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Capital flows during the pandemic: lessons for a more resilient international financial architecture

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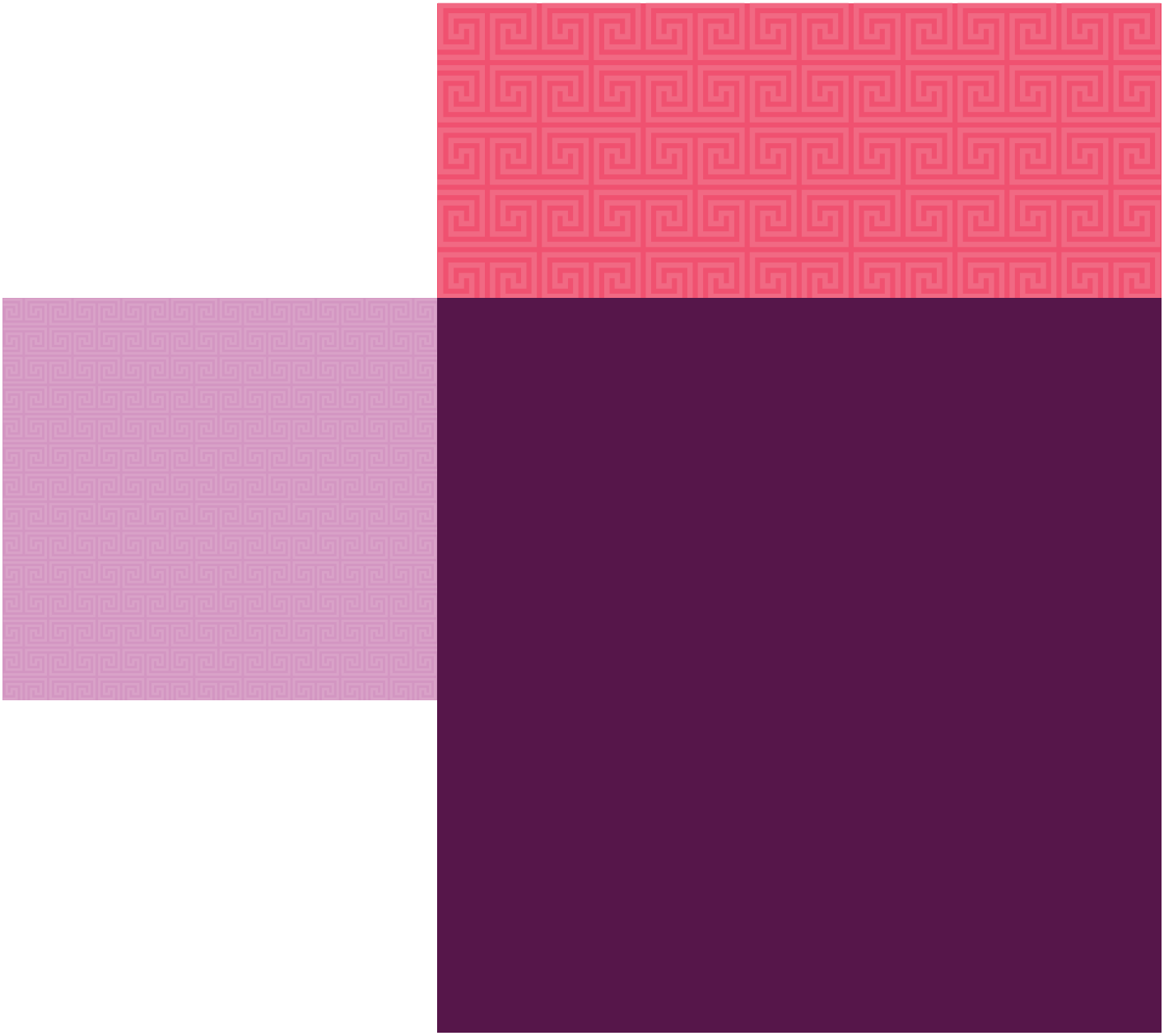

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Capital flows during the pandemic: lessons for a more resilient international financial architecture

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Executive summary

Cross-border capital flows to emerging market economies (EMEs) facilitate investment and help to foster economic development. However, they also mean that countries are more susceptible to external shocks. This paper explores how the sudden stop in capital flows associated with the Covid-19 pandemic unfolded, the substantial policy responses that were needed to alleviate it, and the lessons we might draw from this episode.

The spread of the Covid-19 virus was associated with a sharp deterioration in near-term growth prospects and an increase in economic uncertainty. The resulting pressures on capital flows were amplified by a marked tightening in financial conditions, including strains in US dollar funding markets. The growing importance of more volatile flows from non-bank financial intermediaries, and in particular investment funds, was a further contributory factor to the scale of the outflows seen.

The pressure on EME capital flows started to ease in May, but only after unprecedented policy interventions. Central banks in advanced economies (AEs) introduced a range of measures to provide liquidity in the face of market disruption. Without these actions, the sudden stop in capital flows faced by EMEs would have been even more severe. Nevertheless, the underlying vulnerabilities in the financial system remain. Furthermore, protracted central bank interventions could adversely affect the incentives of market participants, for example by encouraging excessive risk taking.

EMEs also deployed an extensive range of policy measures. Earlier efforts to enhance domestic policy frameworks allowed for a much broader response than in the past. Their expanded toolkit included asset purchases in some cases and macro-prudential measures. Moreover, interest rates were cut across most EMEs. Fiscal policy was also deployed widely, although to a more limited extent than in AEs.

The additional backstop provided by the global financial safety net (GFSN) is also important in responding effectively to systemic liquidity crises. The IMF, as the only truly global layer, is at the centre of the GFSN. However, simulations set out in this paper suggest that in severe and protracted scenarios the financing needs of EMEs could go beyond the IMF's current lending capacity, even after the other layers of the GFSN have been deployed.

The insights drawn from the analysis in this paper point to some potential areas where further work could be undertaken to enhance the policy response to capital flow pressures in the future:

Data gaps. Timely data on capital flows remains relatively scare, particularly for low-income countries. Moreover, there is relatively little information available on the composition of portfolio flows between different types of non-bank financial intermediaries. Greater granularity could improve the monitoring of risks arising from such flows. Further consideration of how to address these data gaps is warranted. More timely data on the measures capital-receiving countries take to manage surges of inflows and outflows (especially capital flow management and macroprudential measures) would also be highly useful.

The role of non-bank financial intermediation (NBFI). The rise of NBFI as a source of financing for EMEs increases the importance of ensuring that these flows are as resilient as possible. It is important that the Financial Stability Board's wider work on the role of NBFI during the period of market disruption earlier this year takes into account also their impact on cross-border capital flows to EMEs.

Lessons on the appropriate policy mix. Further study should be undertaken to learn about the effectiveness of different instruments and their interactions based on the experience during the Covid-19 pandemic. Those lessons should be an important consideration in the scheduled review of the IMF's Institutional View on capital flows, and

could usefully supplement the work recently undertaken by the IMF as part of its Integrated Policy Framework (IPF).

IMF resources. The recent experience highlights the need to keep the potential demands on IMF resources under close review.

Contents

Introduction

Cross-border capital flows play an important role in providing financing for emerging market economies (EMEs). They facilitate investment and help to foster economic development. However, they also leave countries vulnerable to external pressures, for example if changes in risk sentiment lead to capital outflows. The market disruption associated with the Covid-19 pandemic provided an extreme example of this, with many emerging markets experiencing a sudden stop in capital flows earlier this year. While financial conditions have since stabilized, and capital inflows have returned in many countries, emerging markets remain vulnerable to a renewed deterioration in market sentiment. This paper explores how the sudden stop in capital flows unfolded, the substantial policy responses that were needed to alleviate it, and the lessons we might draw from this episode.

The spread of the Covid-19 virus was associated with a sharp deterioration in near-term growth prospects and an increase in economic uncertainty for all countries. The resultant pressures on capital flows to emerging markets were amplified by a marked tightening in financial conditions. Risky asset prices fell and strains emerged in US dollar funding markets, as financial markets experienced a 'dash for cash'. This broader market turbulence was felt acutely by emerging markets, particularly those raising finance in US dollars, as funding costs spiked, and the resulting capital outflows were much larger than in the financial crisis.

An important factor in the scale of the outflows seen at the outset of the pandemic was the shift that had occurred over the previous decade in the composition of capital flows towards non-bank financial intermediaries, and in particular investment funds. These flows tend to be more volatile than other sources of finance, such as bank lending and FDI, and this continued to be the case in this latest episode. Investment funds accounted for around half of all portfolio outflows, despite only making up a third of the stock of portfolio liabilities. Liquidity mismatch in open-ended funds can generate incentives for investors to redeem ahead of others, and there were indications of such run dynamics during the turbulence in the spring.

The pressure on emerging market capital flows started to ease in May, but only after unprecedented policy interventions, by both advanced economies (AEs) and EMEs. In particular, central banks in AEs introduced a range of measures to provide liquidity in the face of market disruption, including in core markets such as those for US Treasuries. Central bank measures included large-scale asset purchases, enhanced liquidity facilities and broadening the availability of swap lines. The measures were successful in alleviating strains in US dollar funding markets, which in turn helped to stabilize emerging market capital flows. Without these actions, the sudden stop in capital flows faced by EMEs would have been even more severe. Nevertheless, the underlying vulnerabilities in the financial system remain, and protracted central bank interventions risk causing market distortions, including excessive risk taking

Emerging markets also deployed an extensive range of policy responses. Some measures, such as foreign exchange interventions and the easing of restrictions on capital inflows were targeted directly at stemming net capital outflows. By contrast, the use of capital flow management measures (CFMs) to restrict outflows has been limited so far.

Other policies helped to stabilize capital flows indirectly, by improving the economic prospects in EMEs. Fiscal policy was deployed widely to support the health response and mitigate the economic impact on households and businesses, although to a more limited extent than in AEs. Monetary policy was also loosened across EMEs, including the use of asset purchases for the first time by some countries. In addition, the development of macroprudential frameworks in EMEs over recent years provided additional tools to manage financial stability and macroeconomic risks. The steps taken by EMEs over time to enhance their domestic policy frameworks have allowed authorities to deploy a wider range of tools than had previously been possible without endangering their credibility. Strong domestic policy frameworks remain the first line of defence against capital flow volatility.

The additional backstop provided by the global financial safety net (GFSN) has also played a crucial role. Different layers of the GFSN have been utilized to help manage the liquidity strains faced by EMEs. Foreign exchange reserves and swap lines have been deployed, and the IMF has been prominent in its role at the centre of the GFSN, with resources being made available through emergency financing, precautionary and other facilities. Regional financing arrangements have not so far played a significant role.

However, the potential pressures on GFSN resources continue to increase as capital markets across the world become more integrated. IMF resources have not kept pace with the rise in external liabilities that has come with that increased integration. Simulations set out in this paper, using refined and innovative techniques, highlight that in protracted systemic crisis scenarios, GFSN resources could come under significant pressure. Indeed, in the most severe scenarios the financing needs of EMEs could go beyond the IMF's current lending capacity, even after the other layers of the GFSN have been deployed.

1 The Covid-19 sudden stop

1.1: What were the broad contours of the sudden stop?

1.1.1: Magnitude

EMEs experienced the largest monthly portfolio capital outflow on record in March.[1] This was led by a sharp increase in outflows of portfolio debt and equity (**Chart 1**). Outflows were larger for gross portfolio debt flows than they were for equity (**Chart 2**). Non-resident portfolio outflows were about 50% larger than those observed over an equivalent period during the global financial crisis (GFC), potentially reflecting the sudden nature and global synchronisation of the Covid-19 shock (**Chart 3**).

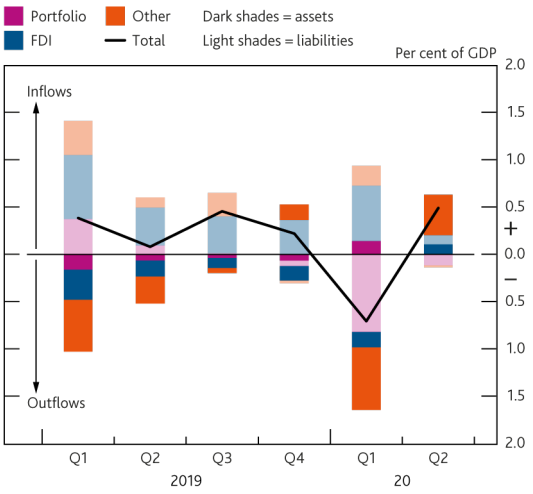
Outflows were large, even when factoring in the deterioration in financial market conditions. Using a framework that allows us to model the entire distribution of non-resident capital flows to EMEs as a function of prevailing (price-based) financial conditions that distinguish between push- and pull-type drivers of capital flows (Eguren Martin *et al* (2020) and Carney (2019)), we see that the magnitude of portfolio outflows observed in March, April and May (as a share of quarterly GDP) was a very low probability event, even when taking into account the deterioration in financial conditions observed during March (**Chart 4**). The probability of observing such large outflows was just 12%.

A key feature of the Covid-19 shock on capital outflows was its high degree of synchronisation across EMEs. More than 80% of the countries for which we have monthly estimates of non-resident portfolio flows reported outflows in March 2020. Although abrupt and highly synchronised, the worst phase of the outflow episode was relatively short lived and individual EMEs fared better than in many past (idiosyncratic) sudden stops. Gross outflows across portfolio and banking flows averaged 0.6% of GDP for a sample of 10 EMs. The average sudden stop between 1991 and 2014 according to this metric has been 1.4% of GDP (Eichengreen and Gupta (2016)).

1 Throughout the paper we will refer to 'emerging markets' (EMEs) but exclude capital flows in to and out of China (also typically regarded as an EME), as these have dynamics of their own.

Chart 1: Portfolio outflows dominated the sudden stop

Quarterly net financial flows into 10 NCEMEs

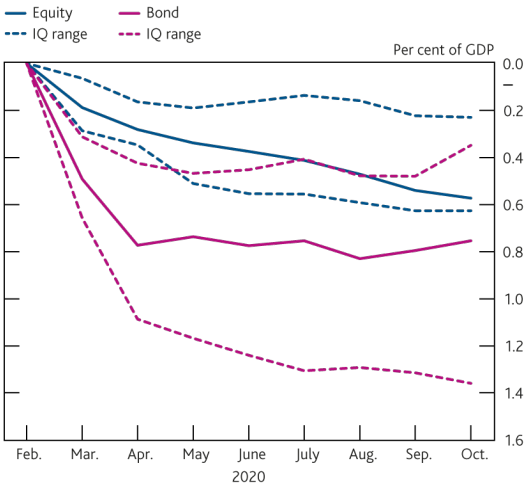


Notes: Average across 10 NCEMEs: Brazil, Mexico, India, Indonesia, Philippines, Thailand, Hungary, Poland, South Africa and Turkey.

Sources: IMF BOPS, IMF *WEO*, national sources and author calculations.

Chart 2: Outflows were larger for portfolio bonds flows compared to equity

Estimate of cumulative non-resident portfolio debt and equity flows into 10 NCEMEs

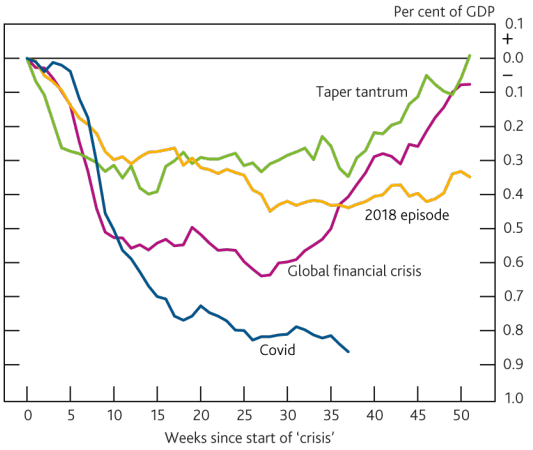


Notes: Non-resident bond and equity portfolio flows into 10 NCEMEs: Brazil, Mexico, India, Indonesia, Philippines, Thailand, Hungary, Poland, South Africa and Turkey. IQ range = interquartile range.

Sources: IIF, IMF *WEO* and author calculations.

Chart 3: Outflows were half as large again as in the GFC

Estimate of cumulative non-resident (gross) monthly portfolio flows into 10 NCEMEs

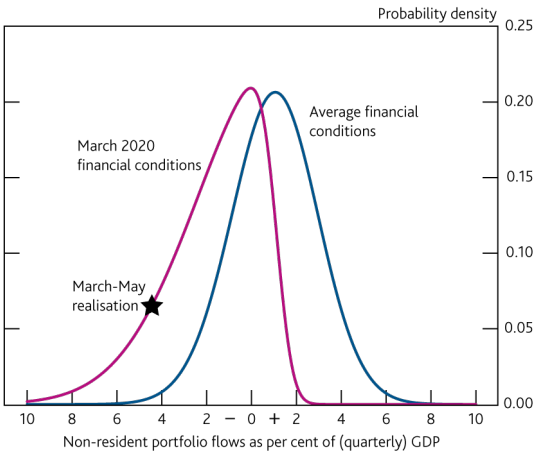


Notes: Non-resident portfolio flows into 10 NCEMEs: Brazil, Mexico, India, Indonesia, Philippines, Thailand, Hungary, Poland, South Africa and Turkey. 'Crisis' start dates: Global financial crisis 03/09/08, Taper tantrum 29/05/13, 2018 episode 18/04/18 and Covid-19 22/01/20.

Source: IIF, IMF *WEO* and authors' calculations.

Chart 4: It was rare to see outflows on this scale, even after accounting for the deterioration in financial conditions

Probability distribution of non-resident (gross) portfolio flows into EMEs as a function of prevailing financial conditions



Source: IIF and authors' calculations based on Eguren-Martin *et al* (2020). EMEs considered for estimation are: Brazil, Chile, Colombia, India, Indonesia, South Africa and Turkey, using monthly data between 2005 and 2020.

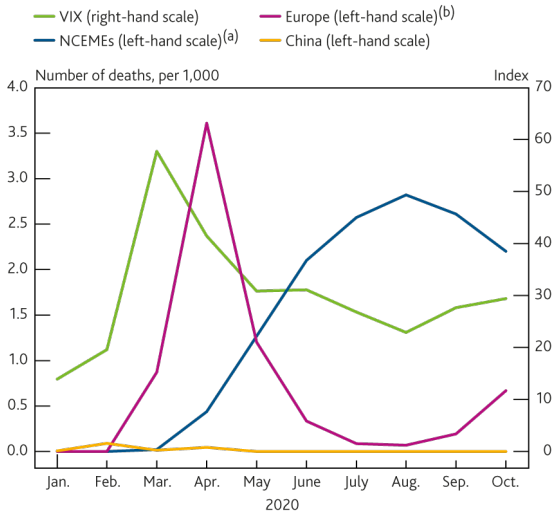
1.1.2: Timing

Non-resident portfolio outflows from EMEs coincided with a global deterioration in sentiment and an acceleration in the expansion of the pandemic in Europe (**Chart 5**). Outflows were underway well before the virus had reached EMEs in full force, as measured by local lockdown stringency indices or mortality rates (**Chart 6**).

Mutual fund-intermediated outflows accelerated during the 'dash for cash' period, and stabilised more rapidly than other non-resident portfolio flows did as that episode was calmed by large-scale central bank interventions in AEs (**Chart 7**). The speed and scale of mutual-fund intermediated outflows during this period, could have been an indication that many of these funds have redemption structures that encourage 'first mover advantage', incentivising investors to redeem ahead of others (Bank of England (2020) and Signorini (2018)).

Chart 5: Global risk aversion spiked as virus expansion accelerated in Europe

Covid-19 progression and global risk aversion

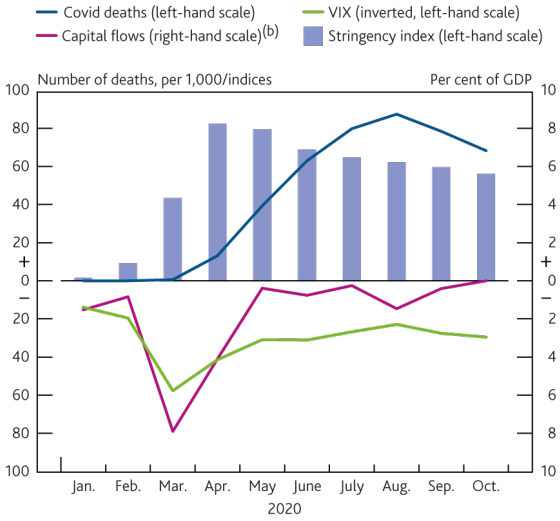


Sources: Bloomberg, IIF, The Oxford COVID-19 Government Response Tracker and author calculations.

(a) EMEs consists of Brazil, Hungary, India, Indonesia, Mexico, Philippines, Poland, South Africa, Thailand and Turkey.
(b) Europe consists of UK, Germany, France, Italy and Spain.

Chart 6: Capital outflows from EMEs coincided with a global deterioration in sentiment, and preceded local cases

Capital outflows and Covid-19 impact on 10 NCEMEs



Notes: 10 NCEMEs consists of Brazil, Hungary, India, Indonesia, Mexico, Philippines, Poland, South Africa, Thailand and Turkey. Capital flows refer to non-resident portfolio flows.

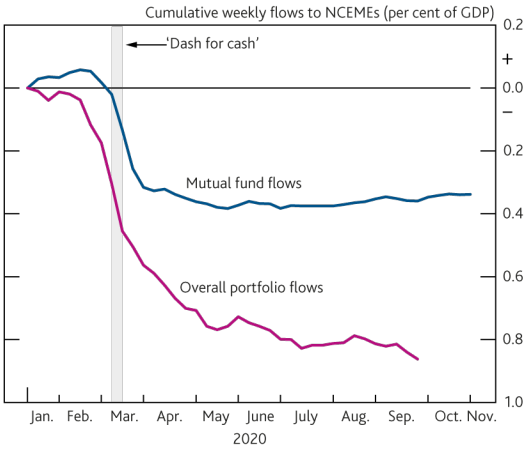
Sources: Bloomberg, IIF, The Oxford COVID-19 Government Response Tracker and author calculations.

1.1.3: Geographical impact

Non-resident portfolio outflows at the height of tensions were large across all of the EMEs we have monthly data for, and particularly large for Brazil, South Africa, Turkey, Poland and Thailand (**Chart 8**)**.** Outflows appear to be uncorrelated with the severity of the pandemic's spread locally, or the stringency of the lockdown measures adopted.

Chart 7: Mutual fund-intermediated outflows were closely correlated with the 'dash for cash'

Non-resident aggregate and mutual fund-intermediated portfolio flows to 10 NCEMEs

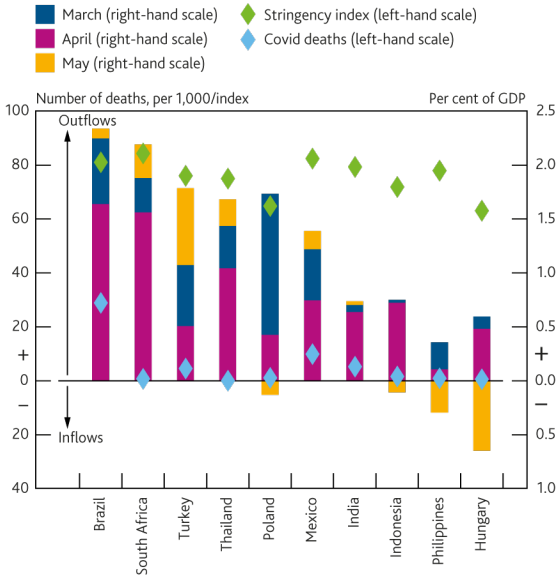


Notes: 10 NCEMEs consists of Brazil, Hungary, India, Indonesia, Mexico, Philippines, Poland, South Africa, Thailand and Turkey. The 'dash for cash' occurred around the period 9–18 March, although exact dates are asset specific.

Sources: IIF (portfolio flows), EPFR Global (mutual fund flows) and author calculations.

Chart 8: Portfolio outflows were large across EMs, but there was some heterogeneity

Non-resident portfolio flows over March-May 2020, by country



Sources: IIF, IMF *WEO*, The Oxford COVID-19 Government Response Tracker and author calculations.

1.2: What drove the sudden stop?

The global outbreak of the pandemic led to a sharp deterioration in the global economic outlook, which gave rise to unprecedented outflows of portfolio debt and equity by non-residents from EMEs, as risk aversion and liquidity hoarding spiked among lenders and intermediaries globally.

During January and February there was a 'flight to safety', in which fears around the Covid-19 virus spreading from China caused a rush for AE government bonds. Then in March, the flight to safety turned into an abrupt and extreme 'dash for cash', with some risky assets becoming difficult to sell and markets in these assets becoming thin. Even safe, usually highly liquid assets, such as advanced economy government bonds, came under selling pressure (**Chart 9**), as demand switched abruptly to cash and near-cash assets (Schrimpf *et al* (2020)).

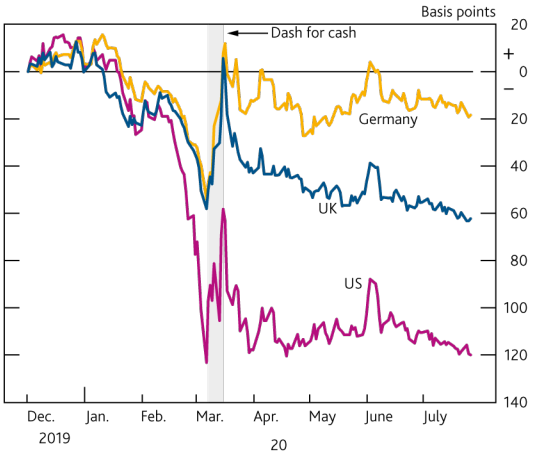
The spike in demand for liquidity was accompanied by a sharp decline in the ability and willingness of some intermediaries to supply it, including ones important for supporting EMEs' access to funding, particularly US dollar funding. EMEs saw their dollar funding costs spike higher, including in FX swap markets, as the major international banks that make markets in FX swaps, themselves saw their funding costs shoot up in the repo markets that US money market funds (MMFs) provide funding to.

There was a negative feedback loop between depreciating EME exchange rates, and foreign investors selling EME local currency debt. Depreciations led to capital losses for these foreign investors, causing them to try and reduce these losses by selling their EME assets, and repatriating the proceeds, causing further pressure on EME exchange rates (Hofmann *et al* (2020)).

Market function recovered following large and unprecedented central bank action, and the flow of capital to EMEs resumed. AE central banks took action through monetary easing, liquidity facility provision, and enhanced US dollar liquidity arrangements (**Chart 10**). Without these actions, it is likely that the liquidity stress would have been even more severe, and the sudden stop EMEs experienced, more pronounced and persistent.

Chart 9: In the dash for cash even AE government bonds came under selling pressure

Year-to-date changes in 10-year nominal yields

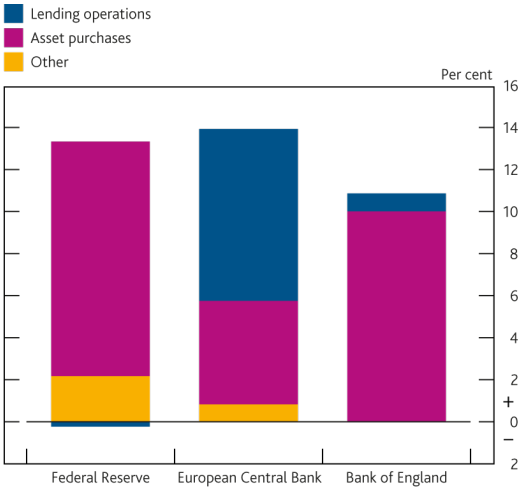


Sources: Bloomberg Finance L.P, and author calculations.

Notes: The 'dash for cash' occurred around the period 9–18 March, although exact dates are asset specific.

Chart 10: AE central banks responded to the Covid-19 shock with large increases in lending and asset purchases

Changes since the end of February 2020 in central banks' balance sheets as a proportion of 2019 nominal GDP in their home jurisdictions



Notes: Bank of England lending operations shown here: Indexed long-term repo, Contingent term repo facility, US dollar repo operations, Liquidity Facility in Euros, Term Funding Scheme and Term Funding Scheme with additional incentives for SMEs. Bank of England asset purchases shown here: Asset Purchase Facility and Covid Corporate Financing Facility. ECB lending operations: Lending to euro-area credit institutions related to monetary policy operations denominated in euro. ECB asset purchases: Securities held for monetary policy purposes. Federal Reserve lending operations: Repurchase agreements, Loans and Net portfolio holdings of TALF II LLC (less TALF II LLC Treasury contributions and other assets). Federal Reserve asset purchases: Securities held outright. .

Sources: Bank of England, ONS, ECB, Eurostat, Federal Reserve Board, Bureau of Economic Analysis and author calculations.

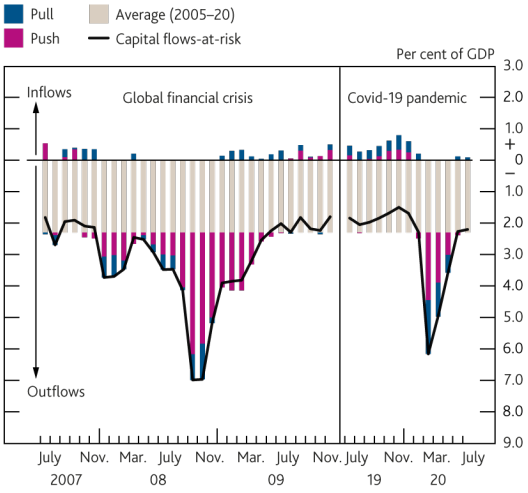
These issues at the core of the global financial system in response to the expansion of Covid-19 were a primary driving force behind the sudden stop EMEs experienced, with local factors playing a smaller role. Using an approach that allows for a time-series decomposition of the drivers underlying shifts in the left tail of the distribution of non-resident portfolio flows to EMEs (Eguren-Martin *et al* (2020)), we find that 'push factors' — factors that drive risk appetite and financial conditions at the global level — dominated the contribution to outflows (**Chart 11**), also in line with the timing of these outflows discussed above. This mirrored dynamics seen in the GFC.

How flows were intermediated also seems to have played an important potential amplifying role. For flows intermediated by corporate bond funds, it was those funds that held (i) less liquid assets and (ii) greater commonality of holdings with other funds, which suffered the biggest outflows (Falato *et al* (2020)). This is in line with previous analysis showing that mutual fund flows are particularly prone to large outflows when global financial conditions tighten, constituting a key 'pipe' in the global financial plumbing, amplifying push and pull-type shocks (Carney (2019)) (**Chart 12**).

The GFSN, meanwhile, has so far proved adequate, preventing the sudden stop from triggering a broad based solvency crisis among EMEs. However, the IMF's resources only represent around 1% of global gross external liabilities and have been on a downward trend from 2.5% in 1980. We estimate that the extra reserves that EMEs have accumulated over the past two decades have reduced the sensitivity of extreme movements of capital flows to push factors by almost 50%. But this extra insurance has global externalities: accumulating safe assets distorts yields, building global imbalances and increasing the risks of a global liquidity trap.

Chart 11: Push factors led the sudden stop during Covid-19

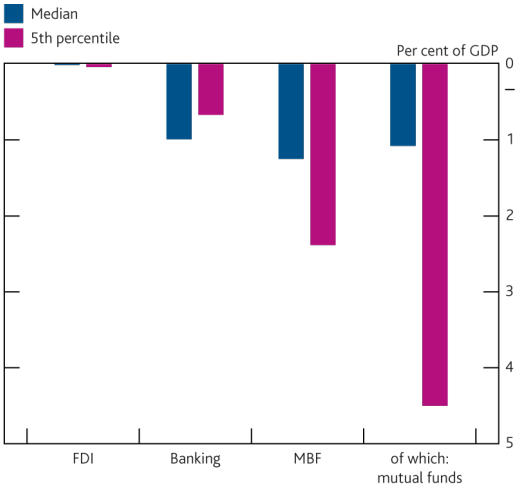
Size of potential capital flow tail event over time and underlying drivers



Sources: IIF and author calculations based on Eguren-Martin *et al* (2020).

Chart 12: Mutual fund-intermediated flows are particularly prone to sudden stops

Size of capital flow tail events for different flow types in the face of a tightening in global financial conditions



Source: Carney (2019). Chart shows the sensitivity of different capital flows to a negative 'push' shock. Coefficients are standardised by each component's share of total flows eg the pink MBF bar shows how total Capital Flows-at-Risk would respond to a one standard deviation tightening in global financial conditions if all capital flows were accounted for by MBF.

1.3: What role did non-bank financial intermediation play in the sudden stop?

The Covid-19 crisis was the first real test of the financial regulatory reforms that were introduced in response to the Global Financial Crisis (GFC), a decade before. Those reforms centred on the banking sector, raising capital and liquidity buffers, and strengthening the globally and domestically systemic banks that provide the key connections in the financial system and with financial markets. As a result, banks entered the Covid-19 crisis with significantly stronger balance sheets than they had in 2008–09. This has allowed them to continue to provide credit to, and support, the real economy, as opposed to weakening it, as happened in the GFC (IMF (2020a)).

Non-bank financial institutions entered the crisis with known and elevated vulnerabilities, and played an important role in the financial turmoil in AEs in March, and appear to have played an important role in transmitting and amplifying those stressed conditions to EMEs (Box 1). Non-banks tried to raise cash to meet margin calls on derivative positions, leveraged investors withdrew from government bond markets, and dealers stepped back from repo markets. Selling pressure in bond markets became acute. Investors seeking liquidity were forced to sell assets and make redemptions from money market funds. Open-ended funds also experienced redemptions. These strains in non-bank financial institutions contributed to a sharp reversal in capital flows to EMEs.

Outflows of portfolio capital, which non-bank financial firms (as opposed to banks) intermediate the majority of (around two thirds), were larger in scale than in either the global financial crisis or the 2013 'taper tantrum'. Different types of non-bank financial investor — including pension funds, hedge funds, mutual funds, insurance companies and sovereign wealth funds — could have been responsible for these portfolio outflows, due to different behaviour in terms of redemptions, but there is little information available to identify their individual contributions.

Separate figures for outflows by mutual funds are available though. Although these funds held less than a third of the stock of emerging market portfolio liabilities going into the sudden stop, they accounted for around a half of the cumulative outflows by the end of April. That is, they were disproportionately large sellers of emerging market debt and equity. This echoes the procyclical dynamics of mutual funds witnessed during the global financial crisis in EMEs (Papaioannou *et al* (2013)). Most mutual funds are open ended (accounting for around two thirds of the US$49 trillion of assets that global investment funds have under management), meaning they operate with a liquidity mismatch, having illiquid assets on the one hand, and promising short term (often daily) redemptions to end investors on the other. This drives the procyclicality. Because emerging market (and high-yield corporate bond)

open-ended funds tend to hold assets that are particularly hard to sell during periods of stress, liquidity mismatches tend to be larger for them than for other open-ended funds (IMF (2015)).

The structural vulnerabilities in non-bank financial intermediaries, which were confirmed by, and contributed to, the severity of the Covid-19 sudden stop, raise important questions for policymakers. Central banks in advanced and emerging economies conducted large scale asset purchases, increased liquidity operations, put in place backstop facilities designed to provide targeted liquidity to specific financial entities such as MMFs and primary dealers. These measures were unprecedented and effectively backstopped financial markets. They alleviated strains in core markets and knock on effects on the real economy that was already under strain, and helped stabilise capital outflows from EMEs.

These actions, while stabilising, raise important moral hazard issues. Markets might fail to internalise their own liquidity risk in future if they anticipate a repeat of these central bank interventions in periods of stress. That these interventions were necessary, suggests there is a need to review the resilience of markets and non-bank financial intermediaries under stress.

Left unattended, these structural vulnerabilities will likely rise in importance for EMEs given the growing share market-based finance is taking in their external liabilities. On current trends, market-based finance could account for half of EMEs' external liabilities by 2030, up from around a third today. Meanwhile, external liabilities overall for these countries could double as a share of GDP.

The Financial Stability Board (FSB) has recognised the need to look at these issues, and undertake a review of what happened in March and the implications of it (FSB (2020)). At the time this paper was being drafted, the FSB's work programme included the development of policy proposals to enhance MMF resilience and an examination of liquidity risk and its management in open-ended funds and its transmission to the broader financial system. There is the need to better understand the aggregated impact funds' individual actions might have had on the market. The work is still at an early stage and is currently focusing on the analysis of the availability and functioning of liquidity management tools, including in the context of severe outflows from high yield corporate debt and EME funds, and on assessing leverage trends within the asset management industry. If issues are found which need further policy consideration options might include measures to better align redemption terms, pricing and the underlying liquidity of assets, where there are a wide and diverse range of proposals that have been suggested including adjustments to swing pricing or to suspension practices, and more structural measures to ensure that funds investing in illiquid assets beyond a certain share of their portfolios should not operate as daily-dealing open-ended funds (Signorini (2019)). A natural next step for the FSB's review of what happened in March, would be for the G20 to reflect on the outcome of the analyses co-ordinated by the FSB, in collaboration with standard setting bodies such as IOSCO, CPMI and BCBS and International organizations such as IMF and BIS to identify the most pressing issues and where appropriate follow that with policy considerations.

Assessing and addressing data gaps should play a key part in any collective action on responding to the vulnerabilities that have been exposed. For some areas of concern, such as mutual funds, data on cross-border flows is relatively rich and timely. Proprietary data on mutual fund flows actually provided some of the most timely indications of scale and incidence of the sudden stop. Other areas of non-bank financial intermediation were largely hidden from view and measurement (including hedge funds, sovereign wealth funds and insurance companies). Data issues also hinder an understanding of US dollar funding as a transmission channel. BIS statistics provide some information on foreign exchange derivatives transactions, but not on the direction of exposures. As a result, it is difficult to assess the role of hedging versus speculation, for instance in FX swaps, and who is doing which of these activities.

Box 1
Key non-bank financial intermediaries and their role in the sudden stop

Some of the properties of non-bank financial intermediation that contributed to the abrupt 'dash for cash' in AEs in March (Bank of England (2020)), appear to have also played a part in worsening the sudden stop in flows of private external financing to EMEs. This box outlines some of these connections and amplification channels.

Prime money market funds (MMFs) in the US saw large and abrupt outflows, which in turn disrupted short term funding markets globally, in particular the markets for US dollars that many EMEs rely on. Outflows from prime MMFs disrupted an important source of US dollar funding for major non-US banks in the markets for commercial paper (CP) and certificates of deposit (CDs) that these banks issue, and that MMFs buy and hold. As these large non-US banks saw their funding conditions tighten, they in turn reduced their on-lending of dollars to other non-US banks, including emerging market ones, through the FX swap market, or for longer term lending, via cross-currency swaps (**Chart A**).

Leveraged non-bank investors, predominantly hedge funds, rushed to unwind large bond and futures positions in the US Treasuries market (Barth and Kahn (2020)). This contributed to the 'dash for cash' that spread across the global financial system. Leverage also appears to have played a more direct role in the sudden stop, with hedge funds withdrawing more aggressively than other funds did from EMEs (Bianchi *et al* (2020)).

Margin calls propagated market stress, including via the FX swaps market, which is an important source of short term funding of dollars for non-US institutional investors who invest in emerging market assets (insurers, pension funds and other portfolio asset managers). These non-US institutional investors who hedged their dollar risk in the FX swaps market, faced margin calls as FX bases widened. These margin calls had to be paid in dollars, which were funded by selling assets, including emerging market assets. This in turn increased the already high demand for dollars, putting further pressure on the basis.[2] This negative feedback loop was amplified for EMEs by two factors: (i) the depreciation of their currencies against the dollar, which caused a further need to post dollar margin, prompting the selling of dollar assets to fund those margin payments, in particular of US Treasuries; and (ii) the large outstanding stock of dollar debt securities these countries' banks, corporations and sovereigns had issued over the previous decade, making them particularly prone to the difficulties in borrowing, funding and hedging in dollars. Market-based finance, largely through the issuance of debt securities, has accounted for all the increase in EMEs' foreign borrowing during the ten preceding years.

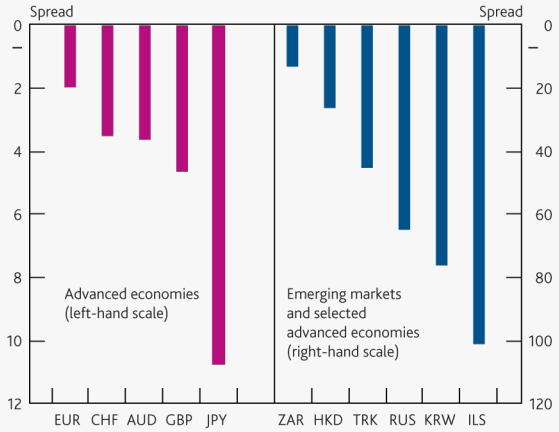
Open-ended funds behaved more procyclically than other investors. Globally, open-ended funds experienced large outflows during March. Emerging market and advanced economy bond funds saw greater outflows despite experiencing lower negative returns on average than equity funds (**Chart B**). Emerging market bond funds saw outflows of around US$48 billion; compared with outflows of US$11 billion from US dollar high-yield bond funds; and US$9 billion global equity large cap fund outflows. This procyclicality was amplified by exchange rate movements. As EME currencies depreciated, the AE funds that had invested heavily in local currency emerging market bond markets over the past decade, faced amplified losses. Because they typically measure their returns in terms of dollars, then as local currencies depreciated, they were prompted to sell even more of their assets (Hofmann *et al* (2020)), exacerbating the sudden stop.

Benchmark-driven open ended funds, whose portfolio allocations across countries are guided by the weights each country has in a benchmark index, seem to have also played a role in driving the record capital outflows from EMEs (Arslanalp *et al* (2020)). Raddatz *et al* (2017) find that 70% of country allocations of investment funds are influenced by benchmark indices. Because these funds invest in EMEs as a group, and focus on issues that affect them as a group, their investments tend to be more sensitive to common factors and as a result, more procyclical. Previous crises have shown that open-ended funds are prone to procyclical herd behaviour, withdrawing capital from EMEs more than closed-end funds (Raddatz and Schmukler (2012) and Borensztein and Gelos (2003)). This herd behaviour has been shown to be particularly sensitive to external 'push' factors that determine global risk appetite and financial conditions, especially in crisis or near-crisis conditions (Carney (2019) and Cerutti *et al* (2015)).

2 Different margining practices apply for cleared and uncleared derivatives, including what approaches are used to mitigate procyclicality in initial margin requirements.

Chart A: US dollar funding costs for some EMEs were particularly high

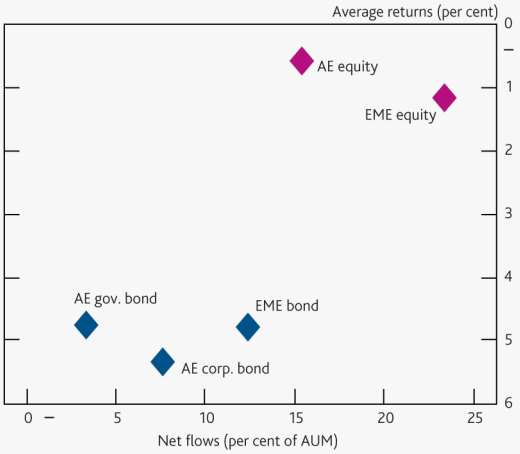
Cross currency swap basis against the US dollar (basis points)



Sources: Bloomberg and authors' calculations.

Chart B: Flows from bond funds were more sensitive to negative returns

Open ended flows and average returns in March 2020



Notes: Funds must have at least 30% of their portfolio invested in the asset class (equity, bond, corporate bond or government bond) and region (advanced economies (AE) or emerging market economies (EME)) to be considered as part of each category.

Sources: Morningstar and authors' calculations.

2 Policy responses during the pandemic

Against the backdrop of large non-resident portfolio outflows, tighter financial conditions, and volatile exchange rates, policy makers in EMEs have responded with a wide range of instruments to mitigate the impact of the Covid-19 shock on the real economy and financial sector. The response has included fiscal policy, FX interventions, monetary policy, macroprudential measures (MPMs), and capital flow management measures (CFMs). Some of these instruments, such as CFMs, have been deployed to dampen capital outflows; others, such as fiscal policy, for different purposes, though they may also affect capital flows indirectly (for example, fiscal policy contributes to restoring confidence and to mitigating the impact of external shocks). A wide set of countries have also benefitted from the implementation of measures taken at the global level, such as the swap lines provided by major central banks and the emergency financing provided by the IMF (Section 3). In particular, the Federal Reserve's bilateral swap agreements and opening of a repo facility dedicated to foreign and international monetary authorities have helped to address US dollar funding pressures and to ease global financial conditions. IMF emergency financing has also helped cushion the impact of the current crisis.

This section describes the policy response in EMEs during the pandemic. Specifically, we focus on actions taken to deal with the sudden stop in capital flows documented in Section 1. We compare these policy responses with those adopted during the GFC. Finally, we provide an assessment of the adequacy of the policy response, factoring in the prescriptions of the IMF Institutional View on capital flows and its recently established Integrated Policy Framework.

Our sample covers 23 EMEs, representing about 50% of world GDP measured at PPP (34% of world GDP measured in current US dollars) and about 10% of world external liabilities. This sample does not include LICs, which are covered in the annex to this paper.[3]

2.1: Fiscal policy

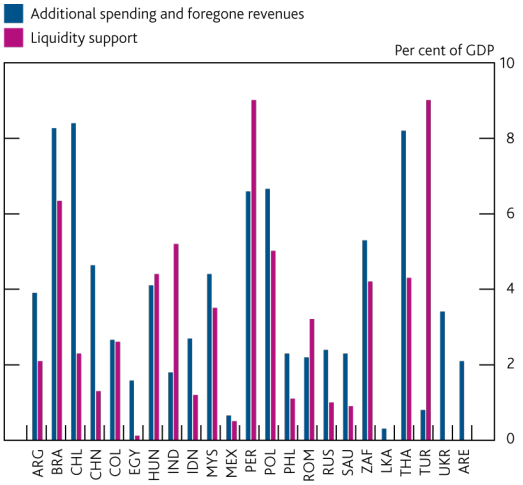
During the pandemic, the role of fiscal policy has been threefold. First, fiscal resources have been used to deal with the health emergency. Second, it has transferred resources to firms and households facing borrowing constraints, in order to cushion the effect of containment measures and to prevent negative effects on long-term growth (Alberola *et al* (2020)). Third, governments have provided loans, equity, and credit guarantees to prevent bankruptcies and avoid large disruptions in credit markets. These fiscal measures may have an impact on the balance of payments though several channels, notably by supporting economic activity and affecting foreign investors' expectations.

In our sample of EMEs the fiscal-policy response to the pandemic has been smaller compared with fiscal packages in AEs. The mean fiscal response to the pandemic (including additional spending and foregone revenues) has been 3.7% of GDP in our EME sample (**Chart 13**), less than half the average size of the fiscal response in the main AEs. Higher financing costs (5.6% on average for 10 year government bond yields at the end of January, vs 0.5% for AEs) have compressed fiscal room for EMEs. The size of fiscal packages has been on average smaller in countries that before the outbreak of the pandemic had higher CDS yields (**Chart 14**). In commodity exporting countries, fiscal space has also been limited by the fall in commodity prices. In many EMEs authorities have also provided liquidity support, mainly through guarantees. The size of these measures has been on average 3.4% of GDP, far less than liquidity support in main AEs (11.4%).

3 The analysis is based on several sources including Covid-19 trackers compiled by the IMF, the OECD and the Yale School of Management, the IMF Fiscal Monitor, and the International Financial Statistics. We complement these data with information taken from reports by the Institute of International Finance, BIS bulletins, and the website of national central banks. The time horizon spans from February to the end of September, whenever possible. We have verified that these data sources are mutually consistent. Our sample is the set of countries covered by the Yale dataset. This source has the most extensive information available on macroprudential instruments.

Chart 13: EMEs provided fiscal stimulus

Fiscal stimulus during the pandemic

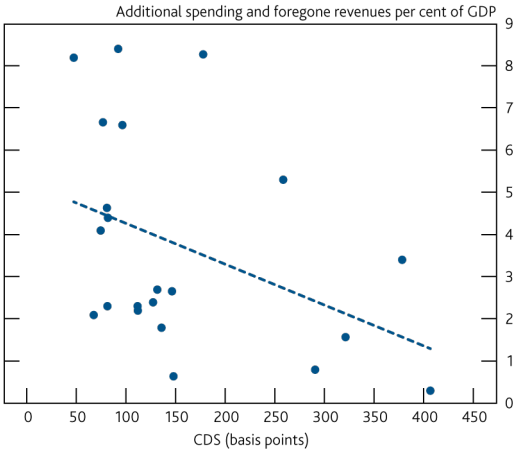


Notes: Fiscal stimulus is the sum of additional spending and foregone revenuers in per cent of GDP. Liquidity support includes equity, loans, and guarantees provided by the public sector.

Source: IMF Fiscal Monitor.

Chart 14: Fiscal stimulus was larger in countries with higher fiscal space

Fiscal stimulus during the pandemic vs CDS rates



Notes: Fiscal stimulus is the sum of additional spending and foregone revenuers in per cent of GDP. Credit default swaps refer to 31 January 2020.

Sources: Fiscal Monitor and Refinitiv.

2.2: Monetary policy

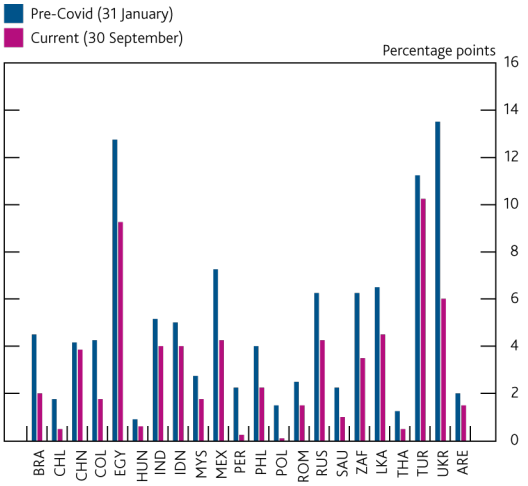
Monetary authorities face a trade-off during a sudden stop: on the one hand, the central bank may be tempted to raise the policy rate in order to attract capital flows; on the other hand, the central bank may be forced to lower the reference rate to mitigate the fall in real activity and employment. In past crises, EMEs often tightened monetary policy when faced with a sudden stop (Mühleisen *et al* (2020) and Vegh and Vuletine (2013)). Nevertheless, Eichengreen and Gupta (2016) show that the tendency to tighten monetary policy in such circumstances has been less common in more recent years, indicating that EMEs are now increasingly able to use monetary policy countercyclically.

During the current crisis, EMEs' monetary policy responses have been more in line with AEs'. All countries in our sample have cut the policy rate in order to stabilize macroeconomic activity (**Chart 15**). Almost all countries have intervened at least twice, with the majority of interest rate cuts occurring in March. There was only one case of a policy rate tightening (Turkey in September). Countries with greater monetary policy space (higher initial rates) were able to ease by more (**Chart 16**). The fact that inflation expectations have decreased on average since the outbreak of the pandemic has reinforced the case for cutting interest rates (**Chart 17**).

On average, the size of policy-rate cuts has been comparable to that observed during the GFC (**Chart 18**), but the timing of the response has been somewhat different. During the current crisis most interventions occurred in the early stage of the pandemic (in March). During the GFC, most policy cuts occurred only in 2009, with some countries tightening the monetary policy stance in the early stages after Lehman: in September 2008, cyclical conditions kept central banks from cutting rates immediately, as most EMEs had a positive output gap and faced inflation pressures (Aguilar and Cantù (2020)). On the eve of the pandemic, in most EMEs economic growth was subdued and inflation under control; moreover, following the actions taken in March by major AEs central banks, global financial conditions improved and the US dollar depreciated, giving EMEs greater room to cut interest rates.

Chart 15: EMEs cut the policy rate

Policy rates pre and during the pandemic

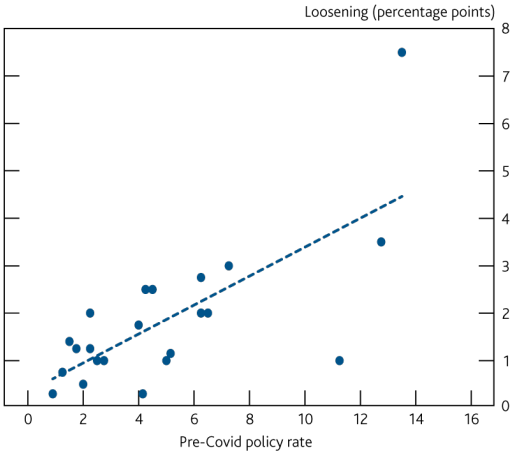


Notes: Rates are in percentage points. We do not report Argentina, which is an outlier: Argentina cuts the policy rate by 12 percentage points overall.

Source: National central banks websites.

Chart 16: Monetary stimulus was larger in countries with higher pre-Covid-19 policy rates

Interest rate cut vs pre-Covid-19 policy rate

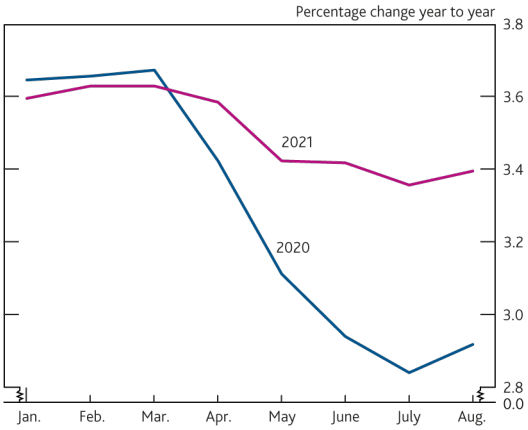


Notes: Rates are in percentage points.

Source: National central banks websites.

Chart 17: Inflation expectations decreased

Inflation expectations for 2020 and 2021

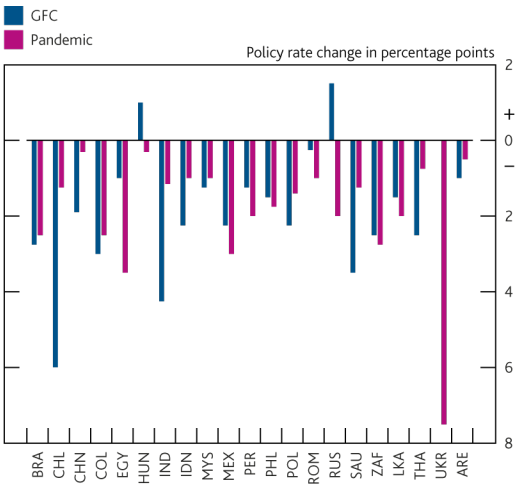


Notes: CPI Inflation expectations for 2020 and 2021 (calendar-year), percentage change year to year, average across countries. Months in the X-axis refer to 2020.

Source: Consensus Forecasts.

Chart 18: The policy rate cut during GFC and pandemic was similar

Policy rate change during the GFC and the pandemic



Notes: the GFC change in the policy rate is the difference between the policy rate on 31 August 2008 and the policy rate on 30 April 2009.

Source: National central banks websites.

During the Covid-19 crisis, some EMEs' central banks started to purchase local-currency bonds to offset foreign investors' sales. The main goals of these programmes have been to avoid the disruption of domestic bond markets and to signal to investors that central banks were ready to provide liquidity, operating as dealer and buyer of last resort (Arslan *et al* (2020) and IMF (2020b)). For some EMEs close to the zero-lower bound (eg Chile and Hungary) these programs contributed to providing monetary stimulus. In addition, in order to repair transmission channels, most EMEs' central banks have adopted other unconventional tools, eg reducing collateral requirements and increasing the duration of repo operations. Some central banks have also adopted measures to support corporate bond markets. Preliminary evidence suggests that the asset purchase programmes were indeed effective in reducing long-term yields (Arslan *et al* (2020) and Hartley and Rebucci (2020)). According to the IMF and the BIS, EMEs local currency markets also indirectly benefited from the measures undertaken by the major central banks and by the IMF.

2.3: Exchange rate policies and FX interventions

The exchange rate pressures experienced by EMEs in the current crisis were generalized but relatively short-lived. As global financial conditions tightened, most EMEs experienced massive portfolio outflows and strong FX pressures, starting around the end of February. Currency depreciation exacerbated strains in domestic markets, by increasing the returns demanded by external investors on local currency bonds (Hofmann (2020)). The currencies of countries in our sample (excluding those pegged to the US dollar) depreciated by 10% on average against the dollar (**Chart 19**). By the end of March, the policy actions taken by AEs after the outbreak of the pandemic, including the introduction of swap agreements by major central banks, had contributed to improve global financial conditions; since May, as investor risk appetite returned, EMEs have benefited from the recovery of capital inflows and lower tensions on FX markets.

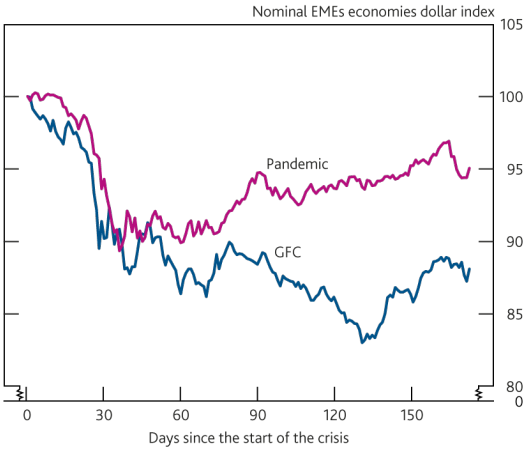
However, international investors seem to have differentiated among currencies. In the countries that faced economic and financial challenges even before the crisis (eg Argentina, Turkey, and Brazil), currencies were still under pressure at the end of September, while in those with better fundamentals (eg China), the currencies partly recovered, also as a result of the weakening of the US dollar after the peak reached in March. Compared with the GFC, during the Covid-19 crisis the extent of the depreciation of EMEs currencies was on average less intense and more concentrated in the early phase (**Chart 19**). In most countries the fact that currency pressures were milder allowed central banks to keep an accommodative monetary stance.

EME central banks intervened heavily in FX markets in the early stages of the Covid-19 crisis, to stem currency depreciation. In aggregate terms, the size of FX interventions peaked in March; after that they slowed, and some countries even managed to resume reserve accumulation. Compared with the GFC, during the Covid-19 crisis, countries have used FX reserve buffers more sparingly (Mühleisen *et al* (2020)): the cumulative decrease of FX reserves (a proxy of FX interventions) has been on average 1% of GDP, much smaller than during the six months following the Lehman crisis (3.1%). However, in some cases (eg Turkey and Egypt) the size of FXI was significant; note that in the eve of the Covid-19 crisis, FX reserves buffers were already below the level considered adequate by the IMF for several countries, implying limited space for further interventions (**Chart 20**).

Overall, compared with the GFC, the lower use of international reserves during the Covid-19 crisis may be ascribed to three main factors: i) the improvement of global financial conditions and the easing of strains in FX markets observed since April reduced the need for FX interventions; this improvement occurred earlier than during the GFC; ii) some central banks may have allowed exchange rates to depreciate (Mühleisen *et al* (2020) and Aguilar and Cantú (2020)); in addition, iii) the macroprudential policy measures (MPMs) that had been introduced by several EMEs since the GFC were at least partly successful in containing currency mismatches, and thereby reduced the need for FX interventions and allowed central banks to focus more on stabilizing the economy.

Chart 19: Currencies depreciated in the early stage of the crisis

Currency depreciation during Pandemic and GFC

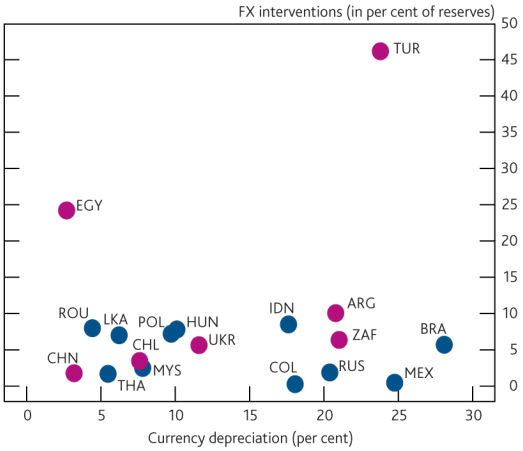


Notes: Nominal EMEs Economies Dollar Index (inverted from original source). Indexes normalized at the start of the crises (end-August for the GFC; end-January for the pandemic).

Source: Federal Reserve.

Chart 20: FX intervention was not large in most EMEs

FX intervention vs currency depreciation



Notes: The X-axis denotes the peak of currency depreciation recorded between the end of January and the end of September 2020. The Y-axis indicates the variation between the amount of FX reserves at the end of January and the minimum value reported in the following months, in per cent of available reserves. Pink dots denote countries having an amount of FX reserves at the end of 2019 below the level considered adequate, according to the IMF ARA methodology.

Sources: IMF International Financial Statistics and datastream.

2.4: Macroprudential policy and capital flows management measures

Although macroprudential policy includes several tools, in this section we focus on capital and liquidity requirements,[4] including microprudential measures—in line with the IMF's approach (IMF (2014)). Most of these tools do not have direct effects on capital flows. However, they may still have indirect effects. For example, some MPMs may have indirect effects on capital flows by affecting credit supply and the funding strategies of domestic banks, particularly for economies with high external debt and an elevated share of FX liabilities. *Ex ante*, MPMs can help contain domestic banks' exposure to financial risks such as those that materialized in the early phase of the pandemic, when international investors scaled down their exposures to EMEs. Ex-post, the easing of MPMs can help absorb the shocks. MPMs may also contribute to reduce the sensitivity of capital flows to global factors and reduce the likelihood of sudden stops (Eguren Martin *et al* (2020)). Most countries in our sample eased MPMs, mainly by relaxing capital and liquidity buffers countercyclically, in order to support credit and preserve the viability of domestic banks. As noted by Restoy (2020), during the current crisis for the first time EMEs have resorted to MPMs to stabilize the economy.

Some financial regulation tools, such as capital flow management measures (CFMs) may also have direct effects on capital flows. Specifically, CFMs may reduce the total volume of capital flows (Nispi Landi and Schiavone (2020)), and they can affect their composition (Ostry *et al* (2012)). CFMs include both currency-based measures[5] (CBMs), which discriminate financial transactions denominated in foreign currency, and residency-based measures (RBM), which entail restrictions on capital flows on the basis of investors' residency. During the current crisis several countries relaxed CFMs, mostly to reduce banks' FX needs stemming from prudential requirements, and in some cases to increase liquidity in domestic bond markets. Overall, their role was smaller compared with the MPMs mentioned above. In particular, several countries relaxed CBMs, while only Turkey and Hungary tightened them in the attempt to curb currency depreciations and to reduce the reliance of domestic banks on FX funding sources. Some countries also relaxed RBMs, either to increase domestic markets liquidity by reducing restrictions on capital inflows, or to reduce the regulatory burden on domestic banks associated to external activities. Only a few countries (eg Argentina and Turkey) have tightened RBMs to contain outflow pressures.

4 Information in this paragraph is mostly taken from the COVID-19 Response Tracker elaborated by the Yale School of Management (https://som.yale.edu/faculty-research-centers/centers-initiatives/program-on-financial-stability/covid-19-tracker) and the document of the Institute of International Finance 'Prudential Regulatory Measures in Response to COVID-19'. We focus only on capital and liquidity requirements, and capital flows management measures. We do not consider other measures like those regarding provisioning, NPL classification, deferred payments, loans to SMEs.

5 Currency-based measures used to contain systemic risks may be also considered as macroprudential measures.

2.5: Reflections on the policy response

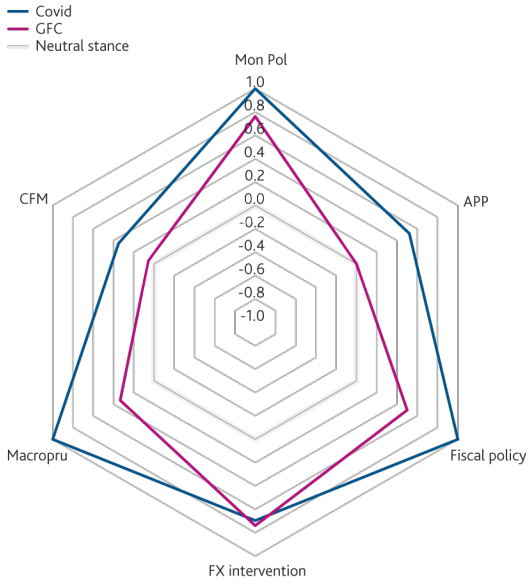
Policymakers in EMEs have reacted in a timely way to the multiple shocks induced by the pandemic. Like AEs, EMEs have adopted expansionary fiscal and monetary policies, consistent with policy advice formulated by international organizations such as the IMF and the BIS (BIS (2020)). On the fiscal side, also given the limited fiscal space, the response was smaller than in AEs, but large by historical standards.

Both conventional and unconventional monetary policy tools have been used. All central banks in our sample have cut policy rates. Some of them have also undertaken asset purchase programs of local-currency bonds for the first time to support the functioning of the sovereign bond markets, as foreign investors scaled back their local currency exposures. Fiscal and monetary policy response were synchronized and more aggressive than in other crises, complementing each other. On the one hand, liquidity support provided by governments reduced credit risks and promoted financial stability; on the other hand, central banks cut policy rates and purchased local currency bonds, mitigating the effects of portfolio outflows on sovereign yields. FX interventions were significant in some cases, but on average their size has been limited. Exchange rate pressures started to decrease in April, after the actions taken by major central banks helped to ease market tensions more generally, which in turn reduced the need for FX interventions. Most countries have relaxed MPMs in order to reduce capital and liquidity needs. Only a few countries have tightened CFMs to curb outflows.

The comparison with the policy responses during the GFC reveals some interesting differences (**Chart 21**), also in the light of the different nature of the two crises. During the GFC the immediate concern for EMEs was the vulnerability of the financial sector, given the abrupt deterioration of global financial conditions; the effects on the real economy were initially subdued and then materialized progressively with varying intensity according to country-specific conditions. Instead, the pandemic induced a recessionary shock across the board, prompting widespread use of expansionary fiscal and monetary policies.

Chart 21: During the pandemic macroeconomic policies have been more expansionary, compared with during the GFC

Macroeconomic policy: GFC vs Pandemic



Sources: Authors' based on various sources. For the Global Financial (Covid-19) crisis, fiscal policy, FXI, MPM/CFM, Monetary policy data are taken respectively from *WEO* (Fiscal Monitor), International Financial Statistics (International Financial Statistics), iMaPP/Fernandez (Yale database), Refinitiv (Refinitiv). Notes: for each policy instruments we report the share of countries that have loosened (+1) the policy stance minus the share of countries that have tightened it (-1).

All EMEs eased fiscal and monetary policies, while the role of FX interventions has been smaller than during the global financial crisis. In addition, all EMEs relaxed MPMs to preserve the functioning of their financial systems and support domestic credit: for the first time, MPMs were largely used in combination with other policy instruments not only for financial stability purposes but also to stabilize the economy (Restoy (2020)).

The policy responses adopted by most EMEs appear consistent with the IMF's Institutional view (IMF (2012)).[6] Indeed, in the current crisis countries have resorted mainly to conventional macroeconomic instruments and MPMs, while CFMs have played a minor role. While in past crisis episodes EMEs tended to tighten CFMs on outflows (IMF (2020b)), during the current crisis only a few EMEs have tightened them. The Institutional View suggests that the introduction of temporary CFMs on outflows might be appropriate when the 'shocks are large relative to the ability of macroeconomic adjustment to handle, or when the size or duration of the shocks are highly uncertain'. However, even where these conditions could have been met during the pandemic, in practice countries have refrained from using CFMs. There are two main explanations for this pattern: first, EMEs were able to resort to other policy options (such as MPMs and APPs) to counter the shock avoiding drastic measures that could have rattled investors further; second, capital outflows were short-lived, though abrupt and intense, and after the improvement of global financial conditions since April, countries were not forced to resort to CFMs on outflows.

The use of MPMs and CFMs appears in line with the prescriptions of the IMF's Integrated Policy Framework (IMF (2020c)). This says that, in the presence of financial frictions (eg shallow FX markets and elevated currency mismatch) the easing of MPMs/CFMs may be useful to deal with adverse global shocks, reducing financial stress associated with capital outflows and allowing for a more accommodative monetary policy. In addition, FX interventions may contribute to reducing interest rate premia and contain exchange rate volatility. During the pandemic, most EMEs have indeed relaxed MPMs and CFMs, which had been largely deployed since the GFC; FX interventions have been concentrated during the early phase of the crisis to contain currency depreciation pressures.

However, further study should be undertaken to address issues that go beyond whether or not policy responses adhered to IMF policy prescriptions. In particular there should be further study of the effectiveness of different instruments and their interactions based on the experience during the Covid-19 pandemic. Those lessons should be an important consideration in the scheduled review of the IMF's Institutional View and could usefully supplement the work recently undertaken by the IMF as part of its Integrated Policy Framework.

The Covid-19 pandemic is not yet over, and EME policymakers may now have more limited policy space. Notwithstanding the modest return of capital inflows to EMEs since May, data available at the end of 2020 pointed to lingering weakness in portfolio equity and local currency debt flows, suggesting that international investors remained cautious towards EMEs. Having already adopted an expansionary stance, policy makers could find themselves with limited policy space should global financial conditions deteriorate again; in addition, underlying vulnerabilities may resurface, exacerbating external shocks. The recent crisis highlighted that foreign investors' participation in domestic markets increases the risk of sudden stops, in particular if liabilities are denominated in foreign currency.

Although the role of lender of last resort played by EME central banks through asset purchase programs has helped to contain the effects of the crisis, developing more robust and resilient financial systems in EMEs should remain a priority. In particular, fostering the development of domestic institutional investors can help to enhance the ability of domestic markets to absorb external shocks. In fact, the capacity of domestic investors to offset the sell-off of local currency sovereign bonds will be critical given the increasing fiscal needs associated to policy responses to the crisis.

6 According to the Institutional View, 'capital outflows should usually be handled primarily with macroeconomic, structural, and financial policies'. The use of CFMs on outflows is warranted only under crisis conditions. In such cases, CFMs should be temporary and transparent; moreover, they should be lifted once economic and financial conditions have improved.

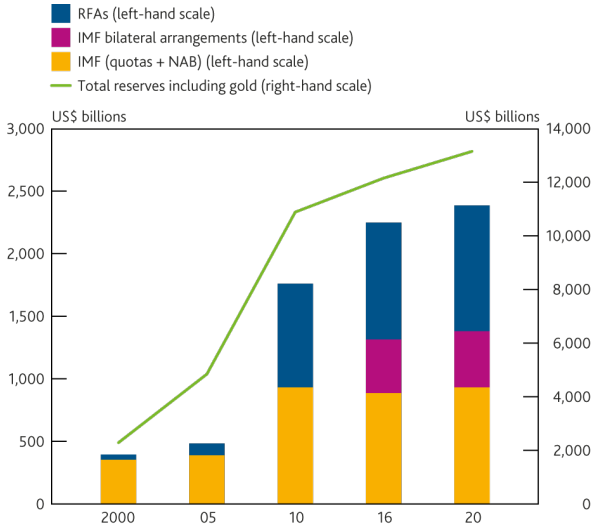
3 Adequacy of the global financial safety net (GFSN)

3.1: Current layers of the GFSN

The GFSN provides precautionary insurance against crises, supplies liquidity to countries and may incentivise, if properly designed, sound macroeconomic policies. It consists of four layers, which in nominal terms have increased in overall size during the past two decades (**Chart 22**):

1. **Foreign exchange reserves**, which countries accumulate as self-insurance.
2. **Central bank swap lines**, which allow central banks to temporarily exchange liquidity in their respective currencies.
3. **Regional Financing Arrangements (RFA)**, generally thought of as regional pools of reserve holdings or mechanisms to combine members' borrowing capacities.
4. The **IMF's** lending capacity, which provides a financial backstop at the multilateral level to all IMF member countries, depending on their characteristics and needs.

Chart 22: Overall the GFSN has increased in size over the past two decades
Layers of GFSN (US$ billion)



Notes: Total reserve assets include SDR allocations and countries' reserve position in the IMF. Reserve position in the IMF is the sum of (1) the 'reserve tranche' — that is, the foreign currency (including SDRs) amounts that a member economy may draw from the IMF at short notice; and (2) any indebtedness of the IMF (under a loan agreement) in the General Resources Account that is readily available to the member economy, including the reporting economy's lending to the IMF under the New Arrangements to Borrow (NAB). Current SDR allocations amount to SDR 204 billion (US$250 billion), two fifths of which are allocated to EMEs (around SDR 80 billion or US$100 billion).

Sources: IMF and RFAs.

The GFSN is a fundamental part of the current international financial architecture, but its design mainly reflects the accumulation and stratification of different forms of financial insurance, without any supranational planning. Therefore, its activation and use involve a series of uncoordinated decisions by different parties and may result in differentiated access and coverage across countries and regions.[7] In the past decade, policymakers have allocated

7 The analysis of the rationale for the existence of the GFSN and the correct set of incentives they should embed is beyond the scope of this chapter. See Scheubel and Stracca (2016) for a review of the literature.

considerable time to discuss how to improve the GFSN — both through a strengthening of its firepower and by enhancing the co-ordination among its different layers — as illustrated by the frequent mentioning of the GFSN in G20 Communiqués.

In this section, we review different layers of the GFSN, look at their evolution since the GFC and at their use during the Covid-19 crisis, and then turn to assessing their adequacy, in particular the adequacy of IMF resources, in the next section.[8]

Foreign exchange (FX) reserves are the first line of defence for countries: they are readily available and under the sole control of the national authorities. Countries might use reserves to offset temporary dislocations in FX markets and preserve financial stability, sustain the value of the domestic currency and address balance of payments problems.[9] The literature has developed a series of metrics to evaluate reserve adequacy (see, among others, Jeanne and Rancière (2006)). The IMF introduced its own reserve adequacy 'ARA' metric in 2011 (updated in 2013 and 2015), taking into account indicators for export income, broad money, short-term debt and other (external) liabilities.[10]

EMEs accumulated reserves for self-insurance purposes between the early 2000s and 2015, a trend broken only by significant usage during the GFC.[11] During the Covid-19 crisis, countries used their FX reserve buffers less than they did in the GFC (see previous section). Since the outbreak of the pandemic, the fall in FX reserves, as a proxy for FX interventions carried out to counter currency depreciation, has been on average 0.5% of GDP, against 1.7% during the GFC. The development of local financial markets (including local currency markets) and anchored inflation expectations following the widespread adoption of inflation targeting regimes across EMEs, might have lessened financial stability concerns related to FX depreciations. EMEs were able to use floating exchange rates as a more effective policy tool. Historical data on the reserve adequacy metrics do not point to significant differences ahead of each crisis. In 2019, out of the 54 EMEs for which the ARA metric is available, 24 had reserve stocks below the lower bound of adequacy, and 12 had excess reserves, while the other 18 countries had reserves within the adequacy range. In 2007, the respective numbers were similar.

Central bank swap lines are established to provide temporary liquidity in foreign currency to countries that request it, usually for financial stability purposes.[12] They are considered a layer of GFSN because they provide a liquidity backstop to countries in need, but their activation depends solely on the decisions of the two central banks involved, and is taken according to their respective mandates. Bilateral central bank swaps have the specific function of allowing other central banks to provide liquidity in foreign currency to banks in their jurisdiction and therefore cannot be used to finance general balance of payments deficits. Reflecting the role of the dollar as the prime global reserve currency and its dominance of global financial transactions, the dollar swap lines provided by the Federal Reserve have proven, in this crisis and in the GFC, to be an effective tool to decrease volatility in global markets. Since activation of the swap lines rests on a discretionary decision by the 'lending' central bank, they are an imperfect substitute for the sources of liquidity traditionally considered standard parts of the GFSN. Uncertainty regarding the activation of swaps may add to general market uncertainty during periods of stress.

Since the GFC, central bank swap lines have come to play an increasingly important role in the GFSN. In 2008, the Federal Reserve extended swap lines to 14 AE and EME central banks. Since then, swap lines have increased significantly in number and value. Swap lines now exist among AE central banks, between some AEs and EMEs, and some EME central banks.

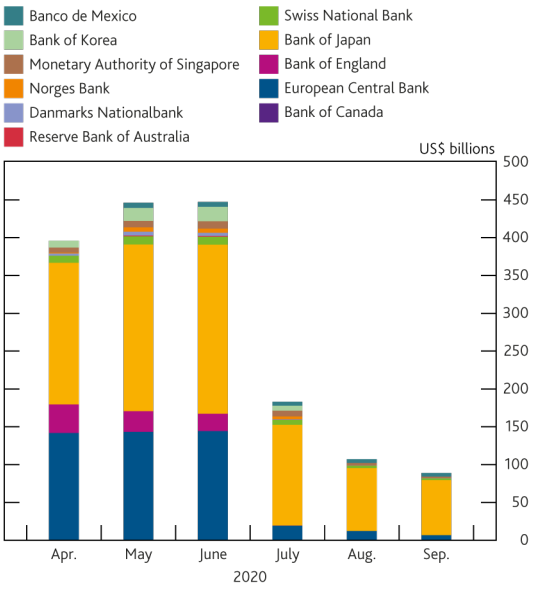
At the onset of the Covid-19 crisis in mid-March, given the deteriorating US dollar funding conditions worldwide, the Fed renewed its dollar liquidity swap lines to nine central banks at twice the 2008 limits. It also strengthened the provision of dollar liquidity via its existing unlimited swap arrangements with the Bank of Canada, the Bank of

8 For a discussion of the characteristics of each layer in terms of versatility of use, effectiveness and cost to the holder, see Denbee *et al* (2016).
9 The IMF's Integrated Policy Framework acknowledges the beneficial role FX interventions can play in certain contexts.
10 The assessment also considers the exchange rate regime and existing capital controls. See www.imf.org/external/datamapper/ARA/index.html for more details. The IMF's Independent Evaluation Office (2020) recommended further research on ARA methodologies, reflecting also that some of the IMF's advice based on them has not been well received and has not gained much traction.
11 The aggregate stock of reserves remained stable after 2015, at around US$13,500 billion, with EMEs' share also stable at around US$7,500 billion. For trade-offs involving reserves accumulation, see Rodrik (2006) and Levy Yeyati (2008).
12 Technically, a currency swap between two central banks is a contractual agreement in which the borrowing central bank obtains foreign currency against its own currency, with the promise to carry out the reverse transaction at a pre-specified date, adding the agreed interest cost to the borrowed currency.

England, the Bank of Japan, the ECB and the Swiss National Bank by cutting price and increasing frequency. By early April, ten of these central banks had just under US$400 billion in outstanding drawings on Federal Reserve credit, with the ECB and Bank of Japan the largest takers of dollars (**Chart 23**).[13] The combined uptake of Fed dollar swap lines peaked at US$449 billion in late May, compared with the peak of US$583 billion reached during the GFC (in December 2008).[14] In March 2020, the Federal Reserve also established a Foreign and International Monetary Authority (FIMA) repo facility, allowing foreign central banks to temporarily exchange their holdings of US Treasury securities for US dollars from the Fed (the initial six-month duration of the facility has been subsequently extended through March 2021).[15]

Chart 23: The Federal Reserve provided extensive dollar liquidity in response to the Covid-19 crisis

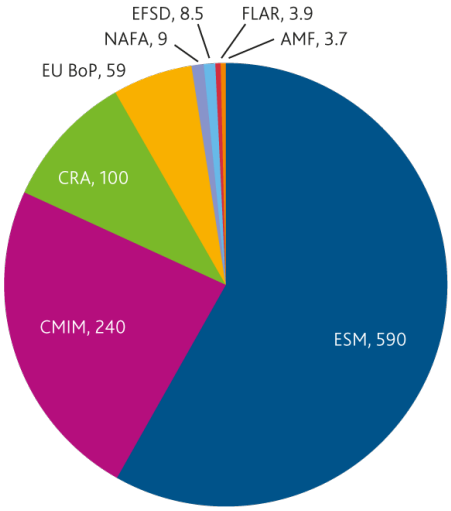
Federal Reserve bilateral swap arrangements in 2020 (US$ billions)



Source: Federal Reserve of New York.

Chart 24: RFAs have different resource endowments

Regional Financing Arrangements: Resources (US$ billions)



Notes: ESM — European Stabilization Mechanism, AMF - Arab Monetary Fund, FLAR — Fondo Latinoamericano de Reservas, CMIM — Chiang Mai Initiative for Multilateralization, CRA — BRICS (Brazil, Russia, India, China, South Africa) Contingent Reserve Arrangement, EFSD — Eurasian Fund for Stabilization and Development, NAFA — North American Framework Agreement, and EU BOP — EU Balance of Payments Facility.

Source: RFAs.

Regional Financing Arrangements (RFAs) are agreements between groups of countries usually belonging to the same region to create a pool of resources that can be made available to members in case of need. They represent an additional source of financing in times of crisis and their use is often linked to the activation of a financial assistance program with the IMF. Their main advantage is the local ownership and understanding, and therefore the ability to tailor financing to the specific needs of regional peers.

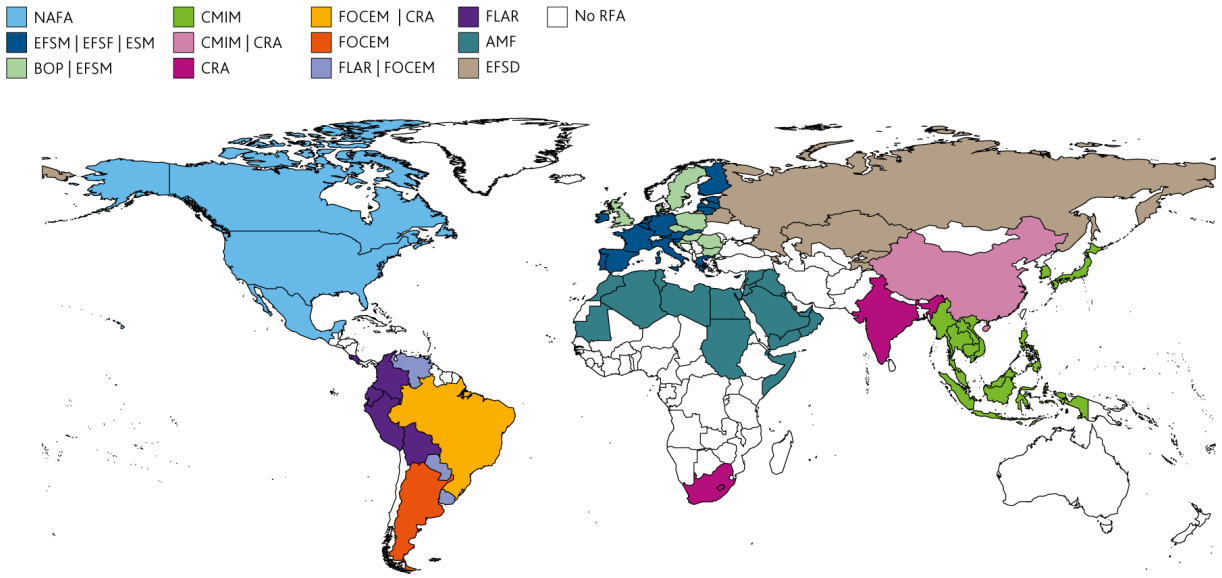
There are significant differences in terms of resources, membership, governance and lending between RFAs of individual regions.[16] While most RFAs aim at easing liquidity and balance of payments pressures, some also pursue other goals, such as facilitating economic adjustment or enhancing economic co-operation and development. For example, the Fondo Latinoamericano de Reservas (FLAR) extends credit for balance of payments support, liquidity provision, public debt restructuring, precautionary contingency and treasury support. The Arab Monetary Fund (AMF) and the Eurasian Fund for Stabilization and Development (EFSD) support sectoral reforms with a view to pursuing economic development. The European Stabilization Mechanism (ESM) also has multiple goals, since it provides loans for macroeconomic adjustment as well as resources for the indirect or direct recapitalisation of financial institutions. The Chiang Mai Initiative Multilateralization (CMIM) and the BRICS Contingent Reserve Arrangement (CRA) swap arrangements feature a stronger focus on short-term liquidity needs and balance of payments support.

13 For a detailed description of the Federal Reserve's swap line activation in the first months of 2020 and its impact on the Covered Interest Parity deviations across currencies, see Bahaj and Reis (2020). Also Eguren-Martin (2020).
14 For an assessment of the adequacy of central bank swap lines based on the short-term dollar funding needs of non-US banks, see Aldasoro *et al* (2020).
15 The FIMA facility has an overnight duration, but can be rolled over as needed. According to the data provided by the Federal Reserve, FIMA use was US$1.4 billion in mid-May and US$1 billion at the beginning of October.
16 For a description of the most important RFAs and their respective characteristics, see L´Hotellerie-Fallois *et al* (2018).

RFA resources total more than US$1 trillion (**Chart 24**), but coverage is uneven, with many countries, mainly low-income ones, not having access to any RFA (**Chart 25**)**.** Although RFA resources have not been called on to any significant extent so far in the Covid-19 crisis (given the global nature of the shock), the major RFAs have stated their readiness 'to support members through lending activities, adjustment of policies and toolkits to make them compatible with the emergency nature of the Covid-19 crisis (…)'.[17] The RFAs have remained 'committed to working together closely, in accordance with the individual mandates and policies, to exchange information on the needs of our members, and to coordinate assistance across different regions of the world', also through co-financing operations, where appropriate and feasible.[18] The subdued use of RFA resources in comparison to the IMF's (Box 2) may be related to the fact that only a global institution has broad enough membership to effectively backstop countries in region-wide or global crises such as the Covid-19 crisis.

Chart 25: RFAs' geographic coverage is uneven

Regional Financing Arrangements: geographic coverage



Notes: ESM — European Stabilization Mechanism, AMF - Arab Monetary Fund, FLAR — Fondo Latinoamericano de Reservas, FOCEM — Fondo para la Convergencia Estructural del Mercosur, CMIM — Chiang May Initiative for Multilateralization, CRA — BRICS (Brazil, Russia, India, China, South Africa) Contingent Reserve Arrangement, EFSD — Eurasian Fund for Stabilization and Development, NAFA — North American Framework Agreement, EFSM — European Financial Stabilization Mechanism, EFSF — European Financial Stability Facility, and BOP — EU Balance of Payments Facility.

Source: IMF.

With its 190 members, the IMF is the only truly global layer of the GFSN. Its resources come from two main sources: the quotas subscribed by member countries in proportion (approximately) to their weight in the global economy and ad hoc (multilateral or bilateral) agreements with subsets of members.[19] Multilateral and bilateral borrowing is contingent on the existence of an actual need and serve as second and third lines of defence, respectively, by providing a temporary supplement to quota resources. These borrowed resources played a critical role in enabling the IMF to support its member countries during the GFC.

The IMF's current total resources, which amount to about SDR 978 billion, translate into a lending capacity of about SDR 715 billion (around US$1 trillion),[20] after setting aside a liquidity buffer and taking into account that only the resources of members with strong external positions can be used for lending (**Chart 26**).[21]

17 Joint statement with the IMF issued in April 2020. The ESM established a Pandemic Crisis Support amounting to a package worth €540 billion, to support domestic financing of direct and indirect healthcare, cure and prevention related costs due to the Covid-19 crisis.

18 'Statement of IMF, ESM and other Regional Financing Arrangements (RFA) on economic impact of Covid-19', ESM press release, 21 April, 2020.

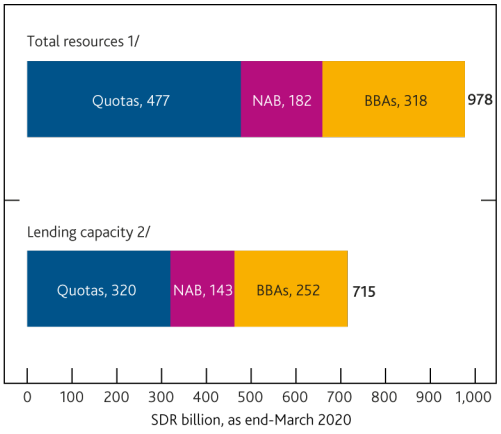
19 For how IMF quotas are calculated and the connected issue of governance and representation, see, among others, Colabella *et al* (2009).

20 Using the mid-September 2020 exchange rate, 1 SDR = 1.4 USD.

21 IMF quotas, which are the institution's main and more stable source of financing, were doubled in 2016 to SDR 477 billion (US$670 billion), following a decision taken in 2010 in the aftermath of the GFC. In the same year, some members also agreed to provide SDR 367.5 billion (US$514.5 billion) under the New Arrangements to Borrow (NAB), while in 2012 an additional SDR 282 billion (US$395 billion) were provided under a set of Bilateral Borrowing Arrangements (BBAs), to help the IMF address the euro area sovereign debt crisis. Subsequently, in 2016 the NAB was reduced to SDR 182 billion (US$255 billion) as part of its resources were folded in the above mentioned doubling of quotas, while the 2012 BBAs were renewed in 2016 for an amount of SDR 318 billion (US$445 billion) through end-2020. Given the lack of consensus among the membership for another quota increase, in January 2020 the IMF's Executive Board approved a doubling of the NAB resources from the current SDR 182 billion to SDR 365 billion until 2025. This doubling is subject to creditors' consents and is expected to become effective on 1 January 2021. As regards to the current BBAs, the Executive Board approved in March 2020 a framework for a new round of BBAs to take effect from 1 January 2021; it will have an initial term of three years through end-2023, which is extendable with creditors' consents for one further year through end-2024.

Chart 26: The IMF's effective lending capacity is less than its total resources

Current IMF resources (SDR billion, as end-March 2020)



Notes: 1/ Agreed quotas, current NAB credit arrangements and 2016 BBAs. 2/ Includes: quotas of members participating in the Financial Transactions Plan (FTP); credit arrangements of NAB participants eligible in the Resources Mobilization plan (RMP) in the event of NAB activation; and credit amounts under effective 2016 BBAs with members participating in the FTP. Excludes 20% liquidity buffer.

Source: IMF.

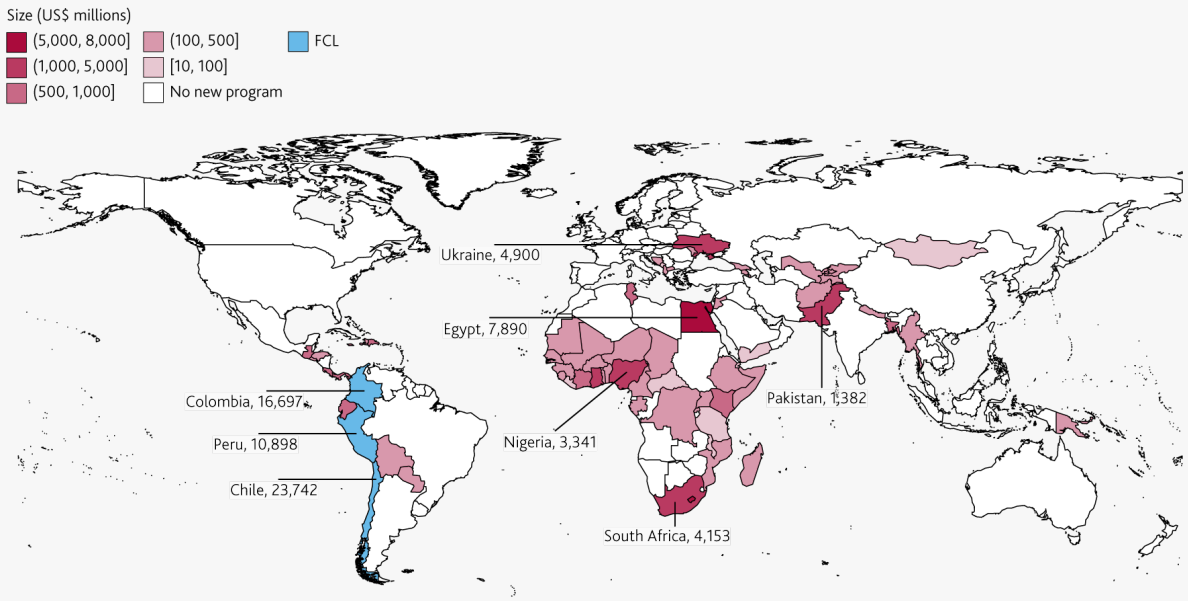
Box 2
IMF responses to the Covid-19 crisis

The IMF responded swiftly to the Covid-19 pandemic with a series of measures aimed at containing the emergency in the most affected countries. These measures included:

i. a doubling of access limits to emergency financing lines (Rapid Credit Facility for Poverty Reduction and Growth Trust (PRGT)-eligible countries and Rapid Financing Instrument for all countries), until 6 April 2021;
ii. temporary increases in program access limits from 145% to 245% of quota on an annual basis for the General Resources Account (GRA) and from 100% to 150% of quota for the PRGT, until 6 April 2021;
iii. the introduction of a new lending tool, the Short-term Liquidity Line (SLL), to provide support to members with very strong policy frameworks and fundamentals, facing potential short-term moderate balance of payments difficulties. The SLL has revolving access, which allows repeated (partial or full) purchases and repurchases within the arrangement, and is cheaper than the Flexible Credit Line when used on a precautionary basis.
iv. debt relief for the poorest countries under the Catastrophe Containment and Relief Trust (CCRT) financed through grant contributions provided by donor countries.

Emergency financing instruments have been the primary instruments for providing support to IMF members, especially among poorer and fragile countries. The IMF has also augmented the amounts agreed under some existing programs and has approved two Flexible Credit Lines to Chile and Peru, for a total commitment of US$35 billion (SDR 25 billion). As of the end of November this year, 83 members had received financial support from the IMF, for a total amount of SDR 74 billion (US$102 billion, **Chart A**).[22] Debt relief through the CCRT has benefited 29 countries for a total of SDR 351 million (US$489 million).

Chart A: The IMF's response to the Covid-19 crisis has been global



Source: IMF.

In November 2020 the IMF's Forward Commitment Capacity (a measure of the resources available for new financial commitments) stood at around SDR 160 billion (US$220 billion), above the threshold of SDR 100 billion required for activating the IMF's second line of defence, its NAB resources. The activation of the NAB would provide the IMF with additional SDR 135 billion for its future lending operations.

22 www.imf.org/en/Topics/imf-and-covid19/COVID-Lending-Tracker.

A campaign to mobilise PRGT resources was launched in April 2020 to raise SDR 12.5 billion. By November, five new agreements and the augmentation of four existing agreements had been finalized with nine lenders, which together provide SDR 10.6 billion in new loan resources. The crisis has also created a sizeable PRGT subsidy gap, which would have to be filled to preserve the self-sustainability of the PRGT.

3.2: Estimating the adequacy of IMF resources

This section provides an assessment of the capacity of the current GFSN to deal with adverse tail events. It considers the scale of potential liquidity shocks, the resources individual countries have access to, and how those resources are distributed. The objective is to evaluate if the GFSN, in its current size and configuration, is adequate to deal with a systemic liquidity shock affecting EMEs, taking into account the Covid-19 shock they have just experienced.

3.2.1: Methods for the calibration of total financing needs

Three layers of the GFSN are considered: FX reserves, RFAs and IMF loans. Our approach to assessing adequacy consists of three main steps:

Step 1: EMEs' total financing needs are computed. Two complementary approaches are used to do this:

a. Scenario analysis: we identify EME sudden stop episodes that occurred in the past and calculate the behaviour of the balance of payments variables during those episodes.
b. Capital flows-at-risk: we calculate the entire distribution of balance of payments variables. Lower percentiles correspond to extreme episodes of capital outflows.

Step 2: We estimate how much of EMEs' total financing needs can be met by making use of their own FX reserves, by getting support from RFAs, and by activating standing IMF precautionary programs (if they have any).

Step 3: Remaining funding needs are estimated. These are the needs not met by FX reserves, RFA support and standing IMF precautionary programs, and indicate the extent to which IMF resources may need to be called on (over and above its precautionary programs).

In Step 1, the stress takes the form of a sudden stop lasting two years for EMEs, characterised by a reversal in portfolio and other investment gross capital inflows.[23] The severity of the shock depends on the potential offsetting reactions from domestic resident investors, who might reduce their investments abroad. We consider two sudden stop specifications:

a) a benchmark sudden stop characterised by a decrease in portfolio and other investment gross capital inflows without any offsetting reaction (the net current account, FDI inflows, and gross capital outflows remain unchanged);
b) a sudden stop with offsetting factors, in which domestic residents reduce their gross investments abroad (gross capital outflows) to compensate for some of the reduction in gross capital inflows. The net current account and FDI inflows also adjust in response to the shock.

The rationale behind the first specification (a) is that portfolio and other investment inflows are 'exogenous' components from the point of view of the country; they do not depend directly on decisions by domestic agents. In addition, portfolio and other investments are the most volatile components of the capital account, ie the most prone to sudden-stops. Specification (b) takes into account that the reduction in inflows could be financed only

23 In the simulations described below, the 49 EMEs included in the sample account for 90% of all EMEs' GDP (34% of world GDP) and 96% of all EMEs' external liabilities (12% of world external liabilities). Low Income Countries (LICs) are excluded from the analysis due to lack of relevant data needed for the simulations. This means that resulting financing needs from our analysis may underestimate the total financing needs arising when LICs are also taken into account. The underestimation due to LICs will translate fully into an underestimation of remaining funding needs, since these countries have no access to other layers of the GFSN.

partially through reserves, with the remainder absorbed by changes in the other components of the balance of payments identity.[24]

For both specifications above, we calibrate the size of shocks to the balance of payments components to simulate both a moderate and a severe crisis. The method for the calibration of these shocks depends on the chosen methodology (scenario analysis or capital flows-at-risk), as described in the next paragraphs.

The scenario analysis framework calibrates the shock to countries' external balance sheets according to past sudden stop episodes. We distinguish between a moderate scenario, considering the median of the historical distribution of these shocks, and a severe scenario, using the 25th percentile. Capital flow stops can be defined both as a percentage of the initial stock of the flow variable or normalised with respect to annual GDP (Box 3 presents further details on the underlying methodology).

Table A shows the median and the 25th percentile of the calibrated shocks for each type of capital flow and considering both a normalisation using the initial stock of the flow variable and GDP. The percentage changes in **Table A** are the variations of capital flows in the first and second year of the sudden stop episode, following a median or a 25th percentile shock. Both variations are calculated with respect to the year before the sudden stop occurs and expressed as a percentage of the initial stock (or GDP). Looking at median estimates, portfolio inflows are likely to be reduced by 14 percentage points with respect to their stock in the first year of the sudden stop or by 1 percentage point of GDP. By construction, the negative variations are larger when we consider the 25th percentile: according to these estimates, portfolio inflows are reduced by 21 and 3 percentage points of the corresponding stock and GDP, respectively. Interestingly, the current account balance improves using the median estimates, and it declines considering the 25th percentile. All these considerations explain why the median parameters define a moderate scenario, while the 25th percentile characterises a severe shock. The estimates based on the two normalisations turn out to be rather similar.[25]

Table A: Calibrated shocks for gross capital flows

	Moderate scenario Median shock				Severe scenario 25th percentile shock			
	Shock defined with respect to				Shock defined with respect to			
	Stock		GDP		Stock		GDP	
	t	*t+1*	*t*	*t+1*	*t*	*t+1*	*t*	*t+1*
FDI inflows	-5.0%	-8.1%	-0.4%	-0.8%	-9.2%	-15.5%	-2.1%	-3.3%
FDI outflows	-2.6%	-5.2%	0.0%	0.0%	-34.1%	-27.2%	-0.5%	-0.5%
Other investment inflows	-17.2%	-15.6%	-4.4%	-4.3%	-34.9%	-25.7%	-8.2%	-7.1%
Other investment outflows	-9.4%	-5.3%	-0.5%	-0.5%	-18.7%	-26.5%	-3.1%	-2.1%
Portfolio investment inflows	-14.0%	-2.8%	-0.6%	0.0%	-21.3%	-11.7%	-2.8%	-0.7%
Portfolio investment outflows	0.6%	-0.9%	0.0%	0.0%	-11.3%	-15.7%	-0.2%	-0.3%
Current account balance (CA)			1.4%	2.7%			-0.5%	-0.5%
Total inflows - Total outflows + CA			-4.0%	-1.4%			-6.6%	-5.2%

Notes: Shocks calibrated on the distribution of capital flows in longer sudden stops episodes (>4 quarters).

In what follows, we use the specification where the shock size is defined in terms of its share of the initial stock of capital flows, since this gives a better indication of a country's degree of financial openness, compared with

24 The hypothesis behind the framework is that exchange rate adjustments in response to sharp shocks would need to be extreme in order to reduce funding needs. As discussed in the literature (eg Krugman (1979)), countries may struggle to offset the financial stability consequences of a currency crisis. As evidence of EMEs not being willing to allow extreme fluctuations of their exchange rates, Ilzetzki *et al* (2019) classify most of the EMEs considered in the following exercise as having *managed* floating exchange rate regimes.

25 This can be illustrated through an example. If Thailand suffers a shock in which portfolio and other investment inflows decline, respectively, by 14 and 17 percentage points with respect to their stock, these flows fall by US$41 billion in total. By contrast, if portfolio and other investment inflows to Thailand decline, respectively, by 1 and 4 percentage points of GDP, these flows are reduced by US$38 billion in total.

defining it as a share of GDP. Normalising by GDP puts more weight to countries' economic importance in the global economy, and it is presented as a robustness check. The use of the same quantile for each capital flow variation in the simulations deserves some caveats. The formulation ignores the correlation structure among the different types of capital flows. To mitigate this, and as a further robustness exercise, we also compute the variations for the aggregate defined as the difference between gross capital inflows and outflows plus the current account adjustment (last row of **Table A**). We refer to the former as univariate shocks and the latter as the aggregated shock (see Box 3 for a formal definition of these two types of shocks).[26]

The capital flows-at-risk methodology estimates the entire probability distribution of capital flows to EMEs. The lower percentiles (such as the fifth percentile and lower) usually represent an extreme set of realisations for capital outflows. The estimated distributions of capital flows are conditional on domestic ('pull') and external ('push') factors, measured by summary statistics of co-movement in a number of financial indicators for individual countries and at the global level respectively. Changes in push factors are associated with shifts in the distribution of potential capital flows. If global financial conditions tighten, the distribution moves to the left and its left tail becomes 'fatter' (in pink in **Chart 27**); [27] that is, capital outflows are more likely, and the probability of seeing large outflows sharply increases. Given that the estimates based on the capital flows-at-risk methodology allow us to analyse a continuous distribution of the adequacy of IMF resources, we call it IMF resources-at-risk.[28] Box 4 provides a formal description of the methodology.

We consider both a moderate scenario and a severe one. The moderate scenario uses the distribution of capital flows without shocks to global financial conditions, while the severe scenario captures a three standard deviation shock to global financial conditions. The setup for the severe scenario corresponds to the estimated shock to global financial conditions during the Covid-19 stress as measured by the VIX index and a broader financial conditions index (FCI). A shock of this magnitude is a very rare event: it has a frequency of less than 2% in the daily VIX since 1990 and less than 3% in the monthly FCI since 1995.

Given differences between the two methodologies, we compare the fifth percentile of the capital flows-at-risk framework to the results of the scenario analysis for each of the scenarios. These generate comparable distributions of gross inflows and outflows for the 2020–21 period. **Chart 28** shows the comparison for portfolio and other investment flows in the severe scenario. The rationale behind the above is that the calibration of shocks in the scenario analysis framework considers only sudden stops episodes, while the capital flows-at-risk methodology uses the entire time-series of capital flows. This means that the episodes used in the former correspond to extreme realisations of shocks in the latter.[29]

26 We can only compute the shock with respect to the GDP for the current account (and, consequently, for the aggregated component), since the current account does not have a corresponding stock. Hence, in the simulations that employ the shocks calibrated with respect to the initial stock of the flow variables the variation for the current account is based on the definition by GDP.

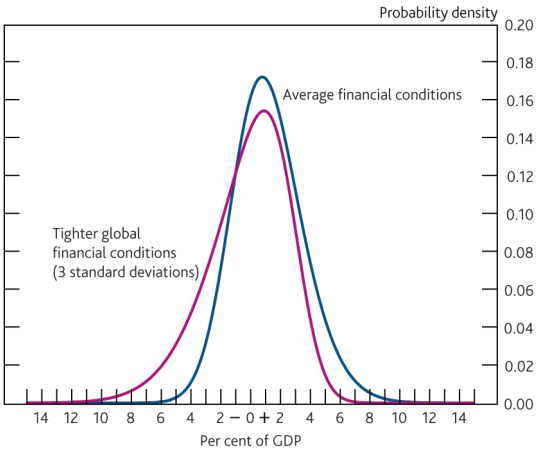
27 **Chart 27** is the resulting fitted distribution for the estimates of the conditional quantile function. See the robustness checks and the description of distributions in the annex for further explanation.

28 This term is an abbreviation and to a certain extent imprecise, given that the goal is to analyse 'demand for IMF resources-at-risk'. The distribution of IMF resources varies little with shocks, depending on the countries that become unable to finance the Fund. The 'at-risk' component comes from the variation in the demand for Fund's resources by countries hit by shocks.

29 Sudden stop episodes identified in the scenario analysis correspond to 5.8% of the total number of observations (998 quarters-countries in distress out of a total of 17,280 quarters-countries). Another difference between the two methodologies is that the scenario analysis framework provides estimates for the *variation* of capital flows during sudden stops and the output of the capital flows-at-risk methodology are forecasts of *levels* of capital flows during stress episodes. At the country level, we might expect quite different results. Further factors affecting the comparison are the different time spans and sample sizes.

Chart 27: The capital flows-at-risk methodology estimates the entire probability distribution of capital flows, and its left tail becomes 'fatter' when global financial conditions tighten

Distribution of capital flows

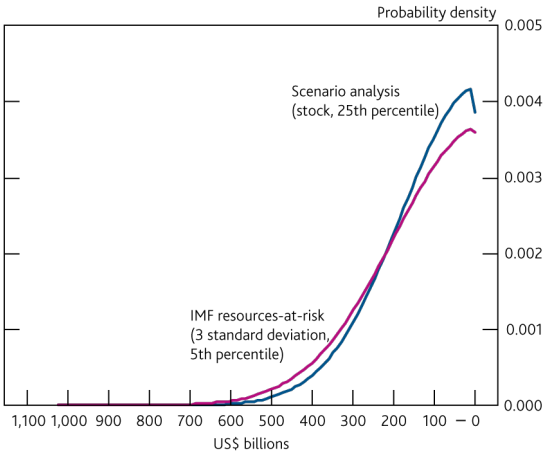


Note: This chart shows fitted skewed t-distributions for flows as defined in equation 1 in one year, given average financial conditions (blue) and global financial conditions three standard deviations tighter than average (pink).

Sources: Authors' calculations based on Eguren-Martin *et al* (2020) and IMF BOPS data.

Chart 28: Really severe episodes of all past capital outflows (5th percentile) in the IMF resources-at-risk framework are distributed similarly to severe sudden stops in the scenario analysis

Comparison of shocks in the two methodologies for portfolio and other investment inflows. Simulated distributions for the 2020–21 period



Notes: The chart shows the cross-sectional distribution of portfolio and other investment inflows obtained by affecting each EMEs with a shock to the two capital flows components. In the scenario analysis, a 25th percentile shock calibrated with the initial stock of the flow variable is used, while the capital flows-at-risk considers the 5th percentile of the capital flows distribution in which the global financial conditions are subject to a three standard deviation perturbation. For both distributions a skewed-t fitting is employed.

Sources: Authors' computations on IFS and *WEO* data.

When a country is hit by a shock (as estimated in Step 1), it turns initially to its own reserves and any precautionary financing arrangement it has to cover its financing needs (in Step 2). First, the country will employ its available FX reserves.[30] Second, countries will exhaust as needed any previously agreed IMF precautionary facility (eg, the Flexible Credit Line or the Precautionary Liquidity Line). Finally, countries will make recourse to their potential RFA memberships, according to relative borrowing limits. We consider five RFAs that can provide financing to EMEs.[31]

The remaining financing needs after using reserves and exhausting precautionary facilities and RFAs represent the demand on 'adjusted' IMF resources following a shock (Step 3). We adjust the supply of IMF resources to take into account the fact that countries in need of IMF support are no longer eligible to provide resources to the IMF under the Financial Transactions Plan. Their contributions through quotas, NAB and bilateral borrowing arrangements (when applicable) are subtracted from the IMF's available resources. This gives the amount called 'adjusted IMF available resources', a proxy for IMF lending capacity.[32]

Central bank swap lines provide no direct support to EMEs' funding needs in our scenarios. During the Covid-19 crisis, the Federal Reserve extended swap arrangements to only two EMEs: Brazil has so far not used its dollar swap line, while Mexico made limited use of it. Fed swap lines acted as a backstop, helping to stabilise global markets and in turn, EME markets. In the context of this paper, while this indirect channel is not explicitly modelled, if it were to be, one might think of it as having the effect of reducing the probability of a severe scenario occurring by stabilising global financial conditions, or decreasing the severity of the scenario to a level closer to moderate.

30 We assume that when a country faces a financing gap, FX reserves can be run down up until a certain level. The maximum amount of usable reserves is the excess with respect to 80% of the reserve adequacy metric (ARA metric) calculated by the IMF (on 2019 data), with a maximum decrease of 40%, whichever is smaller. The rationale is that countries are generally unwilling to use all of their reserves for fear over sending negative signals to financial markets and inducing more destabilizing speculative flows (see also Aizenman and Sun (2012)).

31 The Chiang Mai initiative Multilateralization, the BRICS Contingency Reserve Arrangement, the Fondo Latinoamericano de Reservas, the Arab Monetary Fund and the EU Balance of Payments facility.

32 In the computation of this variable, we consider the 80 percent of the amounts of borrowing agreements and quota resources, since the remaining 20 percent is set aside for precautionary purposes. Resources committed under existing programs are also excluded from the definition of adjusted IMF available resources. Currently, resources under total lending commitments are SDR 184 billion (of which 82 under FCL commitments).

Box 3
Scenario analysis methodology

The methodology underlying the scenario analysis is described formally in what follows. We assume that a sudden stop occurs in year *t* and lasts until year *t+1*. The *potential* change of FX reserves in each country *c* in year $y \in \{t, t+1\}$ consistent with the sudden stop scenario is given by:

$$\Delta RES_c(y) \equiv [PIin_c(y) + OIin_c(y) + FDIin_c(y)] + CA_c(y) - [PIout_c(y) + OIout_c(y) + FDIout_c(y)] \quad (1)$$

In the benchmark sudden stop specification (a), we derive portfolio $PIin_c(y)$ and other investment $OIin_c(y)$ gross inflows by imposing a sharp contraction, based on the historical distributions of these variables, to values recorded in year *t-1*, while the other components of identity (1) simply take the values of year *t-1*.

In specification (b), the negative variation of gross capital inflows is partially offset by a reduction of gross capital outflows $[PIout_c(y) + OIout_c(y) + FDIout_c(y)]$. In this last scenario, FDI inflows $FDIin_c(y)$ and the current account balance $CA_c(y)$ are also allowed to change. There are a few *caveats* to this type of exercise: it is a partial equilibrium simulation; reactions of other key variables, such as the country's GDP and feedback effects onto some of the variables of interest are not considered; there are also no spillovers effects between countries.

The total financing needs over a two-year horizon induced by these shocks for each country *c* are given by:

$$TFN_c = -\min\{[\Delta RES_c(t) + \Delta RES_c(t+1)], 0\} \quad (2)$$

In other words, a total financing need is positive if the potential changes of FX reserves over the two-year horizon implied by the assumptions on the behaviour of the components of the balance of payments is negative.

A country is assumed to firstly resort to its own *usable* FX reserves (ΔUSR_c). After that, countries resort to potential IMF precautionary facilities and to RFAs of which they are members. The remaining funding needs (RFN_c) represent the demand on IMF resources:

$$RFN_c = \max\{[TFN_c - \Delta USR_c - FCL_c - PLL_c - RFAs_c], 0\} \quad (3)$$

Variations of portfolio and other investment inflows in specification (a) and the changes of all the balance of payments components in specification (b) are calibrated according to past sudden stops episodes. Following Forbes and Warnock (2012), we identify sudden stop episodes using quarterly IFS data from a sample of 69 EMEs for the 1980 Q1–2019 Q4 period (we subsequently have to drop 20 countries while calculating financing needs due to data constraints for other variables). We detect 71 short episodes (lasting at most 3 quarters), 57 medium episodes (lasting 4 quarters) and 49 long episodes (with a length greater than 4 quarters). For each sudden stop *s*, country *c*, type of capital flow KF, we compute the following shocks for years *t* (when the sudden stop started) and *t+1*:

$$\begin{aligned} \varepsilon_{c,s}(t) &= \frac{\sum_{q=q(s)}^{q(s)+3} KF_c(q) - \sum_{q=q(s)-4}^{q(s)-1} KF_c(q)}{D_c(t-1)} \\ \varepsilon_{c,s}(t+1) &= \frac{\sum_{q=q(s)+4}^{q(s)+7} KF_c(q) - \sum_{q=q(s)-4}^{q(s)-1} KF_c(q)}{D_c(t-1)} \end{aligned} \quad (4)$$

where $q(s)$ denotes the quarter in which sudden stop *s* begins and $D_c(t-1)$ could be either the GDP in the year before the sudden stop or the previous-year stock associated to the flow variable KF. We end up with a distribution of shocks for the year when the sudden stop started (*t*) and the following one (*t+1*). Relevant quantiles are computed from these distributions.

When $KF \in \{PIin, OIin, FDIin, PIout, OIout, FDIout, CA\}$, the variations in (4) are calculated for each flow variable independently and we call these variations univariate shocks. If $KF = (PIin + OIin + FDIin) + CA - (PIout + OIout + FDIout)$, we define an aggregated shock. These last shocks correspond to the observed changes in net flows during past sudden stop episodes; they implicitly take into account the correlation between different gross inflows and outflows.

We apply the procedure above to assess potential total financing needs and remaining funding needs during the Covid-19 episode. We use annual IFS 2019 balance of payments flow data and the shocks described in (4) to simulate the trajectories of gross capital flows (KF) in the 2020 (*t*)-2021(*t+1*) period, starting from *t-1*=2019, the last available year in the IFS dataset:

$$\begin{aligned} KF_{c,p}(t) &= KF_c(t-1) + \varepsilon_p(t) D_c(t-1) \\ KF_{c,p}(t+1) &= KF_c(t-1) + \varepsilon_p(t+1) D_c(t-1) \end{aligned} \quad (5)$$

for each country *c* and using the median ($p = 0.50$) or the 25th percentile ($p = 0.25$) of the distribution of shocks $\varepsilon_{c,s}$. In the simulations of a moderate sudden stop, the median shock is used for all countries. In order to simulate a severe crisis, more financially open countries, defined as those with higher levels of other investment inflows (which are most relevant in quantitative terms and the ones presenting highest variation during financial distress episodes) as a ratio to their initial liability stock (or GDP), receive a 25th percentile shock. Formally:

$$\varepsilon_c(y) = \varepsilon_{0.50}(y) I\left(\frac{OIin_c(t-1)}{D_c(t-1)} < \tau\right) + \varepsilon_{0.25}(y) I\left(\frac{OIin_c(t-1)}{D_c(t-1)} \geq \tau\right) \quad (6)$$

Where $I(.)$ is the indicator function and the threshold τ is defined as the first quartile of the $OIin_c(t-1)/D_c(t-1)$ distribution. This formulation is consistent with the empirical regularity that more financially open countries, which experience larger inflows in the year before the sudden stop, also suffer larger outflows during financial distress episodes.

The scenarios presented in the main text use the shocks calibrated with respect to the initial stock of the flow variables: so countries' total financial needs will be a function of their degree of financial openness. The robustness checks in the annex cover shocks using the GDP definition.

Our analysis improves on the approach used by Denbee *et al* (2016) since the shocks in (4) and normalised with respect to the corresponding stock (or GDP) are not sensitive to changes in the magnitude of flows. Our methodology also improves on the analysis in L´Hotellerie-Fallois *et al* (2018), as it removes the need for exogenous partial rollover rates to determine countries' financial needs.

Box 4
Capital flows-at-risk methodology

The capital flows-at-risk framework by Eguren-Martin *et al* (2020) uses quantile regressions. It specifies a linear model for the quantiles of capital flows conditional on measures of domestic ('pull') and external ('push') factors. 'Pull factors' are the domestic conditions and institutions that affect the relative attractiveness of investing in an individual country. 'Push factors' are the ones that determine global risk appetite and financial conditions, particularly the level and prospects for US monetary policy and financial stability.[33]

In formal terms, for different time horizons h and quantiles $\phi(p)$ of order *p* of the distribution, a panel regression of capital flows $KF_{c,q+h}$ (relative to GDP) is run on a constant, proxies for pull and push factors, and country-specific quantile-invariant fixed effects δ_c:

$$\phi^{KF}_{c,q+h}(p) = \alpha_h(p) + \gamma_h(p)Pull_{c,q} + \beta_h(p)Push_q + \delta_c \quad (7)$$

Pull and push factors in turn are measured by financial conditions indices (FCIs), summary statistics of co-movement in a number of financial indicators for individual countries and at global level. The global average of these indices can be understood as a summary measure of push factors, and the residual obtained from regressing country indices on this global FCI as a country-specific summary measure of pull factors.

Equation (7) is estimated with quarterly data considering a panel of 13 EMEs in the 1990 Q1–2019 Q4 period. The model then gives us the distribution of capital flows when global financial conditions tighten (a negative shock is given to push factors). The quantile regression machinery allows the estimation of the impact of the (global factors) shock on different horizons *h*. For each set of variables for capital flows, we calculate the distributions of the year of the shock (*q* to *q+*3, in quarterly terms) and the year following it (*q+4* to *q+7*). We transform the results of equation (6), given in terms of GDP, into US$, by multiplying them by *WEO* forecasts for countries' GDP in the years *t* and *t+1*.

In this way, we obtain a forecast of capital flows for each country *c* and percentile *p* of the capital flows distribution. In the benchmark specification (a), the capital flow variable is equal to the sum of portfolio and other investment inflows ($KF_c(y) \equiv PIin_c(y) + OIin_c(y)$). In specification (b), it is equal to the difference between inflows and outflows plus the current account ($KF_c(y) \equiv \Delta RES_c(y)$). By using these expressions, we are able to compute a distribution of *potential* variation of FX reserves and total financial needs.

For the results of the IMF resources-at-risk methodology presented in Section 3.2, we fit quantiles from a skewed-t distribution, which is a flexible distribution requiring limited parametric assumptions (Azzalini (2013) and Azzalini and Capitanio (2003); see annex). This is the same technique used to construct **Chart 27**. We choose the skewed-t as it is the standard distribution used in this stream of the literature. The robustness section in the annex presents results based on other distributions, such as the zero-inflated gamma.

33 Calvo *et al* (1996) pioneered the distinction between these factors while analysing capital account liberalisations in Latin America in the early 1990s, but push factors have received much more attention since then. Koepke (2019) is a complete literature review on the subject.

3.2.2: Main results

Table B presents results for the two shocks (moderate and severe) and the two methodologies when EMEs face a sudden stop according to the benchmark specification (a). It shows the total financing needs arising from the simulated shocks, their partial coverage through FX reserves, IMF facilities and RFAs' support, and the remaining funding needs to be addressed by the IMF. It also reports the adjusted resources available at the IMF.

Table B: Comparison of results from the two methodologies in the benchmark specification (a) (shock to portfolio and other inflows without offsetting factors)

Moderate shock	Scenario analysis (univariate shocks — stock)				IMF resources-at-risk (skewed-t)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**1,592.2**	**1,140.4**	**40**		**1,052.4**	**753.8**	**38**	
Funded by reserves	646.8	463.3	32	6	429.5	307.6	31	14
Funded by FCL/PLL	68.7	49.2	3	2	22.4	16.1	1	1
Funded by RFAs	135.1	96.8	14	1	73.7	52.8	12	4
Remaining funding needs	**741.5**	**531.1**	**31**		**526.7**	**377.3**	**19**	
Impact on IMF available resources	-135.2	-96.9			-82.0	-58.7		
Adjusted IMF available resources	622.3	445.7			675.5	483.9		

Severe shock	Scenario analysis (univariate shocks — stock)				IMF resources-at-risk (skewed-t)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**2,552.0**	**1,828.0**	**40**		**1,962.0**	**1,405.3**	**40**	
Funded by reserves	814.4	583.3	32	2	626.2	448.5	33	13
Funded by FCL/PLL	97.5	69.9	3	0	46.0	32.9	3	2
Funded by RFAs	172.6	123.6	18	2	109.0	78.1	12	0
Remaining funding needs	**1,467.6**	**1,051.2**	**36**		**1,180.8**	**845.8**	**25**	
Impact on IMF available resources	-188.2	-134.8			-118.2	-84.6		
Adjusted IMF available resources	569.3	407.8			639.4	458.0		

Notes: The table shows outstanding amounts both in US$ and in SDR billion. The moderate scenario is defined considering the median shock in the scenario analysis methodology and the distribution of capital flows without perturbations to global financial conditions in the IMF resources-at-risk framework. The severe scenario considers instead the 25th percentile shock in the scenario analysis methodology and the distribution of capital flows arising from a three standard deviation shock to global financial conditions in the IMF resources-at-risk. Column 'N' reports the number of countries experiencing financing needs and relying on a given layer of the GFSN. The column 'N fully funded' counts the number of countries that are able to fully cover their financing needs using reserves, reserves+FCL/PLL, reserves+FCL/PLL+RFAs, respectively.

The two conceptually different frameworks yield broadly similar results, showing that IMF resources will be stretched but adequate in a synchronised, moderate scenario. The total financing needs arising from a moderate shock involving around 40 EMEs are around US$1.0 trillion for the IMF resources-at-risk methodology and US$1.6 trillion for the scenario analysis. Many more countries (19) are able to cover their full financial needs by using reserves, FCL/PLL, RFAs or a combination of these, according to the IMF resources-at-risk framework, against nine in the scenario analysis. More generally, countries can partially deal with their own needs by using about US$400-650 billion of FX reserves. In addition, a couple of them can draw small amounts from their FCL/PLL facilities and between 12 and 14 countries can use between US$70 and 135 billion from the respective RFAs. After considering these, the remaining funding needs are consistently reduced to a value around US$530 in the IMF resources-at-risk and 740 billion in the scenario analysis. Since some countries are no longer able to fund the IMF, its resources are negatively impacted: the reduction is in the US$80–140 billion range, leading adjusted IMF resources to fall to a value between US$600 and 700 billion. This means that, according to the scenario analysis, a moderate shock can deplete IMF resources, while the IMF resources-at-risk predicts that the adjusted IMF resources are just about able to cover EMEs' remaining funding needs. But the difference between the two sets of

results is small in the context of this exercise (the funding gap in the scenario analysis is just US$120 billion and could be bridged if, for example, the impact on IMF available resources was smaller).

Table C: Comparison of results from the two methodologies in the specification with offsetting factors (b) (all the flows of the balance of payments identity are shocked)

Moderate shock	Scenario analysis (univariate shocks - stock)				IMF resources-at-risk (skewed-t)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**1,022.0**	**732.0**	**37**		**1,072.4**	**768.1**	**49**	
Funded by reserves	418.0	299.4	29	4	509.9	365.2	38	27
Funded by FCL/PLL	61.9	44.4	3	1	11.8	8.4	1	1
Funded by RFAs	76.8	55.0	15	3	73.0	52.3	10	2
Remaining funding needs	**465.2**	**333.2**	**29**		**477.7**	**342.1**	**19**	
Impact on IMF available resources	-52.8	-37.8			-93.6	-67.0		
Adjusted IMF available resources	704.7	504.8			663.9	475.6		

Severe shock	Scenario analysis (univariate shocks - stock)				IMF resources-at-risk (skewed-t)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**1,636.5**	**1,172.2**	**34**		**1,794.2**	**1,285.2**	**49**	
Funded by reserves	596.5	427.3	27	3	712.9	510.6	38	20
Funded by FCL/PLL	73.2	52.4	2	0	35.7	25.6	3	3
Funded by RFAs	85.7	61.4	13	1	102.5	73.4	12	1
Remaining funding needs	**881.2**	**631.2**	**30**		**943.1**	**675.6**	**25**	
Impact on IMF available resources	-90.5	-64.8			-121.1	-86.7		
Adjusted IMF available resources	667.0	477.8			636.5	455.9		

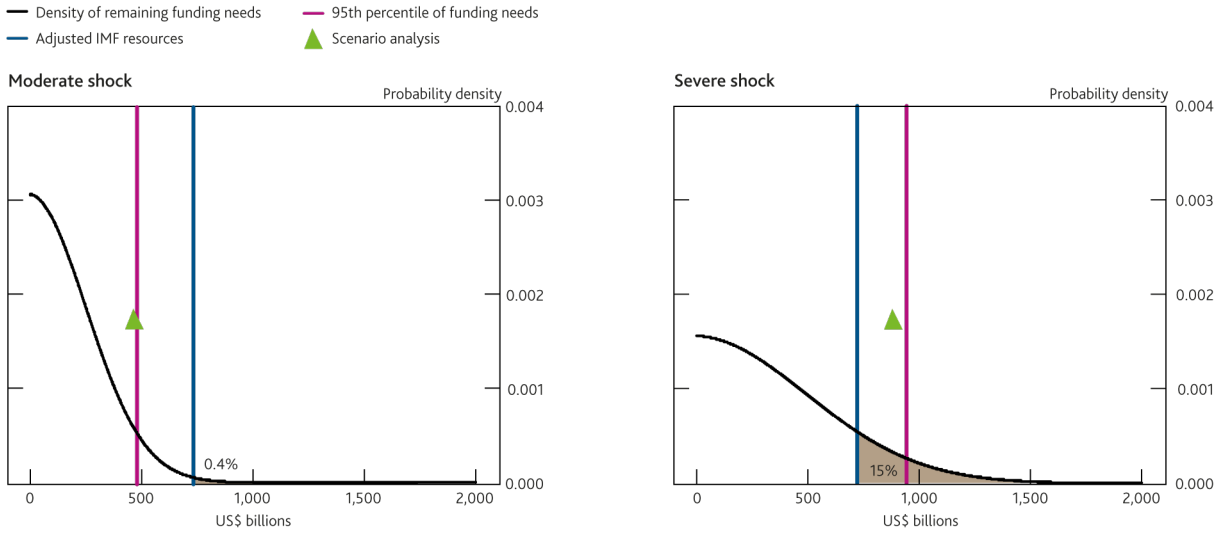
Notes: the table shows outstanding amounts both in US$ and in SDR billion. The moderate scenario is defined considering the median shock in the scenario analysis methodology and the distribution of capital flows without perturbations to global financial conditions in the IMF resources-at-risk framework. The severe scenario considers instead the 25th percentile shock in the scenario analysis methodology and the distribution of capital flows arising from a three standard deviation shock to global financial conditions in the IMF resources-at-risk. Column 'N' reports the number of countries experiencing financing needs and relying on a given layer of the GFSN. The column 'N fully funded' counts the number of countries that are able to fully cover their financing needs using reserves, reserves+FCL/PLL, reserves+FCL/PLL+RFAs, respectively.

IMF resources may be insufficient when countries face a severe synchronized reduction of portfolio and other investment inflows. Considering the severe scenario, the total financing needs are much higher, between US$2 and 2.5 trillion. Remaining financing needs are also increased to between US$1.2 and 1.5 trillion. Hence, according to both simulations, the adjusted IMF resources, reduced in this case by US$120–190 billion, are unable to cover the remaining funding needs.

Table C shows that IMF resources may be insufficient in the severe scenario even when we take into consideration offsetting factors for the synchronized sudden stop (specification b). Given the offsetting factors, total financing needs arising from a moderate shock are, as expected, smaller: in the US$1.0–1.1 trillion range for the moderate scenario and US$1.6–1.8 trillion for the severe scenario. The IMF resources-at-risk methodology predicts that more countries will have financing needs and (as in specification a) will be able to fulfil them by using FX reserves. Remaining funding needs are around US$470 billion in the moderate scenario and between US$880 and 950 billion in the severe scenario. According to both methodologies, the resulting adjusted IMF resources are still able to cover the funding needs induced by a moderate shock, but fall short when considering a severe one.

Chart 29: The probability of IMF resources being insufficient is close to zero for the moderate scenario but around 15% for the severe scenario

Distribution of remaining funding needs according to the IMF resources-at-risk framework and comparison with the scenario analysis main calibration. Estimated distributions are reported for both the moderate and severe scenario



Note: the upper panel show the distribution of EMEs remaining funding needs as calculated by the capital flows-at-risk methodology, derived without perturbations to global financial conditions (moderate scenario). The lower panel shows the same distribution but considering a tightening of global financial conditions corresponding to three standard deviations (severe scenario). The pink line is the 95th percentile of those two distributions, while the line 'Adjusted IMF resources' is the mean of adjusted IMF available resources for the diverse shocks considered in this exercise. For comparability purposes, the estimates of the scenario analysis based on shocks calibrated with respect to the capital stocks are also reported. The grey area is the region of the distribution for which IMF resources are overwhelmed. The number close to or within is the corresponding probability of this happening.

Source: Authors' computations on IFS and *WEO* data.

The IMF resources-at-risk methodology also allows an analysis of the whole distribution of demand for IMF resources, as shown in **Chart 29.**[34] The black curves represent the probability density of remaining funding needs (for specification b). They specify the probability of a variable (in this case demand on IMF resources) falling within a particular range of values. The pink lines represent the 95th percentiles of these densities and correspond to the remaining funding needs in **Table C**. As an example, the pink line in the moderate scenario (left panel) indicates that the probability of demand on IMF resources falling below US$477.7 billion is 95% (the area below the curve up to the pink line). The same principle applies to the calculation of the probability that EME funding needs exceed IMF resources: it is the area below the curve to the right of the blue line indicating adjusted IMF resources, represented in **Chart 29** by the grey area (better seen in the severe scenario). The probability is close to zero for the moderate scenario but higher, around 15% for the severe scenario. The corresponding probabilities for specification (a) are, as expected, higher: 1% for the moderate shock and 24% for the severe shock. The chart also highlights the strong comparability between the estimates from the scenario analysis framework and the 95th percentile of the distribution of remaining funding needs in the IMF resources-at-risk framework.

The annex reports robustness checks to quantify the sensitivity of our results to different calibrations of the shocks in the scenario analysis and different distribution fittings in the IMF resources-at-risk framework. IMF resources are always insufficient when considering severe scenarios.

3.3: Reflections on the adequacy of the GFSN

While there are benefits to EMEs from integrating into global financial markets, there are also trade-offs to be considered, as integration exposes countries to potentially volatile capital flows. A stronger GFSN would improve this trade-off. In the above, we have shown that the coverage of the existing GFSN is uneven, leaving many EMEs potentially vulnerable to shocks in global financial conditions.

The IMF is the only truly global layer of the GFSN and the one with the largest pool of resources. However, according to our simulations, current IMF resources are able to cover EMEs' financial needs in moderate systemic shock scenarios, but not in historically rare, severe systemic shock scenarios. Our analysis shows that if the IMF was

34 The charts show the distribution obtained by fitting a skewed-t on the rough empirical quantiles. We choose this distribution, instead of the zero-inflated gamma (see the robustness subsection in annex), because it delivers more intuitive results from a graphical point of view.

called on in the face of a severe and persistent (two-year) sudden stop in capital flows to EMEs, its resources may quickly be depleted. Over the simulated two-year period, demands on IMF resources may accumulate, as an increasing number of countries experience difficulties as their external debt obligations fall due, or as they need to obtain fresh external finance.

Federal Reserve swap lines appear to have played a decisive role in reducing market volatility. The main effect may come from signalling that the Fed is ready to provide liquidity to offset demand for the main global reserve currency, as the direct benefits to the few EMEs that received them seem to be limited. But uncertainty regarding the activation of the swaps might add to market volatility.

A number of EMEs were able to use their domestic policy tools countercyclically (including prudential policies) in a way that helped delay borrowing from the Fund. Countries also ran down, to some extent, their FX reserves during the Covid-19 episode.

Although RFA resources have not been called on to any significant extent so far in this crisis, or in past ones, we assume they are accessed in our scenarios, given that, in theory, they should be available. The modest use of RFAs resources may be related to the fact that the need for assistance was concentrated in countries with little or no access to RFAs, such as those in Sub-Saharan Africa. This highlights the fact that only a global institution such as the IMF has broad enough membership to effectively backstop countries in region-wide or global crises. Given that this might lead to an underestimation of demand on IMF resources in an actual crisis, we also estimate what the calls on the IMF might be if RFA resources were not available. In this setup, it means that more of the total financing needs would be translated into remaining funding needs for the IMF. Taking this into consideration, the probability that funding needs by EMEs will exceed IMF's lending capacity in specification (b) would increase to almost 20% (from 15% in the main results reported above).

This result suggests the need for a more adequately resourced IMF, notwithstanding the prompt and adequate response given in the immediate aftermath of the Covid-19 crisis.

If the IMF is not able to fulfil its mission with the resources at hand, EMEs might pursue costly self-insurance through reserve accumulation, with at best uneven gains in coverage and undesirable side effects on global financial markets. Or they might reconsider their integration into global financial markets. They might also consider alternative strategies that could lead to a more fragmented GFSN.

Annex 1: Robustness checks for main results in Section 3.2

This annex looks at how sensitive estimates presented in Section 3.2 are to different specifications on both the scenario analysis and IMF resources-at-risk frameworks. In what follows we consider specification (b), in which all components of the balance of payments identity are shocked.

The first check relates to the definition of the shocks in the scenario analysis. **Table D** presents simulations of financing needs and impacts on IMF resources based on the shocks calibrated with respect to GDP, both univariate and aggregated, as an alternative for the scenario analysis based on the initial stock of the flow variable presented in **Table C**. Measuring by GDP puts emphasis on countries' economic importance, while stocks of external liabilities are a better proxy for financial integration into global markets (degree of financial openness). However, the advantage of using the GDP calibration is that it allows the computation of the aggregated shock, ie the variation of gross capital inflows minus gross capital outflows plus the current account balance. Since this last shock compares the observed changes in both inflows and outflows observed in past sudden stop episodes, it takes into account the real correlations between capital flows.

Table D: Scenario analysis: robustness checks

Moderate shock	Scenario analysis (univariate shocks — GDP)				Scenario analysis (aggregated shock — GDP)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**1,024.9**	**734.1**	**36**		**1,020.4**	**730.9**	**36**	
Funded by reserves	490.9	351.6	29	14	489.7	350.8	29	15
Funded by FCL/PLL	12.1	8.7	1	1	12.0	8.6	1	1
Funded by RFAs	94.2	67.5	12	2	94.0	67.4	11	1
Remaining funding needs	**427.6**	**306.3**	**19**		**424.6**	**304.1**	**19**	
Impact on IMF available resources	-119.3	-85.5			-94.0	-67.3		
Adjusted IMF available resources	638.2	457.1			663.6	475.3		

Severe shock	Scenario analysis (univariate shocks — GDP)				Scenario analysis (aggregated shock — GDP)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**2,458.9**	**1,761.3**	**38**		**2,824.0**	**2,022.8**	**41**	
Funded by reserves	789.6	565.6	31	3	808.6	579.2	33	10
Funded by FCL/PLL	97.5	69.9	3	0	93.2	66.8	3	1
Funded by RFAs	173.9	124.5	17	3	148.1	106.1	15	2
Remaining funding needs	**1,397.9**	**1,001.3**	**32**		**1,774.0**	**1,270.7**	**28**	
Impact on IMF available resources	-188.2	-134.8			-164.2	-117.6		
Adjusted IMF available resources	569.3	407.8			593.3	425.0		

Notes: The table shows outstanding amounts both in US$ and in SDR billion. The moderate scenario is defined considering the median shock, while the severe scenario considers instead the 25th percentile shock. Column 'N' reports the number of countries experiencing financing needs and relying on a given layer of the GFSN. The column 'N fully funded' counts the number of countries that are able to fully cover their financing needs using reserves, reserves+FCL/PLL, reserves+FCL/PLL+RFAs, respectively.

Table D shows that results presented in the main text are robust. In particular, in the moderate scenario, the shocks defined with respect to the GDP, both univariate and aggregated, deliver results similar to each other and to the simulation using shocks calibrated with initial stock of the flow variable presented in the main results. According to all these estimates, adjusted IMF resources are able to cover the remaining funding needs induced by the simulated sudden stop. In the severe scenario, both the univariate and the aggregated shocks defined with respect to the GDP lead to (slightly) higher financing and remaining funding needs, in comparison to the shocks

defined as a percentage of the stock.[35] Accordingly, looking at these results, the main message from the scenario analysis in the main text that IMF resources may prove inadequate when facing such shocks is robust.

Table E: IMF resources-at-risk: robustness checks

Moderate shock	IMF resources-at-risk (sample quantiles)				IMF resources-at-risk (zero-inflated gamma)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**1,383.3**	**990.9**	**49**		**1,325.6**	**949.5**	**49**	
Funded by reserves	647.0	463.4	38	27	625.4	448.0	38	27
Funded by FCL/PLL	6.3	4.5	1	1	10.0	7.1	1	1
Funded by RFAs	86.8	62.2	10	2	89.7	64.3	10	2
Remaining funding needs	**643.3**	**460.8**	**19**		**600.5**	**430.1**	**19**	
Impact on IMF available resources	-93.7	-67.1			-112.9	-80.8		
Adjusted IMF available resources	663.8	475.5			644.7	461.8		

Severe shock	IMF resources-at-risk (sample quantiles)				IMF resources-at-risk (zero-inflated gamma)			
	USD	SDR	N	N fully funded	USD	SDR	N	N fully funded
Total financing needs	**2,241.5**	**1,605.5**	**49**		**2,168.2**	**1,553.1**	**49**	
Funded by reserves	873.2	625.5	38	20	835.4	598.4	38	20
Funded by FCL/PLL	40.2	28.8	3	3	37.9	27.2	3	3
Funded by RFAs	117.8	84.4	12	1	120.7	86.5	12	1
Remaining funding needs	**1,210.2**	**866.9**	**25**		**1,174.2**	**841.0**	**25**	
Impact on IMF available resources	-120.4	-86.3			-138.5	-99.2		
Adjusted IMF available resources	637.1	456.3			619.1	443.4		

Notes: The table shows outstanding amounts both in US$ and in SDR. The moderate scenario is defined considering the distribution of capital flows without perturbations to global financial conditions, while the severe scenario considers instead the distribution of capital flows arising from a three standard deviation shock to global financial conditions. Column 'N' reports the number of countries experiencing financing needs and relying on a given layer of the GFSN. The column 'N fully funded' counts the number of countries that are able to fully cover their financing needs using reserves, reserves+FCL/PLL, reserves+FCL/PLL+RFAs, respectively.

The main results of the analysis using the IMF resources-at-risk framework do not change by the choice of the fitting distribution. **Table E** shows the empirical quantiles taken directly from the capital flow-at-risk model (without fitting a distribution on them) and the theoretical quantiles of a zero-inflated gamma distribution (instead of the skewed-t) fitted on the same rough quantiles (see annex on distributions). The zero-inflated gamma should in theory capture better the excess of zeros observed in the distributions of financial needs, arising from some countries' financing needs (estimated using the capital flows-at-risk approach) being equal to zero.[36] Some countries receive capital inflows even when global factors are tighter, in correspondence to the higher quantiles of the capital flows distribution.

As expected, the zero-inflated gamma fits better the rough data than the skewed-t and its theoretical quantiles are closer to the empirical ones. The total financing and the remaining funding needs estimated considering the 95th percentile of this distribution are slightly larger than the ones obtained with the skewed-t, hence supporting our main conclusions. The computation of the probability that funding needs by EMEs will exceed IMF resources also changes with different distributions, but also broadly similar to the ones derived from the skewed-t. When using the zero-inflated gamma, the probabilities are 3.3% and 10.4% for the moderate and severe scenarios respectively. For the sample quantiles, the correspondent probabilities are 4.0% and 11.1%.

35 This overestimate is due to the stronger negative dependence on the countries' degree of financial openness that characterises the shocks calibrated with GDP, otherwise controlled in the formulation behind the main results by the size of the stock of external liabilities.

36 This is captures by the max operator in the definition of remaining financing needs RFN_c in equation 3.

Annex 2: Distributions used in the IMF resources-at-risk approach

The quantiles of the total financing and remaining funding needs, derived from the distribution of gross inflows and outflows and the current account adjustment, are fitted using two distributions: the skewed-t (see the main results subsection) and the zero-inflated gamma (see robustness checks). These two random variables have the following characteristics:

a) The skewed-t model for a random variable Y has the following density function:

$$f(y) = \frac{2}{\sigma} t\left(\frac{y-\mu}{\sigma}; \nu\right) T\left(\alpha \frac{y-\mu}{\sigma} \sqrt{\frac{\nu+1}{\nu + \left(\frac{y-\mu}{\sigma}\right)^2}}; \nu+1\right) \quad (8)$$

where $t(.)$ and $T(.)$ respectively denote the probability density function and the cumulative density function of the Student t distribution. The distribution's parameters determine its location μ, scale σ, fatness ν, and shape α. In particular, α controls the degree of skewness:

- when $\alpha = 0$, the skewness vanishes, and we obtain the standard Student t density;

- as α increases (in absolute value), the skewness of the distribution increases;

- if the sign of α changes, the density is reflected on the opposite side of the vertical axis.

b) A random variable X follows a zero-inflated gamma model if it assumes a value of zero with probability $1-\theta$ and it assumes with probability θ a standard gamma distribution. Its density function is defined therefore as:

$$f(x) = (1-\theta) I(x=0) + \theta \frac{\lambda^\alpha}{\Gamma(\alpha)} x^{\alpha-1} \exp(-\lambda x) I(x>0) \quad (9)$$

where $I(.)$ is the indicator function, $\Gamma(.)$ Is the gamma function, while α and λ are the shape and rate parameters of the standard gamma distribution, respectively. This distribution is very useful to fit data that are continuous with the exception of a significant probability mass located in zero.

Annex 3: How did the sudden stop affect low-income countries and how did they respond?

Low-income countries (LICs) were less able than EMEs to cope with the health crisis, or to sustain containment measures for long, given the larger sizes of their informal labour forces. So far, the spread of the disease has been slower in these countries and especially in Africa (where most LICs are) than in other parts of the world (**Chart A**). LICs entered the Covid-19 crisis with less policy space than EMEs, less flexible exchange rates, an increased dependency on remittances (**Chart B**), and limited FX buffers to deal with capital outflows. Many LICs increased their dependence on international capital markets over the last decade, with associated deterioration in debt dynamics and increasing debt costs. Just over half of all LICs were at high risk of external debt distress or already in distress before the Covid-19 crisis, according to IMF estimates.

Sub-Saharan Africa saw large portfolio debt outflows (**Chart C**)**.** Just one country in the region issued sovereign bonds in March and none since as the time of the writing. However, although more than half a year has passed, and we have evidence that many LICs faced severe external financing pressures in the first quarter of 2020 (Q1), official data still do not paint a representative picture of aggregate balance of payments movements for LICs: only one third of almost sixty LICs have published balance of payments statistics for Q1.

Remittances are estimated to have dropped sharply. Between April and May 2020, remittances to Bangladesh fell by 18%, and by 39% to the Kyrgyz Republic from a year earlier, according to IMF estimates. The World Bank expects remittances to drop by 20% in 2020.

LICs also adopted expansionary macroeconomic policies to mitigate the recessionary impact of the pandemic. Fiscal packages introduced by many LICs were on average half the size of those introduced by EMEs (around 1.9% of GDP for our sample) with limited liquidity support provided through guarantees and loans (**Chart D**).[37] Previously existing high (external) debt stocks limited the scope for further countercyclical fiscal policy in this crisis. Like EMEs, most LICs have cut their policy interest rate; Ghana has also bought local-currency government bonds in primary markets to finance its budget deficit.

In the early phase of the pandemic, LICs' currencies depreciated against the US dollar. In countries with a relatively higher foreign investors' participation in sovereign bond markets (eg Ghana and Nigeria), currencies depreciated more, pushing central banks to intervene in FX markets.

In terms of FX buffers to deal with capital outflows, the median ratio of available FX reserves to GDP was 10% at the end of 2019, while short-term term debt accounted for about 30% of available reserves. Given the increased exposure to international markets and vulnerability to capital outflows, useful steps could be taken to improve assessments of reserve adequacy of these countries: the IMF could develop a methodology to assess the adequacy of LICs' FX reserves, tailored to their needs and characteristics.

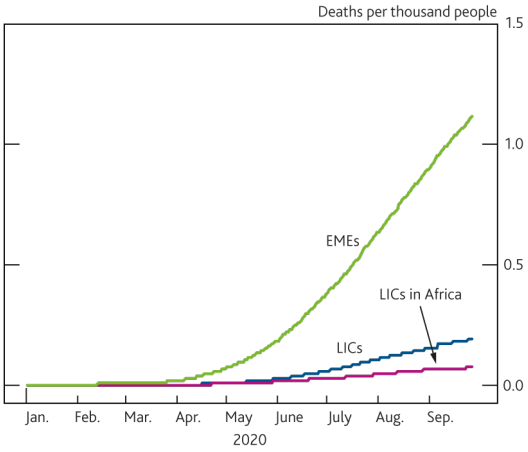
Official development assistance reacted quickly in response to the Covid-19 outbreak, with donors mobilising resources for the IMFs Poverty Reduction and Growth Trust (PRGT). The main relief to external pressures came from the Fund's emergency lending facilities and other multilateral agencies (see Box 2).

The G20 Debt Service Suspension initiative (DSSI) also helped to stem pressures. The initiative allows for a temporary suspension of official bilateral debt service payments by LICs. It was approved initially in April 2020 until December 2020, with an extension agreed in October 2020 to at least June 2021. 46 out of 73 eligible countries have formally requested to join it, deferring around US$5 billion of debt service. The full realisation of the DSSI has so far been hampered by the inconsistent application of terms and conditions across creditors.

37 The sample includes Nigeria, Vietnam, Kenya, Bangladesh, Myanmar, Uzbekistan, Ethiopia, Ghana, Tanzania, and Sudan.

Chart A: The spread of the disease has been slower in LICs and especially Africa

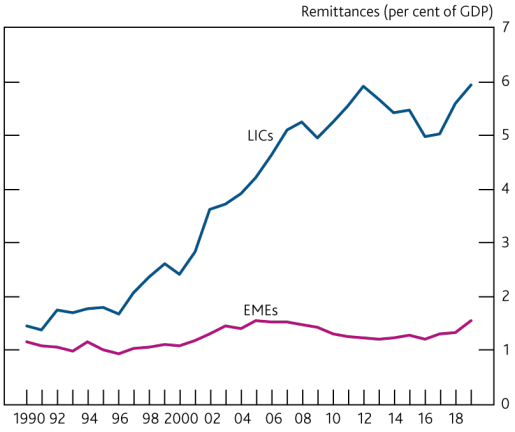
Covid-19 deaths per thousand people



Source: World Health Organisation, World Bank for population.

Chart B: LICs entered the crisis heavily dependent on remittances

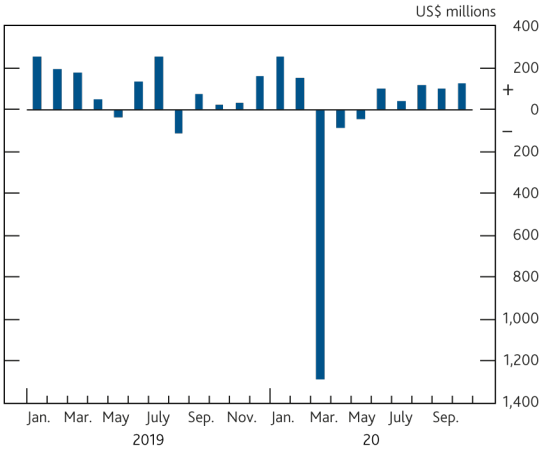
Remittances (per cent of GDP of recipient countries)



Source: World Bank Migration and Remittances Data (2019 is a preliminary estimate).

Chart C: Sub-Saharan Africa saw large portfolio debt outflows at the beginning of the pandemic

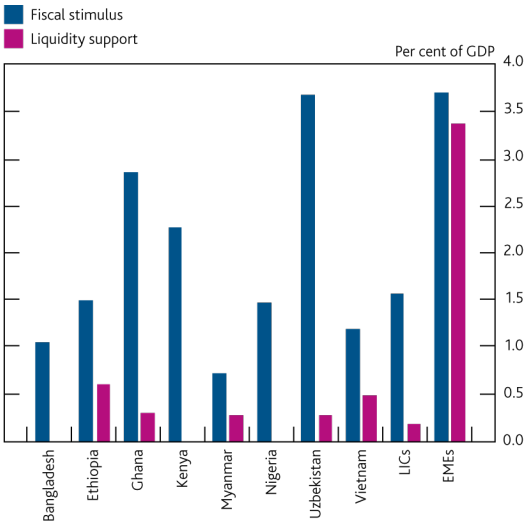
Selected DSSI-eligible countries: cross-border bond flows (US$ millions)



Source: EPFR Global. Countries: Angola, Ethiopia, Ghana, Ivory Coast, Kenya, Mozambique, Nigeria, Rwanda, Tanzania and Zambia.

Chart D: Fiscal packages by LICs were on average half the size of those by EMEs; limited liquidity support

Measures of fiscal stimulus and liquidity support for selected LICs and EMEs and LICs averages (per cent of GDP)



Notes: Fiscal stimulus is the sum of additional spending and foregone revenue. Liquidity support includes equity, loans, and guarantees provided by the public sector. LICs aggregate as defined by the IMF Fiscal Monitor (not limited to countries presented here). EMEs refer to the average values in the sample of 23 countries in Section 2.

Source: IMF Fiscal Monitor.

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