yes, with underlying documentation (above a threshold)	Avg daily options volume: USD 50m
Korea	Avg daily FX forward volume: <1m: USD 8bn >1m: USD 3bn 1-month spread: 10 pips	Yes, for underlying investment	Avg daily NDF volume: USD 3–4bn 1-month NDF spread: 20 pips
Malaysia	Avg daily FX forward volume: USD 1.1bn 1 month spread: 30 pips Avg daily FX swap volume: USD 6.4bn 1–12 month spread: 3–30pips	Yes, with underlying commitment (via a licensed onshore bank or appointed overseas office); institutional investors are also eligible for the Dynamic Hedging Programme without documentation.	The central bank does not recognise offshore trading in MYR, including NDFs
Philippines	Avg daily FX forward volume: USD 550m 1-month: 1–2 cents 12-month: 10–20 cents	Tenor/maturity of FX forwards must be coterminous with the maturity of the underlying	Avg daily NDF volume: USD 400–600m 1-month NDF spread: 2–3 cents
Singapore	Avg daily FX forward volume: USD 1.0–1.5bn 1–6 month: 0.1–1pip	Yes, outright FX allowed. Limits on resident FIs' lending of SGD (including via FX swaps) to non-resident FIs.	–
Thailand	Avg daily FX forward volume: USD 1.5bn Up to 3-month spread: 2–4 pips 6–12 month spreads: 4–6 pips	Yes, unlimited with underlying commitment. If no underlying, amounts are restricted.	–

Sources: HSBC (2022); national data.

As intermediaries, banks headquartered in the region as well as the local affiliates of global banks are active dealers in FX derivatives markets for Asian EME currencies. By June 2019, banks headquartered in India, Indonesia, Korea, Malaysia, the Philippines and Thailand reported a combined amount of more

than \$800 billion in outstanding FX swaps and forwards referencing their respective domestic currency, roughly double the amount reported in 2013 (Graph 4.1.2, right-hand panel, dashed red line). Adding local affiliates of global banks, the estimated global total for these five currencies exceeded \$1.9 trillion (solid red line) in 2019, indicating that foreign banks intermediate more than half of the total.

Regional EMEs still lag regional financial centres in FX hedging market development, but EME central banks play an active role in deepening their onshore FX hedging markets. FX forward markets in Hong Kong SAR and Singapore exhibit better market liquidity than other EMEs in the region, as suggested by narrower bid-ask spreads (Table 4.1, second column). Hong Kong SAR also boasts the most open access to onshore FX hedging for non-residents, followed by Singapore.⁸ Most regional EMEs require non-resident transactions in local FX hedging markets to be backed by underlying exposure, although these can differ in detail, such as threshold size (third column). In China, for instance, non-resident access to onshore FX hedging is restricted by the schemes for qualified foreign institutional investors. In Malaysia, it is conducted via the Dynamic Hedging Programme administered by the central bank. In general, the official sector plays a major role in the growth and deepening of FX hedging markets in EMEs in the region (Table 4.2).

For some currencies, non-residents conduct FX hedging (and speculation) in offshore markets using non-deliverable instruments, such as NDFs and options (Table 4.1, fourth column). Estimates of daily NDF volumes are particularly large for INR and KRW, and non-negligible for PHP. While the NDF volume may seem somewhat sizeable for CNY, it is small relative to the sheer volume of CNY trading, and most offshore activity is conducted via the deliverable CNH.

Recent central bank measures to develop local FX hedging markets in select EMEs Table 4.2

India	In 2020, the Reserve Bank of India rolled out measures such as longer trading hours, merging facilities for residents and non-residents, free cancellation and rollover of contracts and relaxation of underlying asset requirements to facilitate FX transactions and develop onshore NDF markets. Domestic banks are allowed to participate in the offshore market and between themselves to conduct NDF transactions that reduce the spread between onshore and offshore rates (Kumar and Rituraj (2020)).
Indonesia	Bank Indonesia introduced a Domestic Non-Deliverable Forward (DNDF) instrument settled in local currency in November 2018 that helps to smoothen FX demand and ease pressure on the spot market.
Malaysia	The Central Bank of Malaysia introduced the Dynamic Hedging Programme in 2016 that allows institutional investors to manage their portfolio FX exposure by entering and unwinding forward contracts without the need to submit documentation.
Thailand	In January 2021, the Bank of Thailand enrolled non-resident corporates into the Non-Resident Qualified Corporate (NRQC) programme, which allows them greater flexibility in hedging their FX exposure in the onshore market, thus improving the ease of doing business and reshoring FX activities to increase market liquidity. The facilitation of onshore activities helped support growing demand for FX hedging when limits on retail and private sector investment abroad were eased and access to foreign currency deposit accounts was liberalised to reduce home bias in residents' portfolio investment.

Source: BIS Study Group on FX Markets in Asia-Pacific.

⁸ Singapore only limits the lending of SGD to non-resident financial institutions for FX speculation. In Singapore, the SGD exchange rate is the principal instrument of monetary policy.

4.1.1 Study group survey of FX hedging markets and FX risk management practices

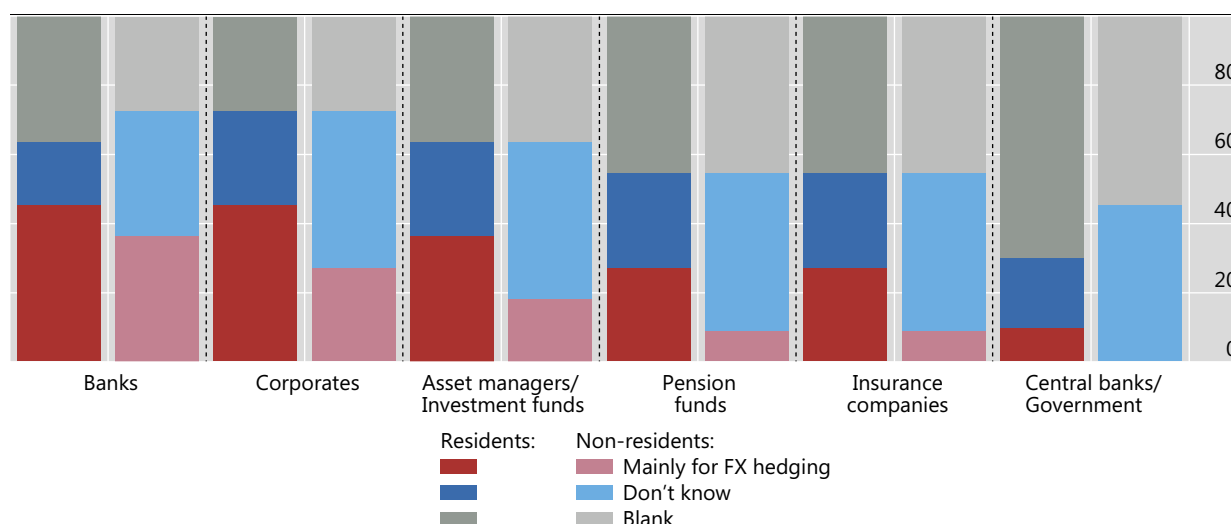
The responses to the survey conducted among the study group members indicate that central banks tend not to have detailed information concerning the *purpose* of trading in FX derivatives by different types of market participant. While central banks collect quantitative information on total transactions in FX derivatives, most central banks do not have detailed information on the hedging policies or hedge ratios of market participants. Central banks generally have better information about the purpose of FX forward or swap trading by residents compared with non-residents. Member responses indicated that about a third to a half of trading by banks, corporates and NBFIs is related to FX hedging (Graph 4.1.3). About a third of the respondents to the survey indicate that FX hedging constitutes the main purpose of trading in FX derivatives by financial institutions and corporates.

The survey responses indicate that different types of market participant hedge FX exposures for different business purposes, but that the extent of FX hedging is still relatively low. For NBFIs, such as asset managers, pension funds and insurance companies, it is common to have formal hedging policies for portfolio debt and portfolio equity investments (Graph 4.1.4). Banks also tend to hedge their portfolio investment, as well as direct investment and loans. Non-financial corporates tend to focus almost exclusively on managing the FX risk associated with traded goods and services.

Purpose of FX forward or swap transactions

Share of respondents

Graph 4.1.3



Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

Regardless of market participant type or business line, the total number of central bank respondents indicating the existence of a formal hedging policy for market participants in their jurisdiction has never exceeded half, suggesting that the extent of FX hedging in the region is still relatively low. As for the hedging instruments, FX swaps and forwards are the most common (Graph 4.1.5). The hedging tenors are mainly less than one year, but also vary across different types of market participant and purpose.

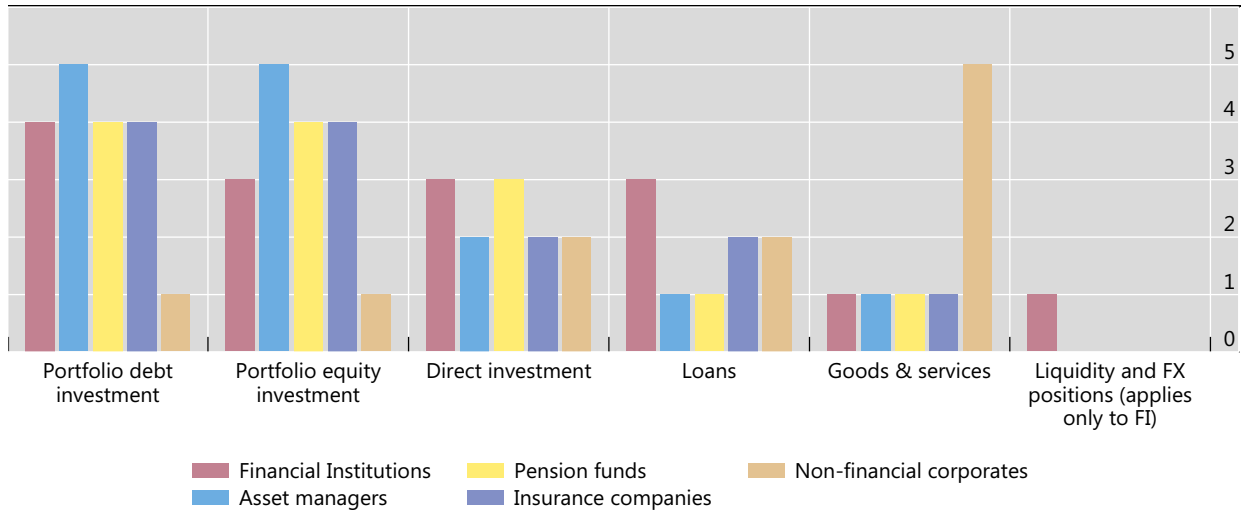
In addition to FX derivatives, foreign currency deposits constitute another widely used tool for FX risk management by market participants (Graph 4.1.6, left-hand panel). Most respondents (eight out of 11) pointed to institutional drivers (eg risk management or investment strategies) and external drivers (eg global market developments) as important in shifting market participants' hedging practices (right-hand panel). In addition, a majority of respondents viewed organic (eg relative exchange rate stability) and

regulatory (eg FX liberalisation policies) factors as important drivers. Finally, five members mentioned the growth in outward portfolio investment by residents as an important driver.

Formal hedging policies by type of market participant and business purpose

Number of respondents

Graph 4.1.4



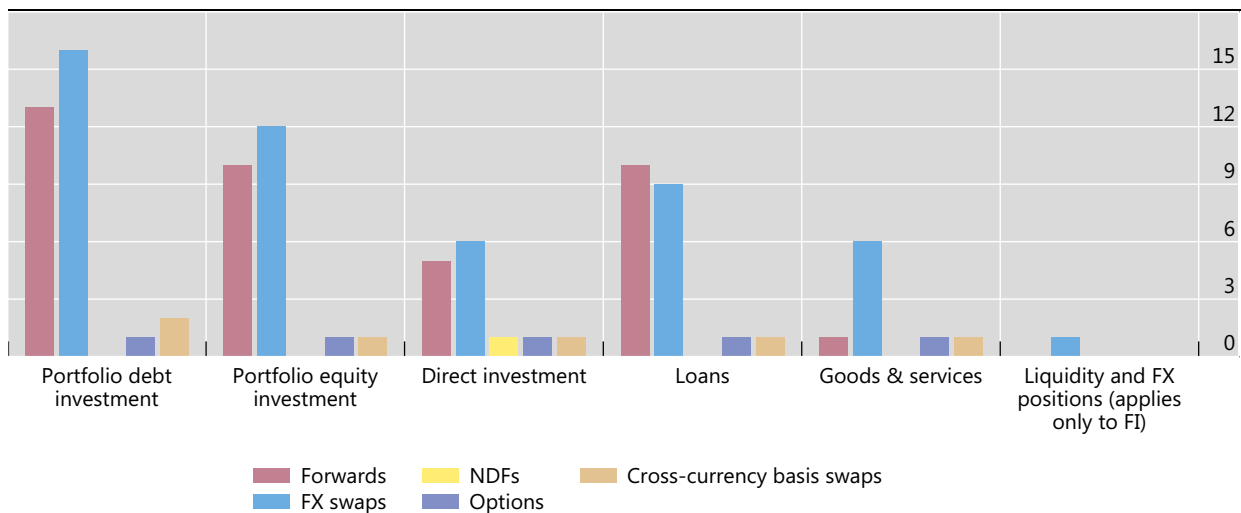
Note: 11 central banks participated in the survey conducted by the study group (sum of responses “most” and “some”).

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

FX hedging instruments by hedging purpose

Number of respondents

Graph 4.1.5



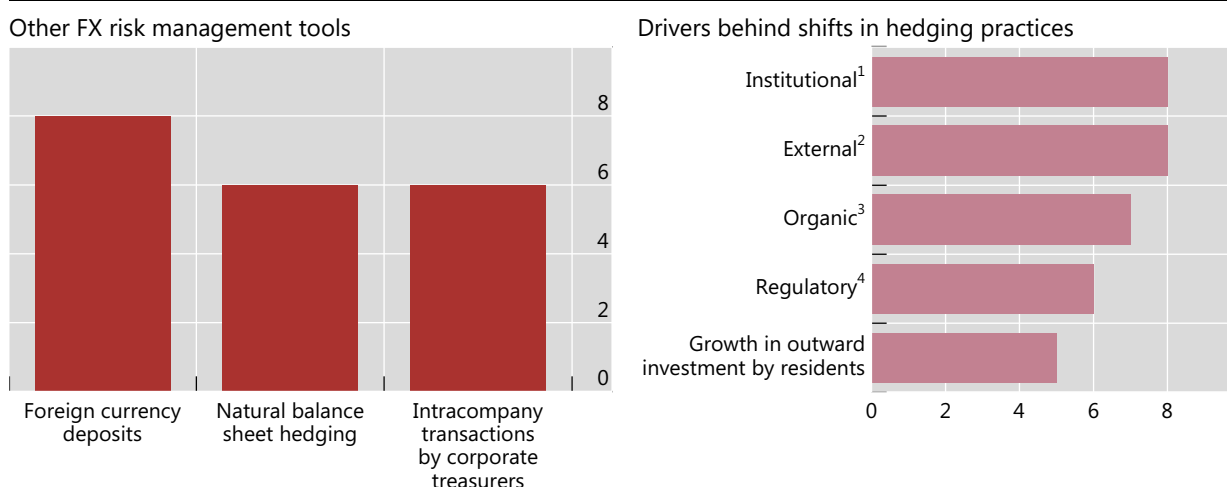
Note: 11 central banks participated in the survey conducted by the study group (the totals can exceed 11 because they represent an aggregate across market participant types).

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

Market participants' FX risk management tools and practices

Number of respondents

Graph 4.1.6



¹ Eg institutional own business decisions, such as risk management or investment strategies. ² Eg global market developments.

³ Eg relative exchange rate stability. ⁴ Eg FX liberalisation policies.

Note: 11 central banks participated in the survey conducted by the study group.

Source: Survey of the BIS Study Group on FX Markets in Asia-Pacific.

4.2 FX market performance during risk events

The degree of the FX market's resilience can be gleaned from its performance during two historical volatility episodes: the 2013 taper tantrum (May–September 2013) and the 2020 Covid-19 crisis (February–April 2020). Generally speaking, regional FX markets and currencies fared better during the latter episode, which indicates the effectiveness of central banks' responses to the crisis as well as structural improvements in the regional FX markets in recent years.

Disruptions to the FX market triggered by the 2020 Covid-19 pandemic were shorter-lived and followed by a faster recovery than those triggered by the 2013 taper tantrum (Graph 4.2.1). The exchange rates of most currencies represented in the study group stabilised and experienced a V-shaped rebound three months after the peak of the crisis. As such, their exchange rates against the US dollar generally fared better during the Covid-19 episode than during the taper tantrum (Graph 4.2.2, left-hand panel). In addition, half of the currencies recorded lower average implied volatility during the Covid-19 risk event than during the taper tantrum, while around half registered lower peak implied volatility (Graph 4.2.2, right-hand panel).

The greater resilience of regional FX markets during the Covid-19 financial market turbulence can be attributed, in part, to swift policy responses by central banks globally. In particular, the US Federal Reserve provided ample liquidity via the existing central bank swap lines and expansion of the swap line network to nine additional central banks.⁹ The Federal Reserve also opened a new temporary repo facility to foreign and international monetary authorities (FIMA Repo Facility).¹⁰ In addition, some central banks

⁹ These include the following central banks in Asia-Pacific: the Reserve Bank of Australia, the Bank of Korea, the Reserve Bank of New Zealand and the Monetary Authority of Singapore.

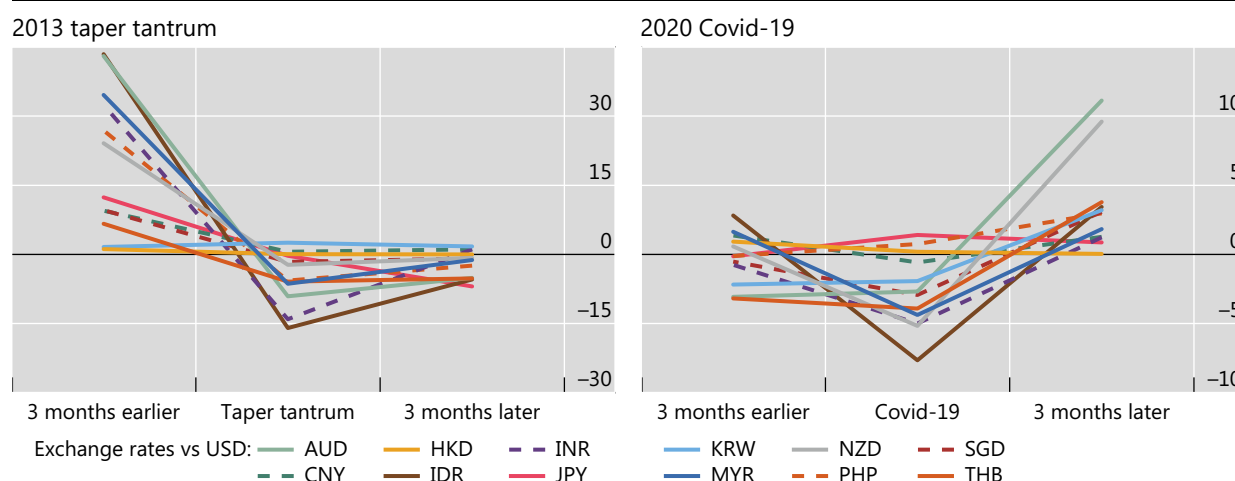
¹⁰ While there was no significant take-up for the FIMA Repo Facility, it may have worked via the signalling channel, in that US dollar liquidity was also available to central banks outside the swap line network.

in the region, such as the Bank of Thailand,¹¹ briefly increased FX swap operations during the initial stages of the crisis as a pre-emptive measure in mitigating stresses in the FX swap market. At the same time, the number of ACC central banks that engaged in spot FX intervention was similar across both risk events, with eight and seven study group members intervening during the taper tantrum and the Covid-19 crises, respectively.

Performance of Asia-Pacific currencies pre- and post-risk events¹

In per cent

Graph 4.2.1



AUD = Australian dollar, CNY = Chinese yuan, HKD = Hong Kong dollar, INR = Indian rupee, IDR = Indonesian rupiah, JPY = Japanese yen, KRW = Korean won, MYR = Malaysian ringgit, NZD = New Zealand dollar, PHP = Philippine peso, SGD = Singapore dollar, THB = Thai baht.

¹ A positive value means an appreciation of the currency against the US dollar. Taper tantrum risk event: May–September 2013; Covid-19 risk event: February–April 2020.

Source: Bloomberg.

In addition to temporary measures implemented during the crisis periods, several central banks have also implemented regulatory and other policy measures that support the resilience and continuous functioning of the market. These measures focus on longer-term key factors that support good risk management practices by market participants, supervisory oversight over offshore financial markets, early detection of potential market stress, and cost-effective hedging by more diversified pool of counterparties in a liquid market.

One example is Korea, where authorities identified four key contributors to the vulnerabilities of Korean financial markets during the Covid-19 financial market stress – among them, the high reliance of Korean institutional investors on securities firms (themselves vulnerable to market stress) for intermediation of outward investment and FX hedges (Bank of Korea et al (2021)). This led to the establishment of the FX Macroprudential Council in 2021 to coordinate the efforts of the financial authorities to enhance FX risk management capacities of institutional investors (eg, an increase in the ceiling on insurance companies' open FX position) and to improve FX liquidity monitoring (indicators to monitor FX risks of insurance and asset management companies and quarterly FX liquidity stress testing) (Arslanalp et al (2020)).

Finally, structural improvements in FX markets over the recent years have probably also contributed to the better performance in the most recent stress episode. For instance, greater participation by NBFIs has contributed to the diversity and resilience of the FX markets in the region. The greater use of FX derivatives as hedging instruments by market participants may have also contributed to the resilience

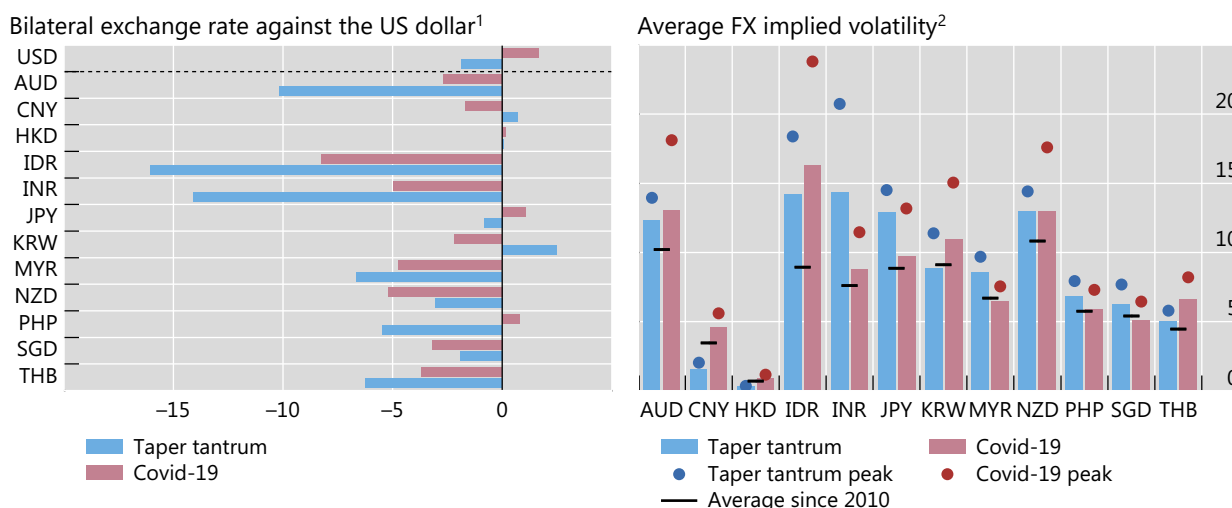
¹¹ The Bank of Thailand has regularly conducted sell-buy FX swap transactions as part of its open market operations to absorb excess liquidity in the Thai baht money market.

of the financial markets and helped avoid potential large sell-offs of local securities and local currencies by foreign investors.

Performance of Asia-Pacific currencies during recent risk events

In per cent

Graph 4.2.2



USD = Bloomberg US dollar index (DXY), AUD = Australian dollar, CNY = Chinese yuan, HKD = Hong Kong dollar, INR = Indian rupee, IDR = Indonesian rupiah, JPY = Japanese yen, KRW = Korean won, MYR = Malaysian ringgit, NZD = New Zealand dollar, PHP = Philippine peso, SGD = Singapore dollar, THB = Thai baht.

¹ A positive value means an appreciation of the currency against the US dollar. For USD, a positive value means appreciation of the US dollar against the basket of other currencies. Taper tantrum risk event: May–September 2013; Covid-19 risk event: February–April 2020. ² Based on implied volatility of currency options with one-month maturity.

Source: Bloomberg.

4.3 US dollar funding vulnerabilities

As mentioned above, many emerging Asia central banks have implemented reforms to help improve market participants' ability to manage FX risk and increase resilience to external shocks, thereby reducing adverse effects on onshore markets. Central banks also conduct market surveillance to decide whether to provide timely liquidity via bilateral swap lines and multilateral currency swap arrangements (EMEAP (2020); Han and Lulu (2022)).

Notwithstanding the recent efforts to address US dollar liquidity shortage during stress periods, Asian EMEs remain vulnerable to the structural imbalance between the limited capacity of local FX hedging markets and the sheer size of capital in- and outflows. A spike in demand for FX hedging can strain FX derivatives markets. The imbalance can accumulate due to, for example, large institutional holdings of foreign financial assets,¹² benchmark-driven flows (Arslanalp et al (2020); BIS (2021)), or the disconnect between onshore and offshore portfolio hedging flows by residents and foreign investors (McGuire et al (2021)). In a stress period, FX funding capacity can erode away rapidly and FX hedging costs can spike. In particular, US dollar funding supplied by domestic banks through FX derivatives in the form of off-balance sheet net US dollar lending can shrink rapidly in the presence of sudden capital outflows or the unwillingness of foreign counterparties to lend US dollars.

In their role as intermediaries, the banking systems remain the locus of vulnerabilities when FX hedging and dollar funding markets come under stress. The size of banks' exposure to off-balance sheet

¹² The Economist (2022) estimated these to have reached nearly \$28 trillion in 2020 for East and Southeast Asia.

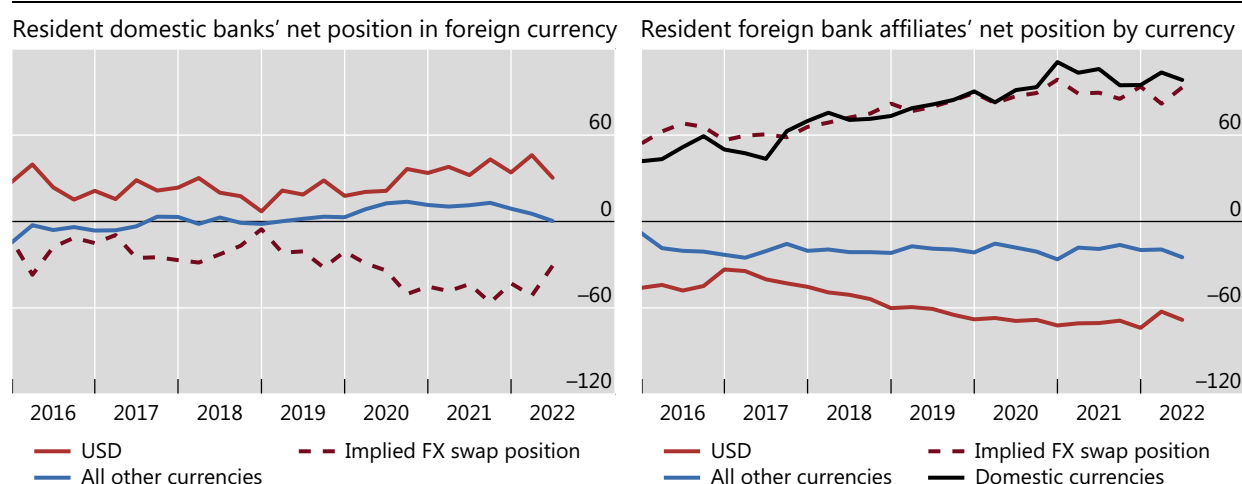
FX derivatives can be inferred from the apparent currency mismatches on their balance sheets. Under the assumption that banks hedge the on-balance sheet cross-currency funding gap with FX derivatives, select Asian EME domestic banks' home offices had a combined off-balance sheet net dollar borrowing via FX derivatives of roughly \$40–50 billion until mid-2022, when the position contracted to about \$30 billion (Graph 4.3.1, left-hand panel). By contrast, the local affiliates of foreign banks run a currency mismatch in the opposite direction (right-hand panel, red and blue lines), and which is larger in magnitude than that of EME domestic banks. Their net investment in local currency assets (right-hand panel, black line) has been close to \$100 billion, implying an equivalent off-balance sheet swap position partly funded with net liabilities in US dollars (\$69 billion, red line) and in other non-local currencies (blue line).

Based on the above estimates, the local affiliates of global banks, which source their dollars from capital markets or from their headquarters, are particularly important as counterparties and intermediaries in local EME FX hedging markets. When foreign banks invest in local currency assets, they swap dollars for local currency, which makes them "natural" suppliers of dollars in local EME FX forward and swaps markets. When compared with the total daily FX forward and swap turnover of these select Asian EMEs, there is a sizeable vulnerability to US dollar liquidity shortage arising from sudden capital outflows or reduced willingness of the counterparties to supply US dollars.

Foreign and domestic banks' net positions by currency in select Asian EMEs¹

USD billions

Graph 4.3.1



¹ Combined on-balance sheet net position (ie assets minus liabilities) of banks located in India, Indonesia, Korea, Malaysia and the Philippines.
Source: BIS locational banking statistics.

High FX hedging costs, especially during stress periods, can lead to tighter domestic financial conditions for countries with a negative net international investment position (IIP). As a result, banks or corporates may be unable to find local funding alternatives to their expensive foreign currency borrowing and may have to sell assets instead (Hong et al (2019)). Countries with a positive net IIP facing higher hedging costs may reduce their overseas investments and divert their funds to invest domestically or elsewhere with lower returns or higher risk, possibly resulting in suboptimal investment allocation between domestic and foreign assets. At the extreme, prohibitively high hedging costs arising from lack of FX liquidity can cause severe market dysfunction, as evidenced during the Covid-19 pandemic in March 2020, particularly for non-banks in jurisdictions without US dollar swap arrangements with the US Federal Reserve.

To address these structural issues, central banks and market participants would need to work together to develop an FX ecosystem and a hedging market structure that support more balanced flows and stable US dollar funding. The aim should be to build on the continuation of current policy mix of

market liberalisation and effective FX risk management by participants, as well as greater cooperation among central banks in market monitoring and crisis mitigation.

4.4 Considerations for further development of FX markets in emerging Asia

This subsection discusses possible roadmaps for developing the FX ecosystem and hedging markets in emerging Asia. Future paths include (i) a continuation of recent reforms to enhance the ability of market participants to manage FX risks in each jurisdiction; (ii) central bank cooperation to manage the mismatch between FX derivatives market capacity and the size of gross capital flows, including growing demand for FX hedging; and (iii) broadening the range of FX risk management tools available to market participants.

First, in the context of trade and investment liberalisation, FX hedging can be facilitated by simplifying procedures, reducing transaction costs and providing incentives to corporates across the region for improved FX risk management. For capital market transactions, regulations involving onshore banks and/or counterparties, such as qualified portfolio investors who would like to invest in domestic or overseas markets, may be further relaxed possibly in conjunction with greater progress in regional corporate/sovereign bond market development (ADB (2015)). To reduce the disruptions caused by US dollar funding squeezes, local and foreign NBFIs and corporates could be allowed to hedge more flexibly within a framework of an effective liquidity and FX risk management including regulatory oversight, risk-based capital regulation, systemic risk monitoring and strict liquidity provision mechanism (McGuire et al (2021)).

Second, central banks also have an important role to play in balancing capital flows and providing US dollar liquidity to stabilise the market during stress periods. Central banks can prevent or mitigate derivatives market dysfunction by acting as liquidity providers of last resort via FX interventions (IMF (2021)), applying CFMs (IMF (2022)) or conducting asset purchases. Asia-Pacific central banks can work with each other and with counterparties in derivatives markets to ensure ample FX liquidity and stable market functioning. Such coordination can be done by establishing swap facilities, enhanced monitoring of potential FX funding or maturity mismatches (Hong et al (2019)), and greater information-sharing and data dissemination on onshore and offshore market activities. To collectively mitigate the impact of high FX hedging costs on domestic financial conditions, Asia-Pacific central banks can strive for a multilateral framework to manage US dollar funding capacity and FX hedging costs during stressed periods (Hong et al (2019)), akin to the existing regional financial safety net arrangements, such as the Chiang Mai Initiative Multilateralisation (CMIM) Agreement,¹³ which came into force in 2010 and serves to expand US dollar swap arrangements within the region. FX funding needs can be significant given that the growth of private foreign portfolios and financial claims has outpaced the accumulation of central bank reserves in some Asian EMEs, such as Korea and Malaysia (The Economist (2022)). However, such regional US dollar funding arrangements can only be considered as additional backstops to the FIMA Repo Facility established by the Federal Reserve and the existing bilateral US dollar swap lines of several Asian EME central banks with Japan's Ministry of Finance (EMEAP (2020); Han and Lulu (2022)).

Finally, Asian EMEs may also consider broadening the range of FX risk management tools used by market participants. Currently, their hedging instruments comprise mainly FX swaps and forwards. Several central banks in this study group also reported that certain market participants used some form of alternative instrument, such as foreign currency deposits, natural balance sheet hedging and intracompany transactions initiated by corporate treasurers. Improving the capabilities of non-financial corporates to hedge optimally could help reduce US dollar funding disruptions associated with trade financing and help local banks to manage increased FX demand amid heightened credit risks and credit line drawdowns by corporate customers (AMRO (2020)). Efforts to support corporate FX risk management

¹³ The CMIM Agreement was developed from the Chiang Mai Initiative bilateral swap network established in the aftermath of the 1997–98 Asian financial crisis.

should complement improved access to liquid FX derivatives markets. In the longer run, the resumption of sustained growth in trade and investment in Asia, with substantially larger amounts of current and capital account transactions and with more balanced flows, will lead to improved liquidity and an expanded set of available FX hedging instruments.

5. Links between FX markets, capital flows and domestic financial market conditions

This section documents the various ways in which FX markets are linked with capital flows and domestic financial conditions, drawing primarily on existing research and policy analysis. The topics covered in this section include: (i) the influence of local FX market structures on capital flows in and out of a country; (ii) capital account liberalisation in the region; (iii) types of links between FX markets and local asset markets; and (iv) lessons from the financial market turbulence during the Covid-19 pandemic.

5.1 Capital flows and FX market structures

The local FX market's structure and its level of development play a key role in determining a country's resilience to external shocks. There is evidence that the sensitivity of EMEs to global financial conditions or push factors is determined to a greater extent by local financial market characteristics, such as market liquidity and the composition of foreign investor base, than by macroeconomic or institutional fundamentals (Cerutti et al (2019)). By implication, having a flexible exchange rate to absorb external shocks may not be optimal if the FX market is shallow or underdeveloped or if it is hit by large, destabilising capital flows (ASEAN (2021)).

Flexible exchange rates may amplify shocks if capital flows are volatile and the FX market is shallow. Domestic financial markets in many ASEAN countries, and those that are small open economies in particular, are exposed to fluctuations in cross-border capital flows. In some countries, vulnerabilities have stemmed from the relatively high shares of bonds and equities owned by foreign investors. The risk of capital flow reversal is higher if the inflows were induced by the expansionary monetary stimulus of central banks in major AEs.

A flexible exchange rate regime allows the relative price of a currency to be determined by market mechanisms. However, volatile capital flows may increase exchange rate volatility and drive the exchange rate away from the fundamental value. This, in turn, affects the domestic economy as well as monetary and financial stability (Warjiyo (2014)). For currencies with limited convertibility in offshore markets, rising global uncertainty will affect NDF pricing and raise hedging costs for investors in local currency bond markets. If the NDF and the onshore spot rates diverge far enough, they may prompt foreign investors to sell bonds and add further depreciation pressure to the onshore spot market.

Policymakers need to consider strategies to deepen their financial markets in order to reduce FX volatility and the potentially destabilising effects of capital flows by combining policy tools to limit the associated spillovers to macroeconomic and financial stability. During stress episodes, central banks can conduct FX interventions to maintain exchange rate stability by supplying enough liquidity to the domestic foreign exchange market to prevent disorderly market conditions. In the Asia-Pacific region, central banks conduct FX interventions mainly in the spot and FX swap markets, with the aim of supporting market functioning and financial stability.

The first subsection gives an overview of regional NDF markets. The second subsection outlines how four ASEAN countries – Indonesia, Malaysia, the Philippines and Thailand – developed their FX markets with the aim of mitigating FX and capital flow volatility. These countries differ in their current account conditions as well as the level of development of their domestic FX markets. For example, during the 2016–19 period, Indonesia and the Philippines saw current account deficits, while Malaysia and Thailand posted surpluses.

5.1.1 NDF markets

Asian currencies boast the largest NDF markets (see Section 2). NDF pricing tends to be more volatile, often diverging from onshore FX markets, with most activities taking place outside Asian trading hours but with a spillover effect to the onshore markets, particularly during stress episodes (Schmittmann and Teng (2020)).

In the case of Indonesia, a study by Lau and Yip (2020) shows that NDF pricing leads that of onshore forwards in the post-QE period. Higher prices for NDFs also result from restrictions in the onshore market (eg documentation and regulation) that dampen the scope for arbitrage opportunities. In the case of India, Reserve Bank of India (2019) finds that the influence between offshore and onshore exchange rates is bidirectional, ie it goes both ways in normal times. The study also observes that, during the last two stress episodes (the taper tantrum and the 2018 emerging markets crisis), the relationship turned unidirectional, with the NDF market driving the onshore exchange rate.

Spreads between NDF prices and onshore forwards prices can be interpreted using the covered interest parity (CIP) condition. When the deviation is (ideally) zero, it implies that both financial markets are well integrated and that the absence of arbitrage holds (Aggarwal et al (2021)). Negative CIP deviations (implying onshore pricing is lower than offshore pricing) have occurred mainly during market stress periods. In the case of India, for example, the deviation from CIP became smaller over time as India's domestic financial markets became more integrated with global financial markets, thanks to financial liberalisation (see eg Hutchison et al (2012)).

Polymakers have tried to limit the negative spillovers from the offshore NDF market to the onshore market by allowing domestic financial institutions to participate in the NDF market, as in the case of Korea, India, and the Philippines. Some jurisdictions, such as India and Malaysia, have chosen to deepen onshore FX markets by relaxing, simplifying and widening market accessibility and by other market development initiatives. Meanwhile, Indonesia has implemented domestic NDFs as an alternative hedging instrument that may mitigate the demand for US dollars.

Finally, initiatives to liberalise the capital account by integrating the onshore and offshore markets may pose some challenges for EMEs. For example, an increase in domestic interest rates triggered by higher inflation may create difficulties for an EME central bank as higher domestic interest rates may induce greater capital inflows to the EME, thus increasing the domestic money supply if not sterilised. Such capital inflows may also cause the EME's currency to appreciate further. The excess liquidity would need to be sterilised by either absorbing it through monetary operations (a temporary expedient) or selling government bonds (a more permanent solution), although both policies are likely to worsen the monetary or fiscal positions. In addition, differences between offshore NDF and onshore market prices could create a dual pricing structure, reducing the effectiveness of FX stabilisation policy.

5.1.2 FX risk management practices and access to hedging instruments

Given the importance of onshore FX and FX derivatives markets in supporting stable exchange rates, the authorities in Indonesia, Malaysia, the Philippines and Thailand recently introduced various policy measures to promote the use of onshore markets and restrict NDF activity in order to strengthen the FX risk management by non-financial companies.

Thailand has faced several structural problems when it comes to FX risk management practices: low investment diversification, high home bias and low FX risk management by Thai corporates. In addition, the central bank has room to improve on the low visibility of offshore market activities, which could potentially influence THB volatility. The Thai FX hedging market is dominated by exporters and importers, who use FX forwards to hedge their international trade exposures, and mutual funds, who use FX swaps to hedge retail clients' offshore investment exposures. Prior to Covid, Thailand had a high current account surplus, at 8% of GDP, while capital outflows stood at only 4% of GDP. This was the result of both a low volume of imported capital goods and low levels of residents' investment in foreign assets. More

balanced regulations regarding the movement of capital would increase efficiency of the Thai FX market by allowing the exchange rate to better adjust in line with economic fundamentals. On the domestic corporate side, Thai exporters and importers tend not to actively manage FX risk. In particular, only 19% of total export value and 24% of total import value of Thai corporates are hedged against FX risks (Bank of Thailand (2020)). This is because many corporates are unfamiliar with hedging instruments and have only limited access to them. Finally, THB volatility is highly influenced by the offshore market.

Since January 2021, the Bank of Thailand has relaxed some regulations to encourage onshore transactions and reduce the impact of offshore markets on THB volatility. Under the Non-Resident Qualified Company (NRQC) scheme, qualified non-financial companies with trade and direct investment in Thailand are not subject to the end-of-day outstanding limit of THB 200 million (approximately USD 6.7 million) on their Non-Resident Baht Account (NRBA) (Bank of Thailand (2021)). This scheme also covers transactions for anticipatory hedging and balance sheet hedging without the need to provide an eligible underlying asset for each transaction. Since the scheme's introduction, onshore hedging activities by non-resident corporates have risen, along with an increase in the number of participants from around 20 firms to 47 across various sectors as of March 2022. Regulations related to FX risk management by corporates have also been relaxed in 2022. Thai corporates are allowed to hedge FX exposures more broadly, including hedging for domestic payment for goods whose price is linked to the global market, hedging on behalf of other resident affiliated companies, hedging of anticipated foreign exchange revenues or expenses with a tenor longer than 1 year, and hedging balance sheet exposures.

As in the case of Thailand, Malaysia has experienced a volatile FX market, which was influenced mainly by the offshore market. Unregulated offshore NDF markets can generate negative spillovers to MYR volatility. Malaysia's onshore FX hedging markets are rather inactive, partly due to onerous documentation requirements. This lack of liquidity in the onshore market has encouraged non-residents to hedge in the offshore markets instead. In order to address these challenges, the Central Bank of Malaysia has moved to deepen and enhance the resilience and prominence of the onshore market. In particular, it has simplified the documentation process with a minimum due diligence (MDD) guide for FX rules to standardise the know-your-customer (KYC) process across Licensed Onshore Banks (LOBs) and by extension their Appointed Overseas Offices (AOOs). In order to address hedging needs for non-resident investors, the Central Bank of Malaysia introduced a Dynamic Hedging Programme in December 2016 that allows non-residents to manage FX risk via forwards without documentation by selling up to 100% of invested underlying MYR assets and buying up to 25% of invested underlying MYR assets (Central Bank of Malaysia (2019)).¹⁴ For flexibility, the participants of the Dynamic Hedging Programme can also unwind their forward contracts. Non-residents can access the hedging instruments through AOOs in addition to onshore banks. Since the programme's introduction, the average daily turnover of onshore FX forwards has increased by 64% to USD 917 million in 2021 from only USD 558 million in 2017. Registered dynamic hedging accessed by non-resident MYR bondholders also increased to 129 investors in 2021, from 84 investors in 2018.

The Philippines has recognised that the NDF market may directly or indirectly create systemic risks. Over the years, the Bangko Sentral ng Pilipinas (BSP) has undertaken pre-emptive measures for residents who conduct NDF transactions for speculative purposes that could create systemic risk should market conditions reverse quickly.¹⁵ Speculative activities are quite common in the Philippine domestic markets, which add to the PHP's volatility. Under a new regulation issued in July 2020, market participants that include banks, quasi-banks and trust corporates need to mitigate currency risk and reduce their use of NDF instruments. The BSP urges that only universal and commercial banks should be allowed to engage in NDF transactions. In addition, the sum of sales and purchases is limited to a fixed percentage of an

¹⁴ Registered institutional investors may apply to the Central Bank of Malaysia to undertake dynamic hedging beyond the existing 25% threshold, if they can justify their need to take additional positions.

¹⁵ See Guidelines for the Treatment of Non-Deliverable Forwards Involving the Peso: <https://morb.bsp.gov.ph/appendix-104/>.

entity's capital base to mitigate the potential build-up of systemic risks. To improve the effectiveness of the regulations, strict sanctions are imposed on market participants who breach the limit.

Indonesia also recognises that IDR volatility is influenced by the offshore NDF market. Therefore, the central bank requires that domestic corporates with FX exposures should hedge a minimum 25% of their net FX liabilities, and that corporates should hedge their positions using mainly FX forwards and swap transactions. In Indonesia, residents are not allowed to do offshore NDF transactions, while non-residents holding IDR bonds usually hedge their positions using offshore NDFs. In order to develop the FX hedging market and reduce the impact of offshore NDFs on the onshore IDR spot market, in November 2018 Bank Indonesia introduced a domestic NDF market. Under the current regulation, participants can buy domestic NDFs with underlying transactions and sell domestic NDFs for a maximum of USD 5 million without an underlying transaction. The participants can also unwind their domestic NDF positions without an underlying transaction. Bank Indonesia uses domestic NDFs as an intervention instrument to reduce IDR volatility along with spot market and secondary market government bond purchases (triple interventions). Since the introduction of domestic NDFs, the spread between the offshore one-month NDF and the IDR spot has been narrowing from IDR 68 (2015–18) to IDR 59 (2018–19) and to IDR 40 (2021–March 2022). As domestic NDFs are settled in IDR on a net basis, this is very effective in supporting Bank Indonesia's efforts to maintain IDR stability without excessively running down its FX reserves, especially during stress periods (such as the trade war in 2018 and the Covid-19 pandemic in 2020).

5.2 Capital account liberalisation – progress and lessons learnt

5.2.1 Capital account liberalisation by type of investment

Table 5.1 summarises regulations relevant to the state of capital account (CA) openness of regional economies. Overall, compared with EME members, AE members enjoy a higher level of CA and financial market openness. For categories closely related to the real economy, such as direct investment and the liquidation of direct investment, the gap between the two groups is significantly narrower. This reflects the fact that, for most countries, the primary goal of CA liberalisation is to promote the development of the real economy. For capital and money market instruments, derivatives, credit operations and personal capital transactions, EME members apply significantly more restrictions, especially for the first two categories, than AE members do. This is probably because EME financial markets are less mature, and therefore require more prudent financial regulation and cross-border capital management in order to manage potential risks. In terms of restrictive measures, two broad types are observed: the requirement for investors to meet certain qualifications (qualitative measures) and quota control (quantitative measures). These two types of restrictive measure may be applied together or separately, depending on the situation. For real estate transactions, study group members tend to implement more diverse policies to meet their own specific needs.

Capital account openness by instrument and transaction type

Table 5.1

Capital and money market instruments	While AEs, such as Australia and New Zealand, and Hong Kong SAR, a financial centre, have generally eliminated restrictions on investment in capital and money market instruments, EMEs have maintained restrictions in various forms. For example, Malaysian residents with domestic ringgit borrowing are subject to a limit on investment in foreign currency assets, but non-residents can invest in ringgit assets in Malaysia in any form and amount. China opted for a channel-based approach to open its financial markets and has consecutively set up the qualified foreign institutional investor (QFII) quotas, the RMB qualified foreign institutional investor (RQFII) quotas, China Interbank Bond Markets (CIBM) and Bond Connect schemes for bond market investments, and it has established Shanghai-Hong Kong Connect, Shenzhen-Hong Kong Connect and Shanghai-London Connect for stock investment. Chinese residents can invest in foreign markets through the Qualified Domestic Institutional Investor (QDII) programme. In recent years, China has continuously relaxed the qualification requirements and quota controls in these investment schemes and has already phased out quota controls in the QFII and RQFII.
Derivatives and other instruments	AEs, such as Australia and New Zealand, as well as Hong Kong SAR, have no restriction on derivatives transactions. In Korea, there is no control on the trading of OTC derivatives if the transactions are made through domestic foreign exchange banks, but corporate clients can only trade derivatives up to 100% of their real transactions (imports and exports). Malaysia has established the Dynamic Hedging Framework for derivatives transactions, and investors are generally allowed to trade plain vanilla derivatives. In the Philippines, a bank's total gross exposure to all forms of peso NDF transactions is limited to a fixed percentage of the bank's capital base, and Bangko Sentral ng Pilipinas (BSP) has established the Currency Rates Risk Protection Programme (CRPP), an NDF contract between the BSP and commercial banks to help bank clients hedge their eligible foreign currency exposures and to help commercial banks manage their hedging needs for foreign currency exposures. China requires foreign investors to hold underlying assets for trading derivatives, while India has put in place a capped quota for derivatives transactions without holding underlying assets.
Credit operations	Australia and New Zealand, as well as Hong Kong SAR and Korea, have lifted all restrictions on cross-border credit operations. Meanwhile, China, Malaysia, the Philippines, Thailand and other EME jurisdictions have maintained various forms of quota controls. In the Philippines, prior BSP approval is required for foreign loans to the public sector and those to the private sector that are guaranteed by the public sector.
Direct investment	In general, regional economies apply only limited restrictions on direct investment, except for caps on shareholdings, censorship due to national security concerns, and the needs to protect strategic industries and resources. As with direct investment, only limited restrictions are applied to liquidation of direct investment.
Real estate transactions	In some jurisdictions, such as Korea, foreign investors enjoy broad latitude in trading real estate, while other jurisdictions apply various restrictions. For example, in Malaysia, residents can invest in real estate outside Malaysia for the purpose of education, employment or migration, while purchases of residential, commercial and office properties in Malaysia by non-residents are subject to national/state policies on minimum property value. In China, non-residents can purchase real estate for self-usage but are subject to a quota limit, while formal arrangements for residents to purchase properties abroad have yet to be established.
Personal capital transactions	Australia, Hong Kong SAR, Korea and New Zealand apply limited or no restrictions to personal cross-border transactions, while other EMEs usually have qualification and quota requirements. For example, after the Asian Financial Crisis in 1997–98, Malaysia imposed approval requirements for personal cross-border fund transfers. In 2021, China's Greater Bay Area rolled out a pilot personal cross-border investment scheme, Wealth Connect.

Sources: IMF AREAER; BIS Study Group on FX Markets in Asia-Pacific.

5.2.2 Lessons learnt

Asia-Pacific jurisdictions are at different stages of CA liberalisation. While AE members have achieved a high level of financial openness, EME members are mostly still in the process. At the same time, there are significant differences in development model and economic characteristics among regional economies. For example, Korea is a more developed emerging small open economy, while most southeast Asian countries are less developed emerging small open economies. China and India are relatively large EMEs, while Australia and New Zealand are developed countries. As a result, it is not surprising that more differences than commonalities could be observed in different countries' experience of CA liberalisation. But still, some shared lessons could be summarised as follows.

First, there is *no fixed route and sequence for CA liberalisation*, and each country must formulate strategies tailored to its own specific domestic conditions.

Australia began opening up its economy in the 1970s. In the early 1980s, in a relatively short period of time, Australia had transitioned to a flexible exchange rate regime and lifted capital controls, thus achieving a high level of CA openness. Notably, the order in which Australian reforms proceeded was somewhat unusual. To some extent, Australia undertook these reforms in reverse order to what a standard approach might suggest, where domestic economic reforms improve efficiency in the economy before exposing it to international competition through CA liberalisation (Berger-Thomson et al (2018)). However, it is generally accepted that Australia's CA liberalisation, among other reforms, benefited the economy. Since the early 1990s the Australian economy has shown resilience to external shocks and did not experience a technical recession for more than 20 consecutive years as its economy expanded.

China's approach has been mainly to push forward its (still ongoing) reforms in an incremental fashion. In most cases, pilot programmes to gain experience and assess risks are conducted before introducing reforms on a larger scale. However, as in the case of Australia, China's gradual opening-up of its capital account has also played a positive role in supporting China's economic development.

Other Asia-Pacific countries also opted for different liberalisation routes and pace of reforms, indicating that there is no fixed path for CA liberalisation, and one cannot simply copy the experience of another country. By comparing the liberalisation process of various countries, the following factors may need to be considered in formulating CA opening strategies. First, the goal of liberalisation: for example, a global financial centre will have different objectives when liberalising CA compared with countries with greater emphasis on the real economy. Hence, not all countries need to set the goal of achieving a high degree of CA liberalisation in a relatively short period of time. Second, the degree of development of the domestic financial market, structural characteristics of the economy and the soundness of the regulatory system. Third, the international financial environment and capital flow trends during the reform period. Besides, whether a country intends to promote its currency as a global reserve currency also has important implications for its route towards CA liberalisation.

Second, a *macroprudential framework* needs to be established and continuously improved to enhance the capacity for managing systemic risks in the process of CA liberalisation

CA liberalisation will make the domestic financial market more closely intertwined with the international markets, leaving the former more affected by international capital flows. In this context, without an effective macroprudential framework, CA liberalisation may result in the accumulation of systemic risks and trigger crises. Risks are especially prominent at the early stages of liberalisation, when domestic financial institutions have little experience of participating and competing in international markets. For example, in the 1980s, some Australian residents entered into foreign currency-denominated loans but neglected to hedge against related exchange rate risk in what became known as the "Swiss loan affair" (Berger-Thomson et al (2018)). A depreciation of the Australian dollar led to a jump in repayment obligations, which many of these borrowers were unprepared for. In the case of the Asian Financial Crisis, serious credit and maturity mismatches on the part of banks and enterprises are deemed to be the root

cause of the crisis, but this fundamentally could also be attributed to the lack of an efficient macroprudential framework.

Therefore, the establishment and improvement of a macroprudential framework needs to be synchronised with CA liberalisation. The study group member countries' experiences also testify to the point that a continuously improving macroprudential framework is indeed effective in containing the risks. For example, Korea started to adopt FX-related macroprudential measures in 2010. These measures proved to have played a key role in alleviating capital inflow pressure and reducing systemic risks (An et al (2021)). Similar examples can also be found in other member countries' experience.

Third, *market-oriented reform* of the exchange rate and interest rate regime needs to be pursued in tandem with CA liberalisation.

Countries promoting CA liberalisation are bound to face the problem of the Mundell Trilemma: ie free capital flows, an independent monetary policy and a fixed exchange rate cannot coexist at the same time in a country. For small open economies such as Hong Kong SAR, the currency board system that features a pegged exchange rate and free capital movement at the expense of monetary policy independence can be an ideal choice of institutional arrangement. For most Asian-Pacific member countries, maintaining monetary policy independence while promoting CA liberalisation appears to be the more preferred option. In this case, countries will inevitably need to let the market decide the exchange rate. When exchange rates are driven by market demand and supply, interest rates must also follow suit, otherwise there could be market distortion.

From the experience of study group members, CA liberalisation is indeed often accompanied by reforms of the exchange rate and interest rate regimes. For example, Korea moved from a managed floating exchange rate regime to a free float regime in 1997, eliminating the daily floating band limit as CA liberalisation progressed. In recent years, while promoting CA liberalisation and financial market opening, China has also actively promoted the market-oriented reform of the exchange rate and interest rate regime. At present, China has moved from a fixed exchange rate regime to a managed floating exchange rate regime. The People's Bank of China has withdrawn from regular market interventions, giving the market an increasingly larger role and moving ever close to a clean floating regime.

Finally, CA liberalisation is usually not a smooth process. When necessary, the authorities may want to introduce *temporarily CFMs*, or even *reverse some CA liberalisation measures*, but the costs of taking such measures will need to be carefully weighed.

The smooth path of CA liberalisation hinges on many factors. Although a country can effectively reduce risks by conducting sound policy plans and forging better macroprudential and microprudential regulatory capacities, policy changes in other countries, especially countries where large international capital flows originate, may still cause large fluctuations in capital flows, thus posing risks. Therefore, when no other means are suitable or available, temporary CFMs, or even reversing certain liberalised CA categories could be considered to prevent a crisis from materialising. The IMF's *Institutional View on Capital Flows* also explicitly supports pre-emptively implementing CFMs on capital inflows when necessary, and restricting capital outflows when a crisis is imminent.

It is not uncommon for some countries to adopt temporary CFMs during a CA liberalisation period. For example, after the outbreak of the Asian Financial Crisis, some hard-hit countries such as Malaysia and Thailand, adopted measures to temporarily restrict capital flows. Since then, they have phased out these measures.

It should be noted that, while CFMs could play a positive role in preventing a crisis, they also come with policy costs and may produce certain side effects. In particular, the impact of those measures on international investors' confidence deserves special attention. Therefore, when countries implement CFMs, they should clearly state the conditions and methods for exiting such measures to avoid prolonged implementation, preserve international investor confidence and mitigate any negative effects.

5.3 Links with local asset markets

The FX market's structure can have profound effects on the composition of participants in local asset markets as well as the pricing of local currency securities relative to that of similar securities in foreign currencies.

5.3.1 Foreign investor participation

The FX market is the gateway through which foreign investors access local asset markets. The roles currencies play in foreign investors' portfolios and the ways in which investors participate in local FX markets can thus have first-order effects on local asset markets. For instance, persistent trends in currency returns can result in sustained foreign portfolio inflows, which can spur positive feedback trading in local bond and equity markets by some local investors who follow suit (Krohn et al (2022)). At the same time, a number of Asian EMEs have in place some form of FX controls that restrict FX transactions with non-residents.¹⁶ Such controls can raise the riskiness of investments by making it more difficult for investors to hedge the FX risk or to repatriate local currency returns on short notice. This can also depress trading in FX derivatives and fragment trading activity between onshore and offshore markets. The lack of a developed FX derivatives market in which to hedge currency risk might deter foreign investment in local currency bonds. FX controls are generally stricter for FX derivatives than for spot. In fact, a little more than a decade ago, the impact of FX controls was most noticeable in FX swap markets (Tsuyuguchi and Wooldridge (2008)).

A general trend among Asian EMEs is to relax FX controls and deepen FX hedging markets. The lowering of barriers to the development of FX swap and derivatives markets, which allow foreign borrowers to finance their projects in the domestic currency, has led to a boom in the issuance of local currency bonds in some jurisdictions.¹⁷

The appropriate degree of foreign investor participation in local bond markets, such that both risks and benefits are balanced, depends, among other factors, on how liquid the FX derivatives market is to hedge currency risk (IMF and WB (2021)). Reflecting a "chicken and egg" problem, initiatives to develop local currency bond markets, such as the Asian Bond Fund 2 Initiative, may have also led to improved local currency convertibility and helped develop FX derivatives markets in the region (Chan et al (2012)).

The gradual opening of the China Foreign Exchange Trade System (CFETS) to foreign investors constitutes another example of the link between FX markets and local asset markets. In 2017, CFETS launched the "Bond Connect", which enables overseas investors to invest in China's interbank bond market via mainstream overseas trading platforms: Tradeweb in the same year and Bloomberg in 2018. In 2020, CFETS allowed prime brokerage on its platform, that is, allowed the interbank CNY FX market to introduce foreign bond investors into the main brokerage mode, thus further promoting the opening of the domestic FX market (CFETS (2020)). There is also evidence that the policies aimed at promoting foreign investor participation in China's financial markets have had a positive effect on offshore FX market liquidity. Cheung et al (2021) find that China's RQFII quotas and the level of equity market capitalisation and, more generally, financial development of an offshore market (ie financial centre) have enhanced the offshore trading of the Chinese yuan.

¹⁶ FX controls are usually intended to limit the opportunities for speculation. FX controls might take the form of requiring central bank approval for sales and purchases of foreign exchange or restrictions designed to suppress offshore trading because it is more difficult to monitor than onshore trading. This typically involves restricting the cross-border deliverability of a currency. A less intended consequence of FX controls is that they also limit the participation of non-residents in local asset markets.

¹⁷ Consistent with this, the Central Bank of Malaysia introduced its Dynamic Hedging Programme in December 2016, which eased regulations on FX hedging by resident and non-resident institutional investors and allowed more flexibility in the management of FX risk exposures. Similarly, the Bank of Thailand is introducing more hedging instruments, easing rules for overseas investment and allowing non-banks to provide FX services (Bank of Thailand (2020)). Finally, Bank Indonesia introduced a domestic NDF in November 2018 to promote the development of the domestic FX hedging market.

5.3.2 Effects on local asset prices

Whether or not asset prices across different currencies are in alignment depends largely on the efficient functioning of the FX market. When FX spot and derivatives markets are deep and efficient, as in many AEs, exchange rates tend to play the role of a stabiliser in the presence of inflows and outflows in local security markets. By contrast, when financial markets are not sufficiently developed, exchange rates are more sensitive to capital flows and seldom play a stabilising role (Gabaix and Maggiori (2015)). Hence, when FX markets are shallow and less efficient, as in many EMEs, exchange rates can play a destabilising role in the presence of strong inflows and outflows in local currency asset markets by amplifying the price movements. Wooldridge (2020) points out that, in many EMEs, market stress in early 2020 was exacerbated by the lack of a large base of domestic institutional investors and liquid hedging markets.

Given the role of the US dollar as a dominant funding currency, dollar exchange rates might exert broader effects on local currency asset prices via the financial channel. Hofmann et al (2020, 2022) document endogenous co-movement of bond risk premia and exchange rates through the portfolio choices of global investors who evaluate returns in dollar terms. Bruno et al (2022) also find evidence of the financial channel working in EME stock returns. In particular, Hofmann et al (2022) and Bruno et al (2022) show that the broad US dollar index has a greater impact on Asian EMEs' local currency asset returns than does these EMEs' bilateral exchange rate against the US dollar.

Investor composition in local bond markets, their trading strategies (eg carry trades versus long-run index tracking), and the balance of their motives for FX transactions (financial versus real) also play an important role. Koosakul and Shim (2021) find that volatility in the Thai FX market increases market participation by financial traders seeking profit opportunities. If foreign investors are attracted by currency carry trade strategies, then local currency bond markets may be subject to destabilising effects, including those affecting the government's cost of borrowing or creditworthiness. For example, focusing on Asia-Pacific markets, Pavlova and de Boyrie (2015) find a strong bidirectional causality between currency carry trade returns and sovereign credit default swap spreads, with the relationship driven by the currency rather than the interest rate component of carry trade returns.

In the presence of FX controls or other frictions in FX markets, cross-currency arbitrage is impeded and conditions such as CIP do not hold. A failure of CIP makes hedging currency risk more expensive and deters some foreign investors or makes them require a premium. When the domestic investor base is shallow, this could mean higher financing costs for the government via the local sovereign bond market. Indeed, the empirical findings of a local currency sovereign credit risk premium by Du and Schreger (2016) speak to the presence of such an effect when cross-currency swap spreads are non-negligible.

FX hedging market development can also influence the local currency yield curve, because foreign investors might be more active in maturities for which FX hedges are easier to obtain or hedging costs are lower. As such, hedging demand by foreign investors tends to affect specific maturities of the local currency yield curve via CIP. For example, one- to three-year maturities are more important than five- to 10-year maturities in some economies to the extent that foreign investors hedge their exposure using cross-currency swaps of one- to three-year maturities. Therefore, fluctuations in local currency bond yields of one- to three-year maturities are more likely to be affected by exchange rates.

Finally, when there is a strong segmentation between onshore and offshore FX markets, price discovery might shift offshore yet still affect local asset price dynamics. For example, conditions in the offshore market might affect funding costs for domestic financial institutions in local asset markets.

5.4 Lessons from the financial market turbulence during Covid-19

5.4.1 Central bank asset purchases and the FX market

The level of stress in Asian EMEs' financial markets during the Covid-19 sell-off was comparable with that of the GFC, but the period of stress was considerably shorter. In line with the past episodes of sharp tightening in global financial conditions, spillovers to Asian EMEs' FX markets were immediate. However, unlike the case of past tightening episodes, spillovers to local EME bond markets were pronounced.

FX interventions, including in some cases through forward contracts, were widespread at the height of the crisis in March 2020, as EME policymakers sought to insulate their economies from excessive volatility in global investors' risk sentiment. While many EMEs intervened heavily in absolute terms, surpassing recent stress episodes in the absolute scale of interventions, the use of FX reserves as a share of the total was about two thirds the magnitude observed during the GFC for the median economy (IMF (2020)). The limited and short-lived use of FX reserves can be attributed possibly to the relatively short duration of the stress episode in currency markets due to a quick rebound in global risk sentiment and prompt deployment of various safety nets (see Section 5.4.2).

By contrast, during the Covid-19 crisis, for the first time on a broad basis, at least 18 EME central banks deployed asset purchase programmes (APPs) for government or private sector bonds in local currency. The scope and motivation of these programmes varied across economies and the objectives were often multifaceted. For EMEs in Asia-Pacific, IMF (2020) identified at least two groups according to their use of conventional monetary policy tools: one group used APPs as a tool to improve bond market liquidity and provide liquidity to the financial sector (eg India, the Philippines), while the other group used APPs to temporarily ease government financing pressures in the face of the pandemic (eg Indonesia, the Philippines).

Importantly, in the short term, APP announcements did not lead to a significant depreciation of EME currencies. Event studies show that APP announcements had a significant immediate impact on asset prices and helped turn investor sentiment around with a sharp reduction in government bond yields and term premiums, but with a relatively limited impact on currencies (Arslan et al (2020); Can et al (2020)).

The medium-term impact of asset purchases crucially depends on whether inflation expectations are well anchored.¹⁸ Given that in 2020 inflation expectations in Asian EMEs were broadly in check and most Asian EMEs maintained flexible exchange rate regimes, APPs were effective in mitigating financial shocks without derailing their currency and inflation outlook. For instance, Mimir and Sunel (2021) find that EME central banks' public and private bond purchase programmes eased financial conditions without causing currency depreciation and thus inflation risk. They also find that central bank purchases of private securities are more effective than those of sovereign bonds. By raising the prices of domestic assets and freeing up bank balance sheets, central bank asset purchases can feed back into bank capital and enhance banks' lending capacity via the "financial accelerator" mechanism (Bernanke et al (1998)). With stronger balance sheets, banks can borrow more from both depositors and foreign lenders, which drives capital inflows, lifting the exchange rate and thus reducing inflation. Currency appreciation further boosts bank balance sheets by reducing the average cost of funds as banks face reduced borrowing costs in foreign currencies to fund their assets.

5.4.2 Roles played by global financial safety nets

The Covid-19 crisis has highlighted the importance of a strong global financial safety net (GFSN) in times of crisis. The GFSN comprises countries' foreign exchange reserves, supplemented by external sources of financing.

¹⁸ If the asset purchases are perceived as monetisation of debt, inflation expectations could be derailed.

International reserves provide self-insurance, serving as a first line of defence in the event of significant shocks. External sources of financing include bilateral swap arrangements (BSAs) between two countries to provide access to foreign currency liquidity; regional financing arrangements (RFAs) within a group of countries to pool and leverage financing in times of crisis; as well as financing provided by international financial institutions (IFIs) such as the IMF, which pools resources from its global membership to provide financing to member countries who face balance of payment needs. During the Covid-19 crisis, some countries strengthened their access to foreign funding by arranging a Flexible Credit Line (FCL) with the IMF and at least one country drew on its FCL (BIS (2021)). The IMF also established a new precautionary instrument that mirrored the characteristics of a swap line, the Short-term Liquidity Line (SLL), for members with strong policies and fundamentals in need of potential short-term support related to capital account pressures.

Since the GFC, the total stock of international reserve holdings has more than doubled, reaching almost USD 14 trillion at end-2020, while the size of external resources available through various GFSN layers has increased about tenfold to about USD 3 trillion driven mainly by BSAs and RFAs (Iancu et al (2021)). In Asia, ASEAN+3 members have access to the CMIM Agreement, a USD 240 billion regional multilateral currency swap arrangement, as well as over USD 350 billion in intra-regional BSAs (Han et al (2022)). These arrangements have collectively increased the resilience of countries, including in Asia, against the Covid-19 crisis.

The Federal Reserve's actions, in particular, were instrumental in reducing the risk of a short-term market seizure in March 2020, when pressures in offshore dollar funding markets and dislocations in the US Treasury market were building up. The Federal Reserve expanded and enhanced their central bank dollar liquidity swap line arrangements with selected foreign central banks. The maturities of dollar auctions via the swap lines were also extended to include three-month tenors more in line with the typical maturity of FX hedges and their increased use by NBFIs, underscoring the vulnerability posed by a partial shift of dollar funding intermediation from banks to NBFIs (Avdjiev (2020); BIS (2021)), including in EME Asia (McGuire et al (2021)). In addition, the Federal Reserve established a new Foreign and International Monetary Authorities (FIMA) Repo Facility to provide broad access to a dollar liquidity backstop. The announcement of these policies helped mitigate dollar shortages through the confidence channel (Choi et al (2021)). Looking forward, the GFSN will continue to play a major role during the post-Covid recovery. The G20 Eminent Persons Group (EPG) on Global Financial Governance has highlighted the importance of an effective GFSN to sustain open markets and support global growth, and has made a number of recommendations on how to improve the GFSN (G20 EPG (2018)). Global policymakers need to continue improving the responsiveness, size and coverage of the GFSN before the next major crisis hits.

6. Policy takeaways

The report's findings yield policy takeaways along three main themes: FX market monitoring and surveillance; further development of FX hedging markets; and broader considerations for FX market structure and capital flows. Some takeaways are relevant particularly to EME central banks but less so to AE central banks in the Asia-Pacific region.

FX market monitoring and surveillance. FX market monitoring and surveillance is a key input for the use of various instruments to maintain macroeconomic, domestic financial and external stability. Central banks can improve *cross-departmental cooperation* in FX market monitoring and risk analysis to better achieve their main objectives. Regional cooperation between central banks may also help overcome challenges for FX market monitoring through technical assistance and the sharing of experiences.¹⁹ In addition, given the rapid electronification of FX markets, central banks may wish to consider, where relevant, *investing in big data analytical capabilities*,²⁰ particularly with regard to providing information to support policy decisions. However, the benefits from this investment will need to be balanced against the costs.

Offshore markets can present a monitoring challenge for EME central banks in jurisdictions with stringent FX or capital controls. While offshore markets lie outside the operational remit of the central banks, they can be a locus of price discovery or currency volatility. Given the rapid electronification and increased central clearing of NDF trades, central banks issuing currencies for which there exist a large offshore NDF market can invest more in *NDF market monitoring capabilities* by leveraging information from electronic trading platforms and clearing data from CCPs, and by working with authorities in locations where NDF trades are booked (eg by leveraging their trade repository data), including important financial centres outside the Asia-Pacific region.

Further development of FX hedging markets. Several EME central banks in the region have played an important role in deepening and promoting growth of their onshore FX hedging markets. In doing so, they have been introducing new instruments, relaxing restrictions on FX transactions and simplifying procedures, and/or allowing foreign investors and qualified corporates to actively manage/hedge their FX exposure. Authorities in some jurisdictions have also been actively promoting greater outward investment by residents, as currently it is seen as lagging several other drivers of FX turnover growth and FX hedging practices.

Notwithstanding the various measures to deepen regional FX hedging markets, if the use of FX derivatives for speculation is prohibited, then FX hedging markets may not clear easily because capital inflows and outflows are rarely balanced. Therefore, *a more flexible approach to FX hedging requirements* for NBFIs, such as allowing "over-" and "under-hedging" compared with the underlying exposure may be useful. EME financial authorities may also consider *broadening the range of FX risk management tools* available to market participants beyond FX derivatives. These can include alternative instruments for trade financing, such as netting or local currency invoicing of trade receipts, and the use of FX deposits. At the same time, authorities can mitigate the build-up of systemic risks by introducing or tightening *FX-related macroprudential measures* ex ante during normal times, while also having tools in place to provide FX liquidity ex post during periods of severe market stress.

Broader considerations for FX market structure and capital flows. The intermediation capacity of local FX markets needs to keep pace with local asset market development. If the pace at which local FX markets deepen does not keep pace with the growth rate of gross capital flows over time, then

¹⁹ One such forum is the EMEAP WGFM Dealing Room Network initiative.

²⁰ For instance, the BIS Innovation Hub has developed a cloud-based FX monitoring platform that processes real-time financial data feeds and computes relevant liquidity and market risk measures. The platform is intended to be tailored to individual central banks' needs: see www.bis.org/about/bisih/topics/suptech_regtech/rio.htm.

FX markets can turn into amplifiers of market stress when capital inflows/outflows are volatile. In this context, the *soundness of intermediaries involved in FX transactions* is a particularly important factor in mitigating financial vulnerability and transmission of stress. Otherwise, intermediaries' inability to source funding in a particular currency will aggravate financial market conditions, eg via the FX swap basis.

When EME FX markets cannot smoothly absorb shocks to capital flows, EME central banks may need to deploy policy tools to limit FX volatility and safeguard macroeconomic and financial stability. In particular, EME central banks may conduct FX interventions to maintain exchange rate stability, and/or domestic asset market purchases to limit fire sale or capital outflows. At the same time, there are limits to deploying policy *tools to provide FX liquidity and mitigate capital flow shocks*. Thus, in pursuing capital account liberalisation, EME central banks may wish to introduce *temporary CFMs* to help avoid severe FX volatility when other tools do not work well. It is also important for EME central banks to assure access to *global or regional financial safety nets*,²¹ and particularly to US dollar funding sources, if they are to weather future periods of FX market turmoil.

²¹ One example is the aforementioned CMIM Agreement. Another recent initiative is the Renminbi Liquidity Arrangement (RMBLA) for central banks through a new reserve pooling scheme, announced by the BIS on 25 June 2022 and developed jointly with the People's Bank of China: see www.bis.org/press/p220625.htm.

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Annex: country case studies

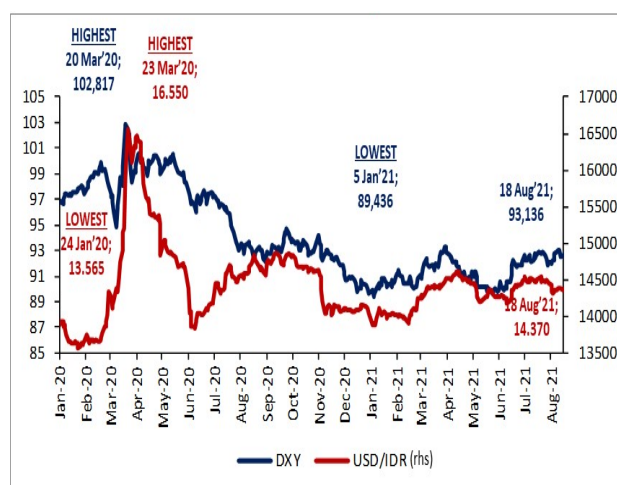
Indonesia

The impact of Covid-19 pandemic on FX market volatility

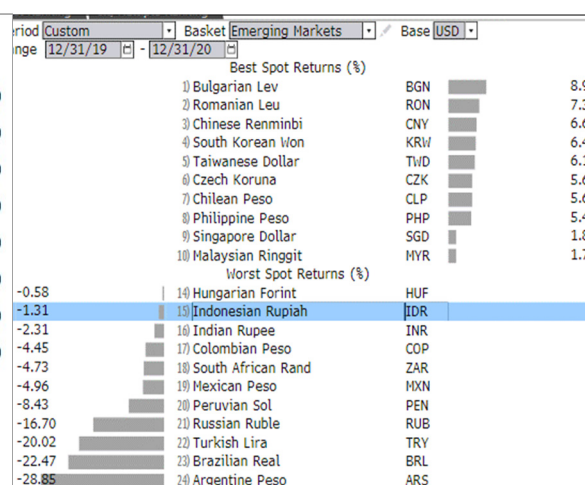
The Covid-19 pandemic severely disrupted financial markets and the real economy worldwide. In Indonesia, it has affected the domestic bond and stock markets. The dominance of foreign investors in tradable government bonds shows a massive decline from 38.6% prior to pandemic to around 29% in June 2020 due to foreign investor outflows. Cumulative outflows amounted to nearly USD 10 billion in February–April 2020, which created a massive demand for US dollars, reaching USD 9 billion in the domestic FX market. The sharp reversal pushed the Indonesian rupiah to its highest level in March 2020, and within a month the rupiah depreciated by 21%.

After March 2020, the rupiah gradually strengthened in line with improvements in global financial markets and support from Bank Indonesia's stabilisation measures. Despite the uncertainty that still lingered, rupiah exchange rate movements have remained under control (Graph 1). The rupiah regained some of its lost value in the second week of April 2020 as financial market panic began to subside. Over the year of 2020, the rupiah recorded a depreciation of 1.31%, which is more moderate than those of some other EME currencies (Graph 2).

Graph 1: DXY Index vs USD/IDR



Graph 2: EME Currencies YTD (2020)



FX market stability

Bank Indonesia has reinforced its policy mix towards mitigating the risk of Covid-19 transmission, while maintaining adequate liquidity in the money market and safeguarding financial system stability through some relevant measures. To maintain rupiah stability, Bank Indonesia strengthened the intensity of its triple interventions (spot, domestic NDFs and purchasing government bonds from the secondary market).

The introduction of the domestic NDF (DNDF) as the first line of defence has proven effective in helping to reduce FX volatility. Bank Indonesia has applied a number of strategies to improve the effectiveness of DNDF instruments such as (i) incorporating DNDFs in the net open position for banks; and (ii) adjusting the time window for Bank Indonesia DNDF auctions from 15 minutes to five minutes.

To deepen the financial markets, Bank Indonesia developed its Blueprint for Money Market Development 2025 to accelerate FX and domestic financial market development, which includes strategies

to enhance the hedging market and instruments in the domestic market. The authorities have also taken some initiatives to relax regulations to encourage the use of hedging instruments by corporates and banks.

FX liquidity management

Liquidity management is carried out by recalibrating pricing and auction frequency in order to provide flexibility to market participants in managing dollar liquidity. In particular, it includes the adjustment of pricing guidance for Bank Indonesia term deposit and FX swap auctions to better align them with market conditions and the increase in the FX swap auction frequency from three times a week to daily from March 2020 to June 2022.

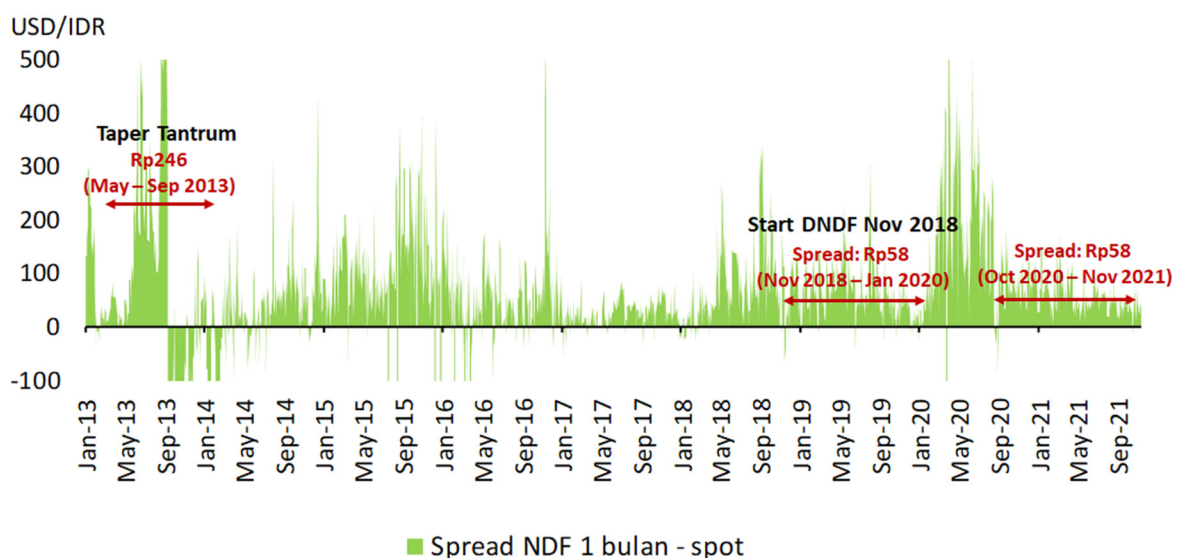
The role of recent regulatory or policy measures towards developing the FX and hedging markets

Indonesia faces many challenges that need to be addressed in order to improve its ability to face global shocks. With some challenges in the FX market such as the dominance of spot transactions, a net demand for FX in the market, and limited hedging activity accompanied with weakness in the external sector, Bank Indonesia introduced the DNDF instrument in November 2018. The main objective of DNDFs is (i) to maintain exchange rate stability; and (ii) to promote hedging instruments.

Bank Indonesia's DNDF operations have played a key role in providing liquidity for hedging instruments and they have been widely used by domestic banks to manage their FX net open positions. Hence, DNDFs have smoothed demand for FX and limited the need for spot market interventions that would have required the deployment of additional reserves.

DNDFs have been successful in stabilising the rupiah spot onshore market as the spread between the one-month offshore NDF rate and the onshore rupiah spot market has narrowed, from an average of 69 bp in 2015–18 to 59 bp during the year after implementation. The spread has widened during the pandemic crisis, but is still relatively small compared with the previous crisis period. For instance, during the 2013 taper tantrum period when Indonesia was in the fragile five group together with Brazil, Turkey, South Africa and India, the average spread was 246 bp.

Graph 3: Spread NDF 1 month and spot



Roadmap for FX market development

Bank Indonesia will continue to strengthen the hedging market. A persistent demand for hedging in the foreign exchange market (mostly the spot market) creates constant depreciation pressure on the rupiah exchange rate. Meanwhile, Indonesia's current account deficit needs to be financed and currency stability is a prerequisite for attracting capital inflows.

On the other hand, less appetite for hedging combined with the limited instruments available is considered to be a constraint, as reflected in low hedging turnover. Bank Indonesia is making efforts to develop the FX market and focus on the hedging market to limit volatility in the rupiah spot exchange rate.

Looking ahead, Bank Indonesia is considering the following strategies to develop the FX market, which address the participant, product and pricing aspects:

1. Broaden participants in the FX market and increase FX turnover (volume).
2. Differentiate hedging products based on the market's preference, such as non-USD and sharia-based hedging instruments.
3. Promote an efficient and healthy market mechanism.
4. Develop infrastructure that will support FX market deepening such as an ETP multi-matching system.

Bank Indonesia is considering taking the initiative in FX market development for a certain period. Once the market is operating efficiently, Bank Indonesia's role would be reduced and efficient price discovery based on market mechanisms would emerge.

Central Bank of Malaysia

Market conditions and policy measures during the Covid-19 financial market turbulence

- The outbreak of the Covid-19 pandemic in early 2020 initially began as a health crisis that later brought about an unprecedented economic crisis and led to heightened risk aversion among global investors and financial market volatility. The ringgit depreciated by 9.7% against the USD to trade to a YTD high of 4.4470 in March 2020. Additionally, USDMYR volatility rose to a high of 8.10% within a short period of time in March 2020, similar to the experience of regional peers who also saw their peak FX volatility ranging between 9.9 and 33.2% amid heightened uncertainties and tightening global financial conditions coupled with capital outflows.
- Concurrently, these capital outflows caused USD liquidity conditions to tighten drastically towards the end of March as observed in other economies, resulting in a spike in onshore USD rates particularly at shorter tenors (<1 month). Shorter-term rollovers and deposit drawdowns by corporates also exacerbated the situation as the market expected USD liquidity to dissipate, with implied funding rates remaining elevated (overnight implied USD funding rate rose to 2.47%).
- While banks with excess USD liquidity continued to lend to the market, USD funding rates remained relatively elevated during the period. Ultimately, the Federal Reserve's injection of USD liquidity via bilateral swap lines and its temporary repo facility were successful in easing the USD funding stress in the onshore market, particularly by supporting market confidence.
- Onshore market development initiatives over the years, which have aimed at deepening liquidity, enhancing risk management capacity and improving market efficiencies, have increased the resilience of our markets to such shocks. These continuous development initiatives have led to relatively more stable USDMYR daily volatility, which recorded an average of 4.4% in 2021, well below the Covid-19 peak of 8.1% in March 2020 (three-year average: 4.6%). Notably, the domestic markets have been resilient against market adjustments, underpinned by healthy trading volumes in the onshore FX and bond markets of USD 11.3 billion and USD 4.0 billion, respectively.
- Some structural changes to the market include:
 - Introduction of the Dynamic Hedging Programme in 2016 has allowed investors to actively manage their FX risk exposure ahead of time, hence facilitating a more orderly adjustment during a period of heightened volatility. In the year to date, 135 investors managing ringgit assets worth USD 56.6 billion have registered, which represents around 49% of non-resident holdings of ringgit bonds. In 2018, 84 investors managed ringgit assets worth USD 30 billion;
 - Stable non-resident holdings of Malaysian government bonds of around 25% compared with a high of around 35% in November 2016, of which long-term stable investors continue to account for around 53.0% of government bond holdings. This has also helped mitigate abrupt, unmanageable portfolio outflows from Malaysia's bond market; and
 - Reduced negative spillovers from speculative offshore flows via the ban on facilitating NDF transactions in 2016.

The role of recent regulatory or policy measures towards developing the FX and hedging markets

- The Central Bank of Malaysia continues to focus its efforts on developing the onshore FX markets to be more resilient and building greater capacity for market participants to manage their FX risk. A more efficient FX market can better reflect prevailing risk factors, limiting destabilising dynamics as these risks materialise.

- On this front, the Central Bank of Malaysia has been continuing its efforts to promote the Dynamic Hedging Programme, which provides institutional investors with the flexibility to actively manage their FX risk exposure.
- The Primary Market Maker (PMM) Framework, formalised in 2020, now has eight PMM banks and their Appointed Overseas Offices (AOOs) with enhanced market-making flexibility to provide continuous reference pricing on international platforms, which has improved ringgit FX liquidity during London and New York trading hours.
- The Central Bank of Malaysia has also undertaken sequential liberalisations focusing on operational efficiency and access to the onshore market since 2019 including the standardisation of documentation requirements for FX transactions via the issuance of Minimum Due Diligence Guide for Foreign Exchange Rules in 2019 and the facilitation of third-party FX transactions.
- The Malaysian FX market has grown from an average daily transaction volume of USD 2.3 billion in 2005 to USD 11.3 billion in 2021, along with gradual liberalisation in the FX market.

Roadmap to further support developments in the FX ecosystem in a sustainable manner

- What we have learned from past episodes of volatile capital flows is the need to focus our efforts on developing the onshore FX markets to be more resilient and building greater capacity for market participants to manage their FX risk. A more efficient FX market can better reflect prevailing risk factors, limiting destabilising dynamics as these risks materialise. Our efforts include gradual liberalisation of foreign exchange rules, putting in place robust surveillance and market engagement capacity, and allowing investors to actively manage their FX risk exposure ahead of time, such as via the Dynamic Hedging Programme.
- On this front, the Central Bank of Malaysia alongside key industry players such as the Financial Market Committee (FMC) and Principal Dealers will continue its collaborative efforts to improve market resiliency, efficiency, accessibility and liquidity in the domestic financial market, while preserving an orderly and transparent onshore financial market.
- This includes the use of technology to improve liquidity and pricing transparency of the onshore market. To this end, wider adoption of electronic trading platforms by onshore market participants will further improve price discovery, enhance market transparency and provide efficient execution. Technology will also be adopted to enhance efficiency of regulatory reporting in the FX, bond and money markets to enable effective analysis as well as disseminate information surrounding risk build-ups in the financial market.

Reserve Bank of New Zealand

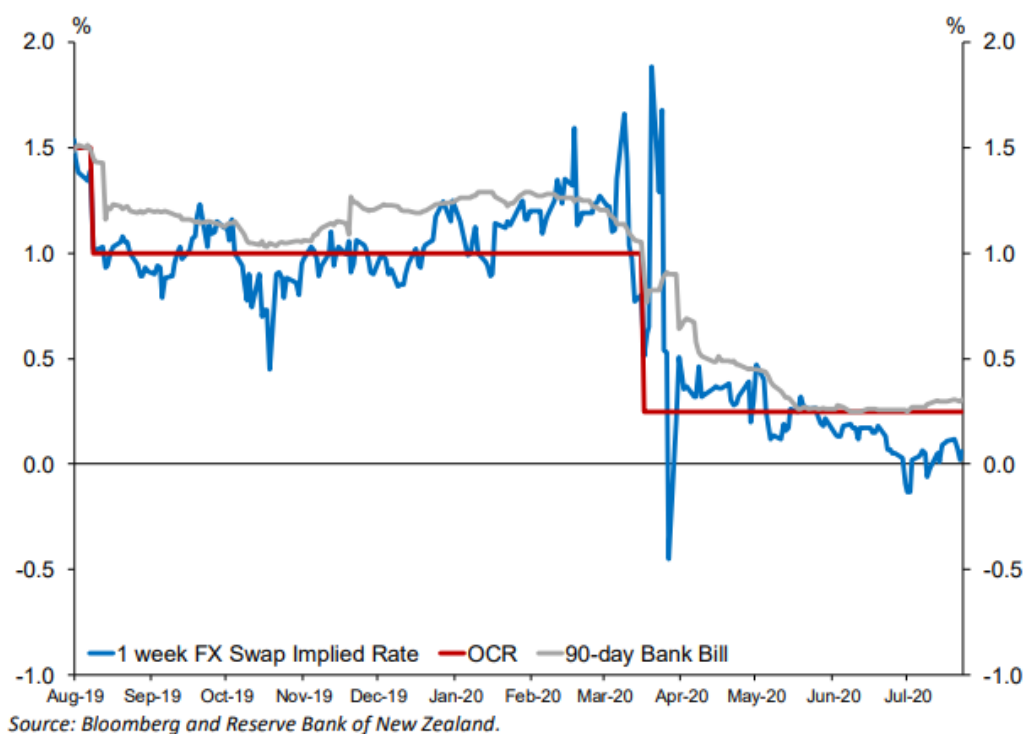
FX market

Volatility in global financial markets increased significantly in early March 2020 as a result of the worsening Covid-19 pandemic. In New Zealand, the FX swap market had become extremely stressed. The global dash for US dollar liquidity had influenced our local money markets through its impact on the FX swap market. Pressure had begun to build in February 2020, and by March the implied interest rates to borrow NZ dollars in the FX swap market were rising rapidly (Graph 1).

The NZD/USD spot exchange rate also fell dramatically. There were no market functioning issues in the spot market. However, the lower exchange rate significantly increased USD collateral inflows for domestic banks using cross-currency basis swaps to hedge offshore issuance. These USD collateral inflows tend to be converted to NZD through the FX swap market thereby adding to the already one-sided flow in the market.

Despite cutting the official cash rate (OCR) to 0.25%, the implied NZ dollar interest rates had risen to nearly 2% to borrow for one week and had spiked to around 20% to borrow overnight. This was spilling over to the bank bill market and other indicators of short-term wholesale funding costs in the New Zealand money market.

Graph 1: New Zealand money market rates



Given the crucial role that the FX swap market played as our primary tool for managing NZ dollar liquidity, we started lending at scale into this market in an attempt to lower these implied borrowing rates, and then drained excess liquidity using other tools to offset the impact on settlement balances. However, this was having only a marginal effect in stabilising interest rates. As a result, on 20 March, we announced a decision to lend on a much larger scale and not drain the impact on settlement cash.

This was a fundamental decision in our crisis response. It marked the end of a target for settlement balances and discarded the “corridor system”. The penalty rate on excess deposits in settlement accounts was removed, shifting to a so-called floor system. All settlement balances would be remunerated at the OCR. This gave us a much better chance to anchor short-term money market rates near the OCR.

This decision resulted in a dramatic expansion of our balance sheet. Within a week, our lending in the FX swap market in maturities from overnight to six months rose to \$20 billion, contributing to the amount of settlement cash in the system quickly rising from \$8 billion to over \$30 billion.

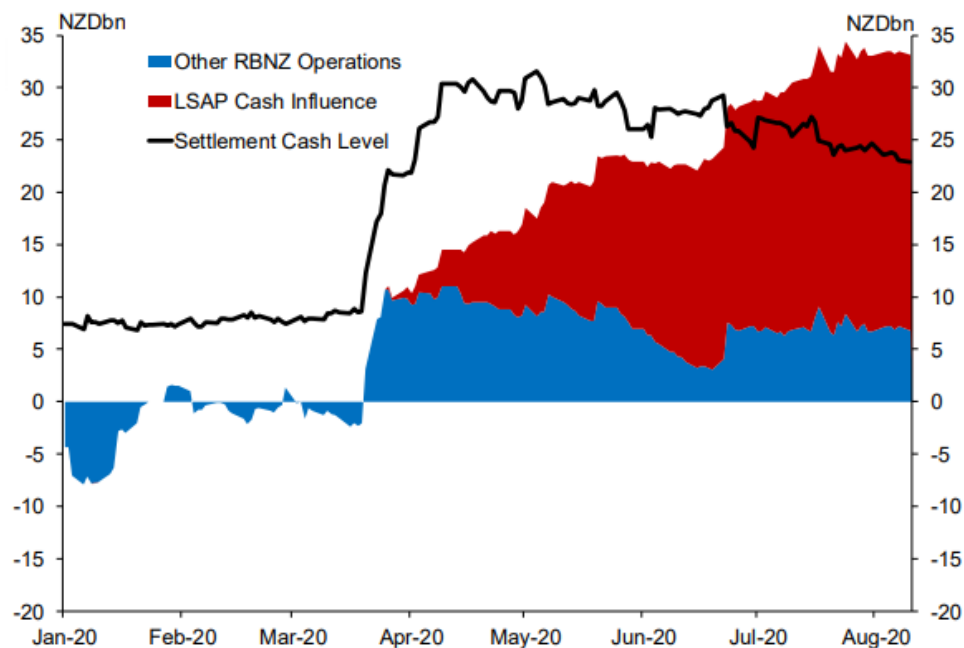
Settlement balances

Since the outbreak of Covid-19, the settlement balances of the banking system have increased from around \$8 billion to \$20–30 billion (Graph 2).

Under the previous corridor system, government cash flows had to be offset through our Open Market Operations (OMOs) to maintain the target amount of aggregate settlement cash in the banking system. This has not been required since the shift to a floor system, where all settlement cash balances receive the OCR. Since then, we have only partially smoothed out the lumpiest government cash flows. Rather, our influence on the level of settlement cash was exerted through two main actions.

- OMOs: Our initial liquidity injections in March 2020 to support the functioning of the FX swap market lifted the level of settlement cash considerably. Since then, we have let some of these maturities run off as conditions in NZ dollar money markets have returned to normal.
- LSAP: The purchases of bonds from banks in the LSAP programme are funded by increasing banks’ settlement accounts. With purchases of up to \$100 billion authorised by the MPC announced in total through to June 2022, this will be an ongoing upward influence on settlement balances and our overall balance sheet.

Graph 2: Settlement cash level and reserve bank influences



Source: Reserve Bank of New Zealand

Note: Other RBNZ Operations includes OMOs and the TAF.

Roadmap for FX market development

The Reserve Bank of New Zealand (RBNZ) will continue to analyse the FX swap market including its participants and the factors that influence pricing. It is imperative that the RBNZ understands how this market works to ensure stable market functioning and any consequences for the implementation and transmission of monetary policy.

Looking ahead, the Bank will also consider the best way to respond to market shocks should they arise again. Illiquidity shocks, such as those experienced during the Covid-19 crisis, can leave long-lasting scars as liquidity providers begin to question the viability of continuing with operations in affected markets. New Zealand is a relatively small market and a key focus for the RBNZ is to ensure that it continues to develop. In general, the NZD FX swap market operates efficiently without the need for central bank involvement.

Bank of Thailand

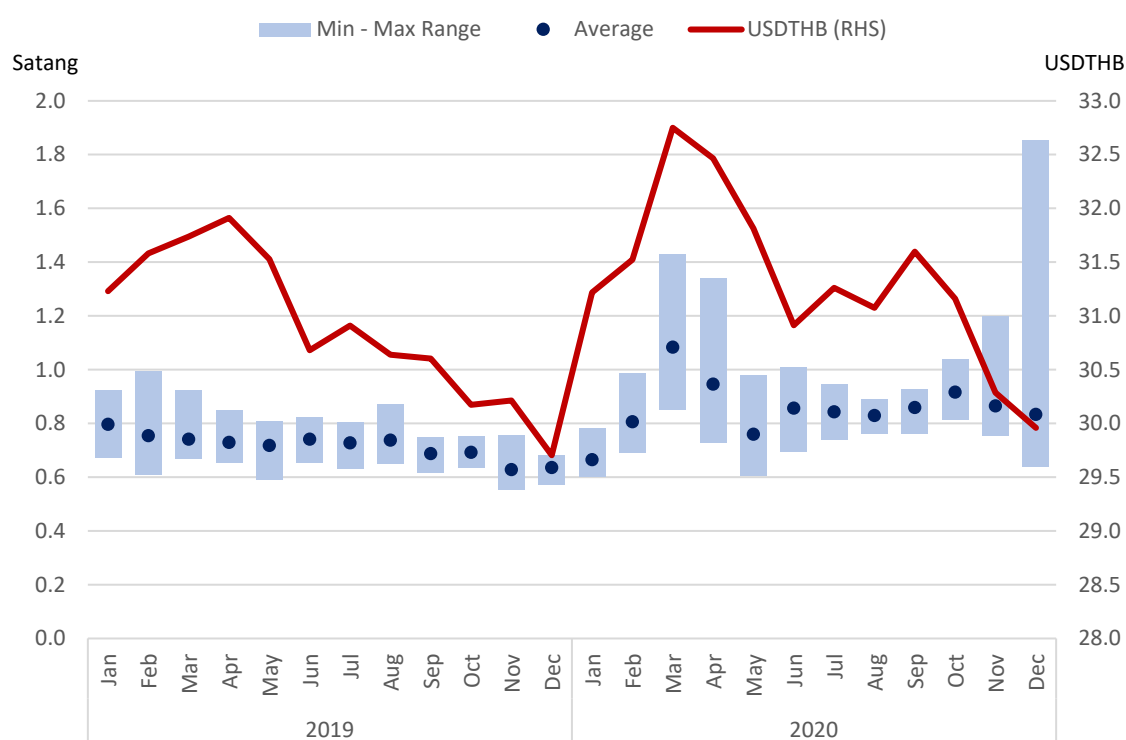
FX market functioning and liquidity conditions during the Covid-19 Pandemic

Despite the global market turmoil and heightened risk aversion that affected pricing and sentiment in local asset markets during the onset of the Covid-19 outbreak in March 2020, the Thai FX market continued to function rather well amid the increased volatilities, and USD liquidity conditions remained quite robust as reflected in the FX swap market.

- As the Covid-19 outbreak evolved into a global pandemic starting in Q1 2020, Thailand has seen a continued decline of securities holdings of foreign investors. Total non-resident portfolio outflows in 2020 amounted to roughly \$11 billion (equity \$8.3 billion; bonds \$2.6 billion) amid the risk-off sentiment. As a result, the Thai baht (THB) was one of the most underperforming currencies in the region and depreciated by 9.5% against the US dollar in March 2020 compared with end-2019, owing to concerns that the pandemic would impact Thailand particularly hard given Thailand's heavy reliance on tourism and exports. Market functioning deteriorated briefly as shown by higher-than-usual bid-ask spreads in the spot market (Graph 1). However, market functioning normalised after a short period, with bid-ask spreads narrowing and trading volume in the onshore FX market recovering.

Monthly bid-ask spread of the USDTHB exchange rate

Graph 1



Sources: Bloomberg; Bank of Thailand.

- Global US dollar liquidity tightening also led to concerns about USD liquidity stress in the swap market. However, the impact on the cost of US dollar funding was relatively limited due to favourable developments in the local market conditions. The demand for US dollar liquidity significantly decreased, as exporters' hedging demand dropped, while the supply of US dollars

increased due to large M&A flows at the time and unwinding of hedging positions by foreign investment funds (FIFs). Also, the unprecedented liquidity injection by AE central banks helped to relieve the stress situation. As a result, Thai onshore basis swap has remained robust throughout the height of the Covid-19 stress period.

Roadmap and policy measures to support development of the FX ecosystem

The BOT has long been developing the Thai FX market to further enhance its resiliency and efficiency in supporting the real economy. The BOT recognises the importance of building an FX ecosystem that could foster resilience against volatilities of exchange rates and capital flows and thus enable businesses and households to efficiently manage their risks. The new FX ecosystem, therefore, gives priority to addressing structural issues in the Thai FX market in a sustainable manner. The development plan consists of the following four pillars:²²

- (1) Reshaping “FX investment ecosystem” to provide a greater opportunity for Thai investors through encouraging outward direct investment and portfolio investment in foreign assets, as well as making available FX-denominated investment products in the Thai market. This mainly involves further liberalisation of capital outflows, as capital inflows have already been largely liberalised.
- (2) Relaxing “FX regulation” to provide higher flexibility in FX risk management and enhance operational efficiency with greater ease of conducting FX transactions for Thai corporates.
- (3) Reviewing “FX service provider landscape” to promote competition among providers aiming to reduce transaction costs, widen access for retail customers, and increase the variety of financial products to meet the arising new demand.
- (4) Enhancing “the FX surveillance system” to upgrade monitoring and foresee emerging risks and enable regulators to put in place appropriate policies and implement more targeted measures, if necessary.

In January 2021, the BOT announced measures to further liberalise outward direct and portfolio investment under the FX investment ecosystem reform (Pillar 1 of the new FX ecosystem plan) along with the project to promote onshore FX activities from offshore corporates with “the Non-resident Qualified Company (NRQC) scheme (under Pillar 4).

The FX investment ecosystem reform addresses issues related to low investment diversification of residents. The BOT has increased residents' ability to manage their FX exposures by 1) easing investment limits for investment abroad for retail and private sector investment; 2) liberalising access to Foreign Currency Deposit (FCD) accounts; and 3) Allowing foreign currency dominated products to be offered in domestic exchanges.

Under the NRQC scheme, non-resident companies having trade and direct investment in Thailand are allowed to conduct FX/THB transactions with onshore financial institutions without having to provide documentary proof for each transaction. Anticipatory hedging and balance sheet hedging are also allowed. Furthermore, NRQCs can manage Thai baht liquidity for their trade and direct investment transactions more flexibly without being subject to the outstanding limits of the Non-resident Baht Account. This scheme helps not only increase the breadth and depth of the onshore FX market, but also to enhance transparency and surveillance in the Thai FX market too.

Recently in May 2022, the BOT announced further relaxation of FX regulation (Pillar 2), in particular aiming to increase flexibility in FX hedging for Thai corporates. Thai corporates can now manage their FX exposures more broadly without having to request for prior approval from the BOT. Companies

²² See Thailand Monetary Policy Report, December 2020, pp. 43-46 for more detail.
https://www.bot.or.th/English/MonetaryPolicy/MonetPolicyCommittee/MPR/BOX_MRP/BOX4MPR_BOTDevelopFX.pdf

are allowed to hedge their balance sheet and FX exposures for payments of goods that are subject to global market prices, conduct hedging transactions on behalf of other resident affiliated companies, and hedge in anticipation of future long-term FX revenues or expenses. Thai residents are also able to conduct foreign exchange transactions (purchase, sell and transfer of FX) for both cross-border and domestic transfers with greater flexibility.

Looking ahead, the BOT will continue to gradually implement the new FX ecosystem development plan as outlined above.