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BACKGROUND NOTE 2: ASSESSING SYSTEMIC FINANCIAL STABILITY RISKS DUE TO FX MISMATCHES

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INTRODUCTION¹

1. This note outlines the approach of the proposed revision to the Institutional View (IV) when assessing whether systemic financial stability risks are elevated due to foreign currency (FX) mismatches.² The proposed change to the IV considers the use of preemptive CFM/MPMs to be appropriate in certain circumstances when systemic risks are elevated, mainly owing to FX mismatches in the private sector. This note illustrates the sources of systemic risks from FX mismatches, the proposed approach to assess such risks, and examples of the information and tools that can be useful in this context.

2. The approach builds on the staff guidance regarding risk assessments in bilateral surveillance, while allowing for flexibility to draw on future advances in best practice. The guidance for bilateral surveillance requires Article IV consultations to include a systemic financial risk assessment, also emphasized in the 2021 Comprehensive Surveillance Review.³ This note elaborates on the component of these risks that relate to FX mismatches, with a view to facilitate the assessment of the appropriate use of preemptive CFM/MPMs under the IV.

3. This note proposes a two-step approach to assess systemic risks from FX mismatches. The first step involves assessing FX mismatches at the relevant remaining maturities, using multiple indicators, with a view to establishing whether these mismatches are high enough to warrant moving to the second step. The second step involves an assessment of systemic risks stemming from such FX mismatches, also taking account of any amplifying and mitigating factors.

4. This note is organized as follows. Section II outlines the sources of systemic risks stemming from FX debt and potential amplification channels. Section III outlines the risk assessment approach in practice and Section IV concludes.

¹ This background note elaborates on paragraphs 15 and 16 of the Board paper. Paragraph 15 of the Board paper states that for preemptive CFM/MPMs on FX debt inflows to be appropriate, systemic financial risks should be elevated owing to FX mismatches. The assessment of such risks is the focus of this Background Note. Paragraph 16 of the Board paper considers that in narrow and exceptional circumstances, there may be a case for the use of preemptive CFM/MPMs on local currency debt inflows. The assessment of systemic financial stability risks for this case is described in the Annex of this Background Note.

² FX mismatch at any relevant remaining maturity is defined as the stock of FX liabilities which is not covered by liquid FX assets or FX hedges (either natural hedges or financial contracts in deep hedging markets). FX mismatches give rise to solvency risks that may arise from impact of currency depreciation on the entire balance sheet and/or liquidity risks from short-term liabilities.

³ See Section III.A of IMF (2015) and IMF (2021a-e).

SOURCES OF SYSTEMIC RISKS FROM FX MISMATCHES

A high stock of FX-denominated debt may expose countries to vulnerabilities that give rise to systemic risks. Vulnerabilities from FX debt stocks can arise from: (i) FX balance sheet mismatches, where assets and liabilities are denominated in different currencies and balance sheet solvency is affected by changes in exchange rates; and (ii) FX maturity mismatches, where firms' operations and/or long-term assets are funded by short-term FX liabilities, creating rollover risk in the event of liquidity pressure, such as from a capital flow reversal. FX liquidity risk is more concerning than liquidity risk in local currency since the central bank's ability to function as a lender of last resort may be limited when the liquidity gap that needs to be bridged is in FX. Risks from FX mismatches can be further amplified by high leverage of domestic borrowers or lenders, or overvalued asset prices. The degree of foreign investor holdings of local currency securities can also be an amplifier, as an abrupt reversal in response to a global shock can lead to a large depreciation which leads to realization of liquidity and solvency risks due to preexisting FX mismatches.

5. FX mismatches can arise from an overall FX balance-sheet mismatch across all remaining maturities, or an FX maturity mismatch at shorter horizons, or both.⁴ An FX balance sheet mismatch arises if the currency denomination of a borrower's liabilities differs from that of assets. Currency movements then affect valuations of assets and liabilities in expectation across all remaining maturities, and hence solvency. But even in the absence of an overall balance sheet mismatch, the borrower may have an FX maturity mismatch: a mismatch between FX liabilities coming due and the FX resources readily available (from FX income, hedges, or liquid FX).⁵ Overall, a borrower is fully hedged only in the absence of currency mismatches affecting valuations even over long horizons, and liquidity shortfalls at shorter maturities.

6. Both types of FX mismatches can give rise to systemic risks. FX mismatches can give rise to systemic risks when they amplify the effects of financial shocks, such as a reversal of capital inflows or a depreciation of the exchange rate, and thereby lead to sharp adverse effects on the economy. Such macro-financial effects can contribute to a sharp tightening of financial conditions, a procyclical cutback in lending (in both local currency and FX), and in extreme situations, a systemic banking and/or a currency crisis. For example:

- *FX balance sheet mismatch.* When agents in the private sector hold local currency assets funded by FX-denominated liabilities and do not hold hedges to offset the balance sheet

⁴ The term FX balance sheet mismatch as defined here corresponds closely to the commonly used term "currency mismatch" and reflects the gap between FX assets and liabilities irrespective of their maturities. The term FX maturity mismatch relates closely to the commonly used term "FX liquidity risk." FX liquidity risks arise in the presence of FX maturity mismatches, as defined here, whether owing to contracted or unforeseen cash outflows, and lead to shortages in the availability of liquid FX assets to service FX obligations.

⁵ An agent faces FX liquidity stress when their net FX cash outflows exceed their FX liquid asset buffers. FX cash outflows could become larger than FX cash inflows (i.e., net FX cash outflows) for both flow and stock reasons. A sharp decline of export receipts (i.e., commodity price declines to commodity exporters) reduces FX cash inflows. Contingent claims, such as activation of FX credit lines for financial institutions, derivatives contracts, and covenants with FX debt that trigger repayment before maturity, could also spike FX cash outflows.

effects from changes in exchange rates, a depreciation increases the value of FX liabilities in local currency, while the value of assets remains the same, putting pressure on solvency.⁶ The depreciation also increases the local currency value of FX debt service coming due. These pressures may lead to higher direct and indirect credit risk as the agents may default on both FX and local currency debt, and can also lead to broader macro-financial feedback effects, e.g., through cutbacks in expenditure.⁷

- *FX maturity mismatch.* FX maturity mismatches can cause both liquidity and solvency risks.⁸ For instance, when agents hold short-maturity FX-denominated liabilities, they are exposed to rollover risk in the event of a reversal of FX debt inflows. Contingent claims, such as activation of FX credit lines for financial institutions, derivatives contracts, and covenants with FX debt that trigger repayment before maturity, could also spike FX cash outflows. In this event, borrowers may default on short-term FX liabilities, or liquidate physical or financial assets at fire sale prices to generate FX liquidity. Moreover, when agents sell illiquid assets, they may incur valuation losses, affecting solvency. Interest costs could also rise if agents try to borrow money to fill the cashflow gap. These valuation losses and higher funding costs can weigh on profitability and weaken solvency.

7. Each type of FX mismatch may be present without the other. Rollover risk can be present without an overall FX balance sheet mismatch, which therefore necessitates assessing balance sheet mismatches at the relevant remaining maturities. For example, for banks, regulatory limits on open FX positions or capital requirements based on market risk typically keep FX mismatches on their balance sheet limited or hedged, but these regulations by themselves often do not prevent the use of short-term FX funding to fund short- or long-term FX assets, such as FX loans.⁹ Conversely, an overall FX balance sheet mismatch does not require FX maturity mismatches to be present, as FX liabilities could be long-term (short-term) and funding local currency long-term (short-term) assets.

8. Systemic risks from FX mismatches can be amplified by leverage. To illustrate, the likelihood to default on current obligations in the event of a depreciation is greater when debt

⁶ The concept of FX balance sheet mismatch also may be applied to cases where FX assets are funded by local currency debt (in which case an appreciation can threaten solvency) or where assets and liabilities are both in FX but in different foreign currencies.

⁷ For instance, FX balance sheet mismatches were widespread in Central and Eastern Europe prior to the global financial crisis and contributed to sharp increases in banks' non-performing loans in a number of these countries (see, e.g., Rosenberg and Tirpák, 2008, and Ranciere and others, 2010). The experience in Iceland was similar (see e.g., Olafsson and Vignisdottir, 2012). Aghion and others (2001) analyze the role of firms' FX debt obligations in a currency crisis.

⁸ The role of FX maturity mismatches in creating systemic risk is discussed in IMF (2017) and the accompanying case studies for Korea, Sweden, and Turkey. See also Ree and others (2012) for empirical evidence on Korea. Chang and Velasco (2001) study the role of maturity mismatch and illiquidity of short-term funding in an emerging market financial crisis model. Barkbu and Ong (2010) discuss how the extensive use of FX swaps for funding and hedging purposes may expose banks to liquidity risk, especially in periods of market stress.

⁹ Several macroprudential tools are available to address liquidity risks and maturity mismatches including the Basel III liquidity coverage ratio and net stable funding ratio.

service costs are a larger share of income. In addition, and more broadly, if firms' leverage is high, the macro-financial effect from a depreciation can be expected to be greater since it is a non-linear function of the size of the equity cushion. If firms have high leverage, the small equity cushion may not be able to absorb the valuation effects of a depreciation, increasing the likelihood of cutbacks in operations or investments and a rise in unemployment. High leverage is also likely to affect the rollover risk from FX maturity mismatches. If agents have strong capital positions, their ability to convince foreign investors to roll over or extend funding—or attain FX funding locally—may be enhanced.

9. High leverage from accumulated FX debt stocks can be coupled with an overvaluation of local asset prices, adding another layer of systemic vulnerability. If inflows lead to an accumulation of FX debt stocks (such as through mortgages denominated or indexed in FX), the increase in leverage may fuel an overvaluation of domestic asset prices. This can present an additional systemic vulnerability during a capital flow reversal, as a fall in asset prices would typically compound the tightening of financial conditions for both local currency and FX borrowers.

10. Significant presence of foreign investors in local currency bond markets, when these markets are not well developed, may in some cases amplify the risks from FX mismatches.¹⁰ Foreign investors investing in local currency bond markets may have FX mismatches on their balance sheets which are absorbed only at a premium, and their inflows could be sensitive to changes in global financial conditions and currency valuations. A reversal of funding by foreign investors in response to a global shock, when these investors hold a significant share of the market and the domestic investor base is not deep, could put pressure on the local currency bond market at the same time as there is a reversal of FX debt inflows. The sale of local currency bonds and subsequent purchases of FX may lead to a tightening of financial conditions and a sharp depreciation, compounding problems for those borrowers who have FX-denominated liabilities.

RISK ASSESSMENT APPROACH

Systemic risks from FX mismatches can be assessed using a two-step approach. The first step involves assessing FX mismatches at the relevant remaining maturities, using multiple indicators, with a view to establishing that these mismatches are high enough to warrant moving to the second step. The second step involves an assessment of systemic risks stemming from such FX mismatches, also taking account of any amplifying and mitigating factors.

A. Step 1. Assessing the Level of FX Mismatches at Relevant Maturities

11. The first step would comprise assessing the level of FX mismatches at the relevant remaining maturities. To assess FX mismatches at the relevant maturities, three components are needed: (i) the stock of FX liabilities; (ii) the denomination of assets and availability of hedges; and (iii) the maturity structure of the balance sheet (including FX liabilities, assets and hedges). Multiple

¹⁰ See BIS (2021) for a discussion of the evidence.

indicators should be used to assess each of these components, subject to data availability.¹¹ Box 1 illustrates how publicly available data sources can be used to assess FX mismatches for a hypothetical country.

12. The assessment of FX mismatches at relevant maturities could involve the following elements and data:

- *FX debt stocks.* To assess the liabilities component of FX mismatches, it would be helpful to look at the stock of private sector FX debt, both economy-wide as well as at the sectoral level. The breakdown of FX debt stocks across households, non-financial corporations (NFCs), banks, and non-bank financial institutions (NBFIs) could be particularly useful in identifying pockets of vulnerabilities that would be difficult to identify in the aggregate data. Even within these sectors, there may be significant heterogeneity that should be investigated as much as possible. For example, NFCs that are exporters and/or larger in size may have higher FX debt stocks but may also have better access to international financial markets to weather capital flow reversals. In addition, corporates may issue FX debt through their offshore affiliates, or may be interlinked through trade credit in FX, and where possible, such off-balance sheet exposures or contingent liabilities should be considered.
- *FX assets and hedges.* The assessment of FX assets and hedges would involve assessing whether the sector's FX debt is hedged at the relevant maturities. This hedging could be of various forms: natural; or via holdings of liquid FX assets; or through financial contracts in deep hedging markets.¹² Natural hedges can be approximated by export revenues net of FX expenses for corporates or remittances for households. However, natural hedges may provide coverage for only a limited segment of the economy, i.e., the export sector or households supported by remittances from abroad. Hedging through non-deliverable instruments (such as onshore non-deliverable forwards) protects the buyer from losses due

¹¹ Sectoral breakdown of the FX and/or external balance sheet is available in BIS Locational Banking Statistics (LBS), BIS International Debt Securities Statistics (IDS), BIS Quarterly External Debt Statistics (QEDS), IMF Monetary and Financial Statistics (MFS), and IMF International Investment Position Statistics (IIP). The data availability for end-2019 is as follows. Households: 145 countries from IDS, 186 countries from LBS and 156 countries from MFS. NFCs: 86 countries from IDS, 182 countries from LBS and 156 countries from MFS. Non-Bank Financial Institutions: 76 countries from IDS, 147 countries from LBS. Banks/deposit taking corporations: 78 countries from IDS, 180 countries from LBS, 114 countries from QEDS, and 156 countries from MFS. Other sectors: 113 countries from QEDS. The Balance Sheet Approach (BSA) matrix data are also well-suited for this analysis, as it contains sectoral from-who-to-whom exposures which may have a breakdown between local currency and FX. Some countries (e.g., Australia, EU members, USA, Japan, etc.) also compile full sectoral accounts, that contain sectoral balance sheets by instruments. For an application of this data, see IMF (2018). IDS provides a breakdown not only by currency and sector but also by maturity, i.e., "short-term" (up to one year) and "long-term" (greater than one year). QEDS provides a breakdown of external debt by maturity for deposit-taking corporations and other sectors for up to 114 countries, and by currency and maturity for up to 44 countries.

¹² In a deep hedging market, investors can execute their (large) transactions efficiently, i.e., without causing significant price movements that could affect the cost of executing the transaction, or significantly increasing their exposure to counterparty risk. The key measures of market illiquidity are price impact and price reversal. Bid-ask spreads and effective spreads could also capture market liquidity, but high frequency data on these are unreliable in more underdeveloped markets. These and other useful measures for assessing market liquidity are discussed in Abdi and Ranaldo (2017), Amihud (2002), Corwin and Schultz (2012), Roll (1984), and Vayanos and Wang (2013).

to exchange rate movements but does not provide the FX liquidity needed at maturity. Liquid FX assets of both short- and long-term maturities can be used to cover debt positions of all maturities. Another important consideration is whether the entities that are indebted are also the ones that hold the hedging instruments, the assessment of which requires more granular data than country-wide or even sector-wide aggregates, and this data may only be available for few countries.

- *Maturity structure.* A breakdown of FX debt stocks and assets by maturity would help identify whether a sector that carries high FX debt has high short-term FX debt, and if so, whether there is a mismatch between FX obligations falling due in the short term and the stock of liquid FX assets. The timing of FX income and the maturity structure of hedges would provide important information as to whether there is a mismatch with the maturity of FX obligations, and whether the financial hedges need to be rolled over, creating further FX maturity risks. In this context, a key question is whether hedging markets will remain deep and liquid even under conditions of stress.¹³ Some data gaps may be filled by complementing the available data with soft information. For example, if the maturity structure of FX debt is not available, it can be helpful to use as proxies those debt categories that are likely to comprise mostly short-term and FX debt, e.g., external interbank debt. On the asset side, portfolio assets and other investment assets (especially the currency and deposits subcomponent) in the IIP or BSA data can be assumed to have significant liquid components. Available information could also be used to come up with a reasonable proxy for the ratio of FX to local currency debt in the short-term external debt series available in the IIP database.

13. Other country-specific information should be used to assess FX mismatches. While the primary data sources proposed for this exercise provide coverage for a great majority of the Fund's membership, data gaps may be severe for some countries, e.g., the country may not be included in the dataset, or the datasets may not measure all information on external liabilities and assets, which may be large for some countries (such as FX loans from non-BIS-reporting institutions, inter-company FX debts, contingent FX liabilities, FX swaps, and other off-balance-sheet FX liabilities). In these cases, quantitative and qualitative information regarding these debt and asset positions should be uncovered as much as possible to assess the level of FX mismatches. Country authorities contemplating preemptive CFM/MPMs may have access to additional information, e.g., unpublished data on FX mismatches. Similarly, they may have other soft information, e.g., whether most borrowing is by FDI companies with parent guarantees, which can be considered hedged, or from parent companies, which may be considered more stable.

14. The assessment of whether FX mismatches are elevated would require judgment.

Granular data on FX debt and hedges are often incomplete, and in addition, country-specific factors affect the functioning of hedging markets and the appropriate level of sectoral aggregation at which

¹³ Barkbu and Ong (2010) discuss how the extensive use of FX swaps for funding and hedging purposes may expose banks to liquidity risk, especially in periods of market stress.

to measure FX mismatches. As a result, judgment on whether FX mismatches are elevated requires a holistic assessment of the available data and country-specific factors, and should consider historical trends and peer country information among others.

15. If FX mismatches at relevant maturities are judged to be high in Step 1 for at least one macro-critical sector, the assessment would proceed to Step 2. In cases where FX mismatches are in an intermediate range—neither high enough to clearly be assessed as elevated, nor low enough to clearly be considered as safe—it would be desirable to err on the side of caution and move to Step 2. It would be sufficient for the FX mismatches to be elevated for one macro-critical sector, and the analysis in Step 2 should focus on the identified sectors.

Box 1. Step 1 Applied to a Hypothetical Country

This box illustrates how the level of FX mismatches can be assessed using publicly available, granular data for a hypothetical country. We assess FX debt stocks across four sectors: households, NFCs, NBFIs, and the banking sector. The figure plots the stock of internationally issued FX bonds, cross-border FX loans from BIS reporting institutions, and FX loans from domestic financial institutions.

This hypothetical country's data suggests that the FX debt of the non-financial corporate sector may be elevated. The household and NBFIs FX liabilities as a share of GDP are both quite low, and possibly not worrisome (Text Box Figures 1a and 1c). However, NFCs' FX borrowing is substantial: about 6 percent of GDP from external sources and about 25 percent of GDP from domestic sources (Text Box Figure 1b). The banks' cross-border borrowing in FX is high, at about 19 percent of GDP, and it is possible that some of this borrowing is being channeled to domestic NFCs (Text Box Figure 1d). Banks themselves may be hedged, but the "final recipient" of that flow may be an unhedged corporate entity.

NFCs' domestic and cross-border FX liabilities have grown steadily over time (Text Box Figure 2). Finally, NFCs' cross-border borrowing in FX as a share of GDP is moderate relative to peers, but their domestic FX debt is relatively high (Text Box Figure 3).

On the assets side, while the data available is less granular and comprehensive than the liabilities data, the liquid FX and external assets (proxied by claims on domestic or foreign banks and portfolio assets) appear to be smaller than the liabilities as a share of GDP, although total external assets (available in BSA data) are larger, especially for NFCs (Text Box Figure 4).^{1/}

On the maturity composition, while the share of short-term debt in total external debt and in internationally-issued FX securities for banks or depository corporations has declined in recent years, it remains significant at about 40 percent (Text Box Figure 5a). If this borrowing is used to lend longer term in FX to NFCs, it could pose risks to the continued stable funding for these corporations in the event of rollover problems for banks. For other sectors, the share of short-term debt in total external debt is stable over time but still significant at 30 percent.

Ideally, the assessment would also use other information on the maturity structure of assets and the hedging of FX liabilities in NFCs. However, based on the publicly available data already shown, there may be sufficient reason to judge that FX mismatches are high enough to proceed to step 2.

Box 1. Step 1 Applied to a Hypothetical Country (Continued)

Figure 1. FX Debt to GDP Across Sectors

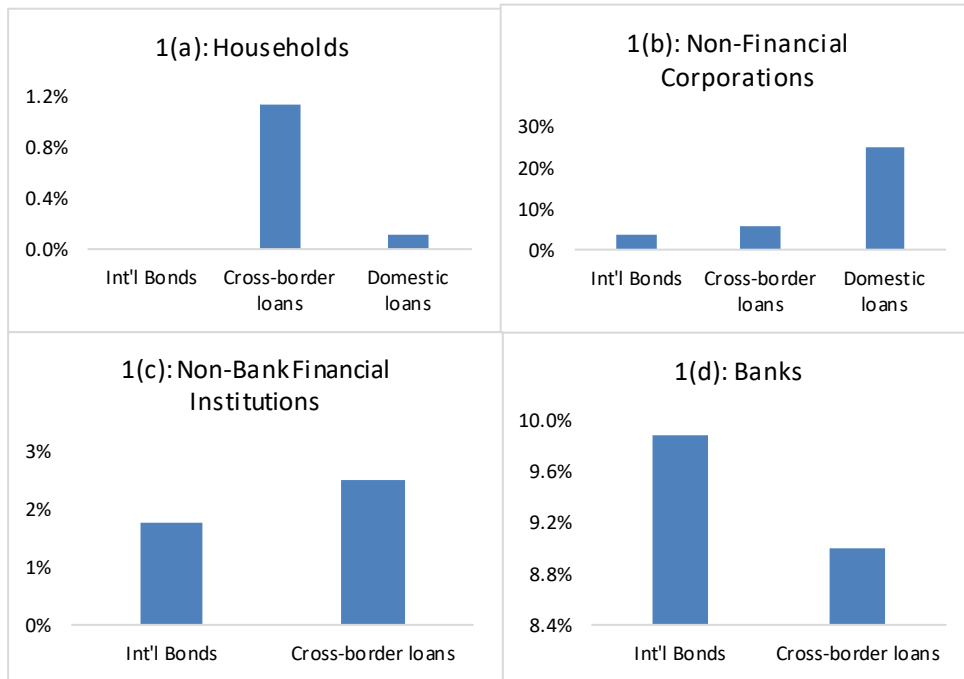
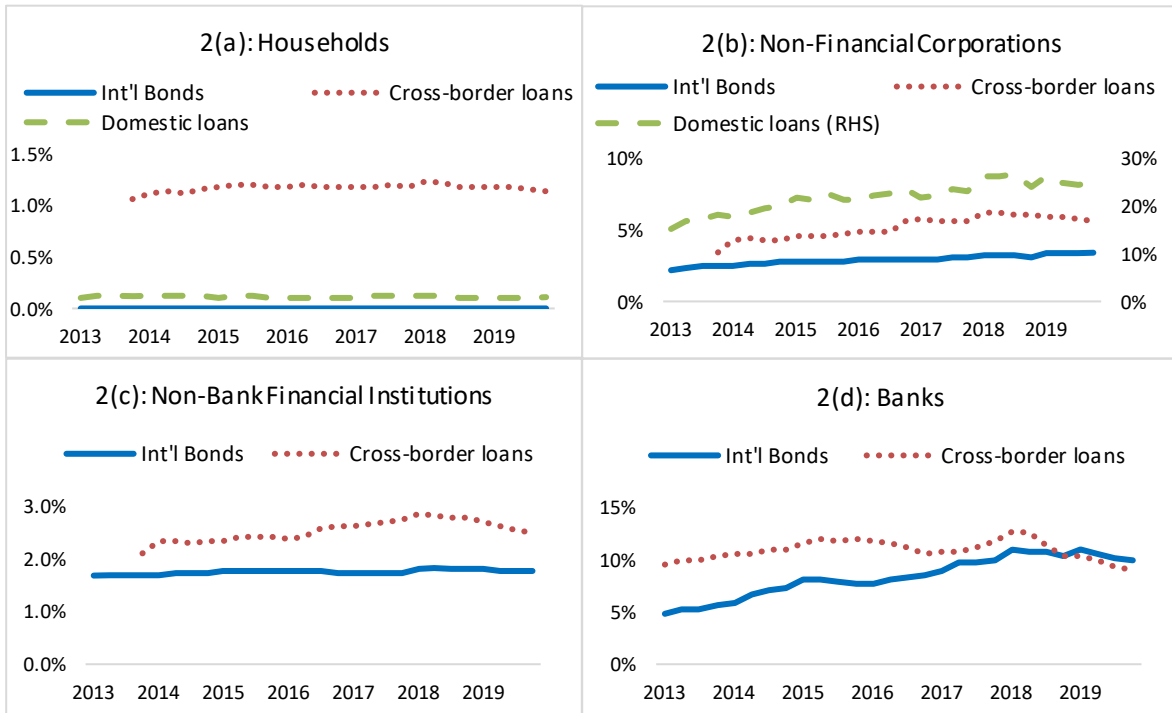


Figure 2. FX Debt to GDP Across Sectors and Time



Box 1. Step 1 Applied to a Hypothetical Country (Concluded)

Figure 3. Non-financial Corporates' FX Debt to GDP Relative to Its Peers

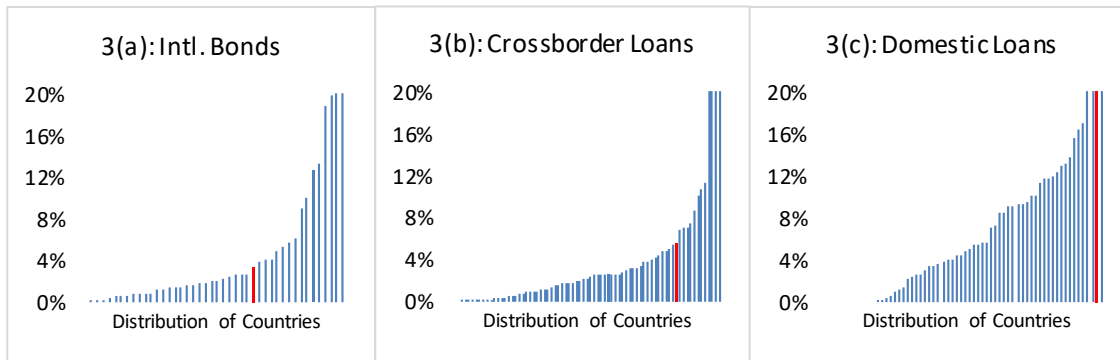


Figure 4. Assets to GDP Across Sectors

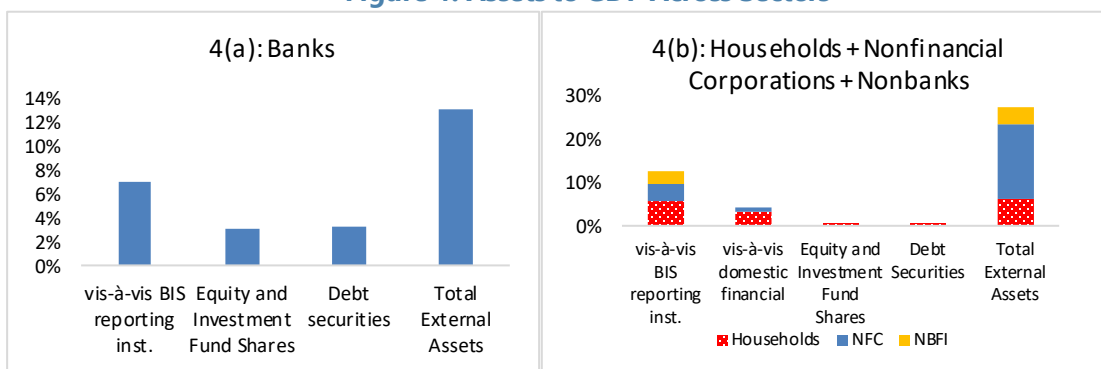
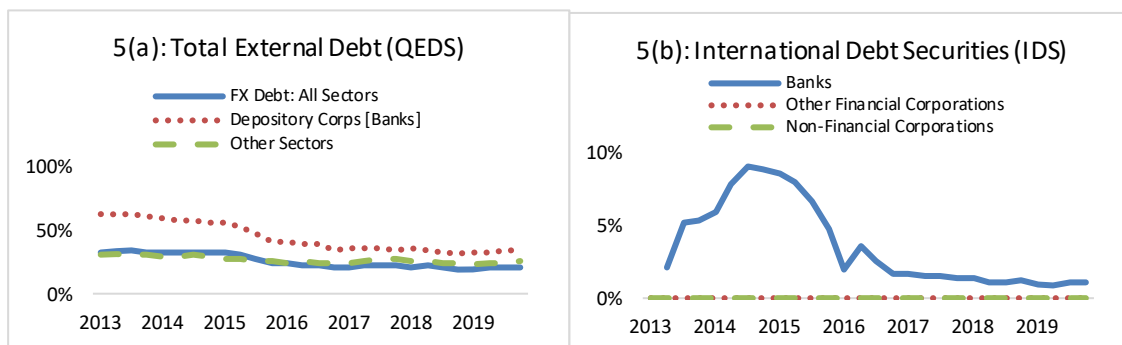


Figure 5. Short-Term Debt in External Debt, by Sector and Currency



^{1/} Text Box Figure 4 does not include some types of FX assets held by the private sector, including FDI and trade credits, as without further information, it is unclear how much of it can be considered liquid assets.

B. Step 2. Assessing Systemic Risks from Elevated FX Mismatches

16. The second step is to assess whether the systemic financial stability risks arising from those FX mismatches are elevated. For any given level of FX mismatches, the associated systemic risks depend on the economy's financial structure, the type and strength of the expected macro-financial linkages, and the factors which may mitigate or amplify the domestic transmission of shocks through these linkages. Multiple sources of information and tools should be used to understand how shocks may interact with FX mismatches and other mitigating or amplifying factors, and trickle down through the financial system.

17. A preferred approach is a granular stress test of the relevant sectors. A stress test would allow for designing a reasonable adverse scenario and trace the transmission of shocks through the domestic financial and non-financial sectors. Stress tests may cover both liquidity and solvency risks and may be available from a past Financial Sector Assessment Program (FSAP) or can be done in the context of the Article IV surveillance if the necessary data are available.

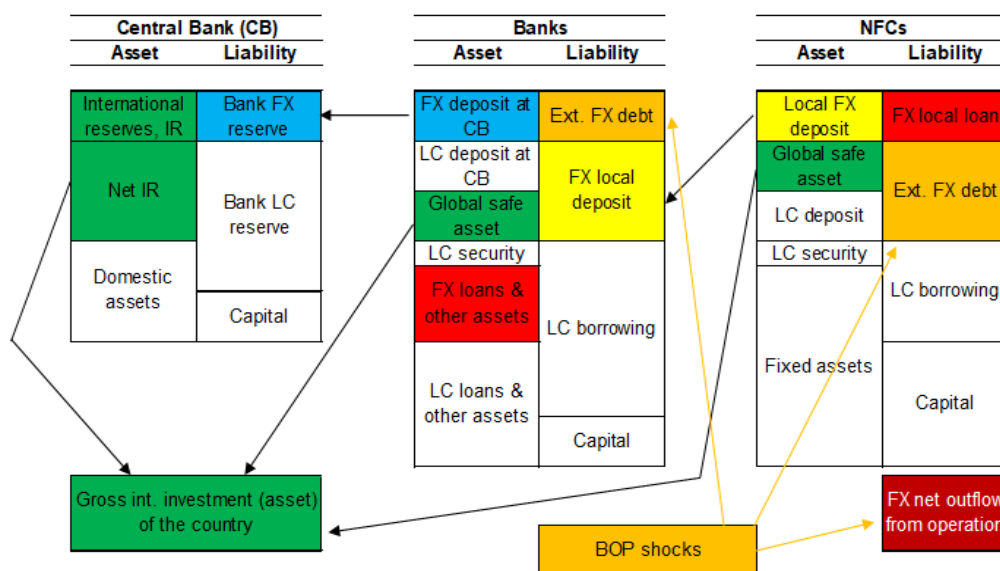
- A solvency stress test can be used to assess how an adverse macroeconomic scenario, including a calibrated level of depreciation, may increase the defaults of private sector agents such as banks, corporates, and households owing to FX balance sheet mismatches, and how this in turn may affect the solvency of banks.
- A liquidity stress test attempts to understand how a withdrawal of FX funding or a drop in FX revenue interacts with FX maturity mismatches at the sectoral level to create systemic shortfalls including through amplification from an interaction between domestic sectors. Such an exercise would begin with a calibration of the size of the depreciation and the withdrawal of FX funding to the private sector, together with assumptions for the liquidation of each sector's FX assets and the operation of the FX hedging markets under stress. The stress test would enable the identification of the spillovers of FX shortfalls onto the rest of the economy, using available information on the structure of the financial system, the presence of elevated asset valuations, and the availability of policy support.
- The objective of both kinds of stress tests is to assess whether the key sectors can withstand the shock, to quantify the size of the domestic contagion, and to judge the degree of FX policy support that may be needed. Box 2 illustrates one example of a system-wide FX liquidity stress-testing tool that is available to country teams.

Box 2. System-Wide FX Liquidity Stress Testing Tool

This box provides an example of a stress-testing tool which may be useful in assessing the liquidity dimension of the systemic risks from FX mismatches, namely, FX liquidity risks (Oura and Leika, 2020; Oura, forthcoming).

The tool applies the standard liquidity stress-testing approach for banks to other sectors. Agents fall into FX liquidity stress when their net FX cash outflows within a given period exceed their FX liquid asset buffers. There are three sources of cashflows: operations (such as import expenses and export receipts), investment income and expenses (such as interest and dividend payments), and financing. Financing flows include contractual flows, contingent flows such as credit lines and repayments related to the triggering of debt covenants, and new contracts including rollovers.

Figure 1. Illustration of System-Wide FX Liquidity Stress Testing Tool1/



The tool identifies the key channels of transmission from balance-of-payment-related FX liquidity shocks to domestic contagion via cross-sector balance sheet linkages. Text Box Figure 1 illustrates a stress test in which capital outflows trigger FX liquidity shocks to NFCs with substantial external debt. If the NFCs have sufficiently high FX liquid assets, they can absorb the shock. If their FX liquid assets consist of global safe assets, these can be sold to foreign counterparts, and domestic contagion should be limited. However, if most of their FX liquid assets are FX deposits at local banks, the NFCs' liquidity stress is transmitted to banks. If the banks' FX liquid assets are mostly reserve deposits and central bank paper, the banks' FX liquidity stress could be transmitted to the central bank, causing a drawdown in international reserves.

The extent of contagion effects and the drawdown in reserves depends on the extent of maturity mismatch in FX assets and liabilities, the composition and nature of liquid FX assets, and the order in which agents liquidate.

Box 2. System-Wide FX Liquidity Stress Testing Tool (Concluded)

The tool relies mostly on the balance sheet approach matrix data (also called the “who-to-whom” flow of funds, capturing the financial account data by counterparty). These data are becoming increasingly available for EMDEs; developing such data was called for in IMF (2015b) and has been a focus of the G20 data gap initiatives. The tool can be implemented using BSA and typical WEO projections, together with assumptions regarding the missing information and financial structure (especially for the NFC sector) and drawing on staff judgment.

^{1/}Ext. = external; NFC = non-financial corporate; LC = local currency; global safe assets = currencies and sovereign securities of reserve currency issuers.

18. Country authorities may have specific concerns and additional data about the transmission of systemic risks owing to FX mismatches. The authorities may have specific concerns that can shape the analysis in Step 2, e.g., the stress scenario. Country authorities may also have access to additional information which could help inform the assumptions that staff need to make when undertaking stress tests, e.g., the composition of the foreign investor base, granular data on the financial network, unpublished information regarding non-financial corporates’ balance sheets, credit registries, and legal guidelines for the sequence of asset liquidation in adverse scenarios. In addition, they may have access to unpublished stress tests undertaken by the central bank. Staff and the authorities may also be able to fill in gaps in quantitative and qualitative information regarding the connection of the amplifying and mitigating variables to FX mismatches, e.g., the overlap between the holders of domestic assets and the sectors which undertake FX borrowing, FX contingent liabilities in large corporates, and under what circumstances the government would be able or willing to draw down its FX buffers.

19. In addition to stress tests, and especially if stress tests are not feasible, the systemic risk assessment can build on the existing risk assessments in bilateral surveillance. Risk assessments are routinely conducted as part of bilateral surveillance for all countries, using a variety of approaches which draw on the available data and country-specific conceptual and qualitative information. The assessment of the FX-related systemic risk would involve building a narrative with the following elements:

- *Assessment of systemic risks.* The assessment to be undertaken under the IV would build as appropriate on the assessment of systemic risks in Article IV reports that staff are already performing in line with existing guidance for such analysis (IMF, 2015; IMF, 2014). This analysis would need to become more systematic and deepened substantially when staff conduct a focused assessment of systemic risk from FX mismatches for the purposes of the IV.
- *Consequences of a capital inflow reversal.* In the context of the overall assessment of systemic risks, the relevant consideration for the use of preemptive CFM/MPMs to be appropriate relates to whether a capital inflow reversal, due to a domestic or external shock, could lead to elevated systemic financial stress.

- *Connection of the amplifying and mitigating factors to FX mismatches.* There should be an explanation of whether the variables judged to be amplifying or mitigating the risk of a costly capital flow reversal operate via transmission mechanisms which are closely connected to the FX mismatches identified in Step 1, e.g., whether FX debt service is high as a percentage of export revenues, whether elevated housing or stock price valuations are associated with high leverage which would be unwound in the event of a reversal of FX debt inflows, whether there are large FX contingent liabilities in adverse scenarios, whether FX hedging markets would continue operating smoothly in such scenarios, whether the central bank or the government has access to FX buffers such as sovereign wealth funds, FX reserves, FX swap lines, and/or Fund arrangements, etc.

CONCLUSION

20. The two-step approach outlined in this note helps structure the assessment of the systemic financial stability risks arising from FX mismatches. The approach emphasizes a holistic assessment, using all available data and judgment. The question of whether elevated FX mismatches pose systemic risks is a key element of the assessment process for the appropriateness of preemptive CFM/MPMs, even as other elements listed in Section II of the Board paper, e.g., that MPMs are not sufficient, need also be met. The granular information uncovered in this risk assessment can help better understand the structure of the financial system and its interlinkages to the domestic macroeconomy, which could be useful in the assessment of risks in bilateral surveillance more broadly. While the elements included in this note would be a natural starting point for such analyses by Article IV teams, there may be methodological and data innovations that would lead the approaches to evolve over time.

Annex I. Assessment for Preemptive CFM/MPMs on Local Currency Debt Inflows

Preemptive CFM/MPMs on local currency debt inflows may be appropriate in narrow and exceptional circumstances. In these circumstances, systemic risks from local currency debt stocks can be assessed using a two-step approach. The first step involves assessing whether there are elevated local currency leverage and/or maturity mismatches that are fueled by local currency debt inflows. The second step involves an assessment of the associated systemic risks.

1. The circumstances for beginning the assessment process for preemptive CFM/MPMs on local currency debt inflows would be narrow and exceptional. For such CFM/MPMs, it would first need to be judged that conditions (i)-(iv) from paragraph 16 of the Board paper—which relate to the functioning of FX and local currency markets under stress, the effects of depreciation, and the impairment of other policy instruments during crises—are jointly satisfied. If they are satisfied, the risk assessment process would begin. If they are not satisfied, the CFM/MPM would not be appropriate. By contrast, these conditions do not need to be satisfied for the risk assessment process for preemptive CFM/MPMs on FX debt inflows to begin; as a result, the circumstances for beginning the assessment process for measures on local currency debt inflows are narrower and more exceptional.

2. Once it is decided to begin the assessment process, Step 1 of the risk assessment would be to establish that local currency leverage and maturity mismatches are elevated owing to local currency debt inflows.¹ Data on local currency debt stocks, assets, and maturity structure would be used to establish whether leverage and maturity mismatches are high enough in at least one macro-critical sector to proceed to Step 2. Judgment would be necessary, and in cases where leverage and maturity mismatches are neither high enough to clearly be assessed as elevated nor low enough to clearly be considered safe, it would be desirable to proceed to err on the side of caution and move to Step 2. The analysis in Step 2 would focus on the identified sector(s).

3. Step 2 of the risk assessment would be to assess the systemic risks related to local currency leverage and maturity mismatches:

- *Stress tests.* A preferred approach would be granular stress tests of the relevant sectors to assess both solvency and liquidity risks (such as those already conducted in FSSAs). The stress tests would build in the impairment of policy instruments during crises which is considered applicable for the specific country and which justified the beginning of the assessment process (such as the need for sharp increases in policy rates, or the inability of the central bank to provide liquidity support).

¹ If the main vulnerability of concern is FX mismatch owing to FX debt inflows, staff should conduct the risk assessment outlined in Section III of this Background Note. If local currency vulnerabilities are substantial owing to local currency debt inflows, and the narrow circumstances outlined in this Annex apply, staff should conduct the risk assessment outlined in this Annex.

- *Building on existing risk assessments.* The risk assessment can also build as appropriate on existing risk assessments in Article IV reports that staff already perform in line with existing guidance (IMF, 2015; IMF, 2014). There would need to be a narrative establishing whether the systemic vulnerabilities arise from the local currency debt inflows, and whether crisis risks would be accentuated in the event of a reversal in these flows owing to FX mismatches or to other factors, e.g., whether elevated housing or stock price valuations are associated with high leverage due to local currency debt inflows and which, when unwound during a reversal, would lead to stress that could not be alleviated by central bank local currency liquidity support.

References

- Abdi, F., and A. Ranaldo (2012). "A Simple Estimation of Bid-Ask Spreads from Daily Close, High, and Low Prices," *The Review of Financial Studies*, Volume 30, Issue 12, December 2017, Pages 4437–4480.
- Aghion, P., P. Bacchetta, and A. Banerjee (2001). "Currency Crises and Monetary Policy in an Economy with Credit Constraints," *European Economic Review*, Vol. 45, Issue 7, 1121-1150.
- Amihud, Y. (2002). "Illiquidity and stock returns: Cross-section and time-series effects" *Journal of Financial Markets* 5:31–56.
- Barkbu, B. B., and L. L. Ong (2010). FX Swaps: Implications for Financial and Economic Stability. IMF Working Paper No. 10/55.
- BIS (2021). "Changing patterns of capital flows," Committee on the Global Financial System paper no. 66.
- Chang, R., & Velasco, A. (2001). "A Model of Financial Crises in Emerging Markets," *The Quarterly Journal of Economics*, Vol. 116(2), 489–517.
- Corwin, S. A., and P. Schultz (2012). "A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices," *The Journal of Finance*, Volume 67, Issue 2, pages 719-760, April 2012.
- International Monetary Fund, 2014. Staff Guidance Note on Macroprudential Policy, International Monetary Fund, Washington, D.C.
- _____. 2015a, Guidance Note for Surveillance under Article IV Consultations. International Monetary Fund, Washington, D.C.
- _____. 2015b, Balance Sheet Analysis in Fund Surveillance, International Monetary Fund, Washington, D.C.
- _____. 2017, "Increasing Resilience to Large and Volatile Capital Flows—The Role of Macroprudential Policies," IMF Policy Paper, International Monetary Fund, Washington, D.C.
- _____. 2018. "Romania: Financial Sector Assessment Program-Technical Note-Balance Sheet Analysis," Country Report No. 18/162, International Monetary Fund, Washington, D.C.
- _____. 2021a. "IMF Executive Board Concludes the 2021 Comprehensive Surveillance Review." Press Release No. 21/136., International Monetary Fund, Washington, D.C.
- _____. 2021b. "2021 Comprehensive Surveillance Review — Overview Paper" IMF Policy Paper No. 2021/027, International Monetary Fund, Washington, D.C.
- _____. 2021c. "2021 Comprehensive Surveillance Review— Modalities for Modernizing Surveillance." IMF Policy Paper No. 2021/028, International Monetary Fund, Washington, D.C.
- _____. 2021d. "2021 Comprehensive Surveillance Review— Background Paper on The Surveillance Priority Confronting Risks and Uncertainties." IMF Policy Paper No. 2021/029, International Monetary Fund, Washington, D.C.

- _____. 2021e. "2021 Comprehensive Surveillance Review— Background Paper on Systemic Risk and Macroprudential Policy Advice in Article IV Consultations." IMF Policy Paper No. 2021/033, International Monetary Fund, Washington, D.C.
- Olafsson, T., Vignisdottir, K., 2012. "Households' Position in the Financial Crisis in Iceland: Analysis Based on a Nationwide Household-Level Database" Working Paper No. 59, Department of Economics, Central Bank of Iceland.
- Oura, Hiroko (forthcoming). "Capital Flows and Systemwide FX-Liquidity Stress Tests," IMF Working Paper.
- Oura, Hiroko, and Mindaugas Leika (2020). "System-wide FX Liquidity Stress Test," Special Series on COVID-19, June 29.
- Ranciere, R., A. Vamvakidis, and A. Tornell (2010). "Currency Mismatch, Systemic Risk and Growth in Emerging Europe," *Economic Policy*, Vol. 25, 597-658.
- Ree, Jack Joo K., Kyoungsoo Yoon, and Hail Park (2012). "FX Funding Risks and Exchange Rate Volatility—Korea's Case," IMF Working Paper No. 12/268.
- Roll, Richard (1984). "A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market" *The Journal of Finance*, Volume 39, Issue 4, Pages 1127-1139, September 1984.
- Rosenberg, C. B. and M. Tirpák (2008). "Determinants of Foreign Currency Borrowing in the New Member States of the EU", IMF Working Paper No. 08/173.
- Vayanos, Dimitri, and Jiang Wang (2013). "Chapter 19 - Market Liquidity—Theory and Empirical Evidence" *Handbook of the Economics of Finance*, Volume 2, Part B, 2013, pages 1289-1361.