European Central Bank

EUROSYSTEM

Occasional Paper Series

IRC Task Force on IMF issues

A quantitative analysis of the size of IMF resources

Contents

Abstract

In this report, three methodological approaches are applied to assess the size of the International Monetary Fund: benchmarking Fund resources against a number of relevant global economic and financial indicators; an extrapolation of past and current IMF programme characteristics; and a shock scenario analysis. Overall, while the results of the different approaches depend on the assumptions and the timeframe considered, the quantitative analysis indicates that a prudent approach would call for maintaining Fund total resources at their current levels. Yet, the quantitative analysis of the size of the Fund made in this report should be seen only as one element to assess the adequacy of Fund resources. It does not take into account qualitative considerations, such as the increased resilience of the global economy and the efforts made to strengthen regulation and supervision since the financial crisis, which should complement the quantitative analysis to complete the analytical basis for decision makers. Moreover, the final decision on the appropriate size of Fund resources will need to include political judgement. Therefore, this report does not provide recommendations on the appropriate level of IMF resources after the expiration of borrowed resources.

Keywords: IMF, GFSN, shock scenario analysis

JEL codes: F3, F32, F38, F42, F65, G28

Non-technical summary

This report assesses – from a quantitative point of view – the amount of resources that the Fund should have available to appropriately pursue its mandate as the key international financial institution. The global financial safety net (GFSN) has undergone a significant expansion both in the number of layers and the amount of resources available over the past decade, but the IMF remains the core global institution at its centre, responsible for maintaining stability at the global level, preventing crises and supporting member countries under balance of payments stress. Additional sources of liquidity support are available to a number of countries but not all.

Three methodological approaches are applied to assess the size of the Fund: the traditional approach of benchmarking Fund resources against a number of relevant global economic and financial indicators; the analysis and extrapolation of past and current IMF programme characteristics; and a shock scenario analysis. Before describing the results, there are some aspects of the size of the Fund worth mentioning: (1) the 14th General Review of Quotas (GRQ) and the 2010 Reform represented a significant improvement of the Fund's own resources; (2) the 15th GRQ is under way; (3) going forward, the expiration of bilateral borrowing agreements (BBAs), in 2019-2020, and of the New Arrangements to Borrow (NAB), in 2022, may imply a strong reduction in the Fund's lending capacity; (4) the level of actual commitments of Fund resources in the past has always been below 50% of quota and NAB resources; and (5) neither the 2012 nor the 2016 BBAs have had to be activated yet.

Our results show that the traditional-indicator analysis is not conclusive on the adequacy of Fund current resources, although it points to a sizable deterioration in the medium term. The Fund current resources appear sufficient in terms of GDP or capital-inflow metrics, but they look too low compared with other indicators such as external liabilities, which better represent the increasing size of global financial interconnections and the related risks of propagation. In the same vein, current programme characteristics would not signal the need for additional IMF resources at the present stage, but this situation may change going forward if the global economy moved from the present phase of cyclical upturn and benign financial backdrop to more stressed situations.

Finally, the variety of hypotheses and assumptions used in the shock-scenario analysis leads to a wide range of results: they suggest that the IMF's current overall resources are sufficient to cover remaining financing gaps in most moderate sudden-stop scenarios in Emerging Market Economies (EMEs) or sovereign debt shock scenarios in Advanced Economies (AEs). However, Fund resources (including the currently inactivated borrowed resources) would just cover – or not even cover – the potential demand for financing in more severe scenarios. Furthermore, it cannot be excluded that systemic crises in advanced economies, for example, could rapidly spill over into other regions, making the shock more severe and therefore potentially

increasing the need for Fund resources by more than suggested by the separate shocks to the two groups of countries.

All in all, the results of the different approaches applied in this report to assess the Fund's resources depend on the assumptions and the time frame considered. Having said that, the quantitative analysis indicates that a prudent approach would call for maintaining Fund total resources at their current levels. This conclusion is also relevant from another perspective, as a strong and well-funded IMF is a central piece of a strong and credible GFSN.

Yet, the quantitative analysis of the size of the Fund made in this report should be seen only as one element to assess the adequacy of Fund resources. It does not take into account qualitative considerations. The report does not discuss either issues related to the composition of Fund resources between quota and different types of borrowed resources.

1   Introduction

This report assesses – from a quantitative point of view – the amount of resources that the Fund should have available to appropriately pursue its mandate as the key international financial institution. In section 2, we present a metric-based analysis, using traditional benchmark indicators. An approach based on current programme characteristics is applied in Section 3. Section 4 contains a brief description of the different layers of the GFSN other than Fund resources (i.e. reserves, swap lines and regional financing arrangements), information that is used in Section 5 in order to estimate the potential calls on IMF resources under adverse shock scenarios for both Advanced Economies (AEs) and Emerging Market Economies (EMEs). The analysis focuses on quantitative benchmarks and scenarios and does not enter into qualitative considerations, such as the resilience of the global economy and the efforts made to strengthen it since the financial crisis. The note does not discuss issues related to the composition of Fund resources. These aspects will need to be considered by policymakers in order to make well-informed decisions.

As background information for the discussions and assessments in the note, Table 1 provides data on the Fund's size and financing capacity. In the metric-based analysis of Section 1, a broad definition of the Fund's resource envelope is used: the total amount of disbursed quotas and standing borrowed resources. In the shock-scenario analysis, a narrower definition of the Fund's financing capacity is used, i.e. uncommitted and potentially usable resources for non-concessional financing, computed as the sum of the Forward Commitment Capacity (FCC) and inactivated borrowed resources from NAB and bilateral borrowing agreements (BBAs), excluding the prudential balance.

Traditionally the GFSN had consisted mainly of countries´ own foreign exchange reserves, with the IMF acting as a backstop (ECB, 2018). However, since the global financial crisis, the GFSN has expanded significantly with the continued accumulation of reserves as well as the sharp increase of swap lines between central banks, and the further development and creation of new Regional Financing Arrangements (RFAs). GFSN resources now comprise four broad categories each having its particular country coverage, characteristics, strengths and weaknesses: foreign exchange reserves, bilateral swap lines, the IMF and RFAs (Scheubel and Stracca, 2016 and ECB, 2016 and 2018).

In 2011, the G20 agreed on a set of general principles to guide the relationship between the IMF and RFAs. Since then, the GFSN has continued to grow, becoming more multipolar. RFAs have expanded, reaching an aggregate size comparable to that of the IMF. The IMF, with its quasi universal membership and its large amount of resources available, continues to be at the centre of the GFSN. The G20 has taken a lead role in discussing and overseeing the GFSN. In 2017, the G20 Finance Ministers and Central Bank Governors mandated a group of experts (denominated Eminent Persons Group) to consider the optimal role of the international financial institutions (IFIs) including the IMF and recommend practical reforms to improve the

functioning of the global financial architecture. The Group will present their report at the IMF-WB Annual Meetings in October 2018.

Table 1

IMF key financial indicators (year-end 2017)

Total IMF resources[1]	SDR billions	USD bn[3]	In percent of world GDP[4]
Quotas	475.5	675.5	0.84
NAB	182.4	259.1	0.32
BBAs	287.6	408.6	0.51
Total	945.5	1,343.3	1.68

IMF uncommitted resources[2]	SDR billions	USD bn[3]	In percent of world GDP[4]
FCC	219.4	311.6	0.38
Unactivated NAB	118.6	168.5	0.21
Unactivated BBAs	230.1	327.0	0.40
Total	568.1	807.1	1.01

Sources: European Commission, Haver Analytics, World Bank and ECB calculations (total IMF resources); IMF (2017), WEO Database and update of FCC (December 28, 2017) (IMF uncommitted resources).
Notes: FCC is the main measure of the IMF's capacity to make new resources available to its members. It comprises uncommitted usable resources from quota and IMF borrowing. For more details see IMF Financial Operations 2018.
(1) Quotas are year-end disbursed Quotas; BBAs are year-end approved agreements.
(2) IMF uncommitted resources as in the shock scenarios in Section 4. Data from IMF's weekly report as of December 28, 2017.
(3) Exchange rate as of end December 2017.
(4) October 2017 WEO.

2 The relative size of the IMF according to traditional measures

This section presents a metric-based assessment of the size of the IMF based on the traditional approach of benchmarking Fund resources against a number of relevant global economic and financial indicators. Fund resources consist of quota, effectively members' capital subscriptions to the Fund, and borrowed resources. The (currently inactivated) borrowed resources are the NAB and the more recent BBAs; both are credit arrangements between the IMF and a group of member countries, the main difference being that the BBAs are only used after the NAB is exhausted. The indicators used to assess the size of these resources are GDP, international reserves, balance of payments (BoP) flows – financial inflows and current account payments – and gross external liabilities.

In this paper, the analyses give a view of potential resource needs from a broad set of measures.[1] IMF staff usually calculates ratios of resources to global indicators using the agreed quota size in past quota reviews (those where quota increases were agreed), relative to each indicator's average for the review period.[2] Instead, in this report resources are measured on a yearly basis and compared to the historical average (1975-2016 post Bretton Woods)[3] and the post-crisis period (2008-2016); in doing so, the adequacy of quota-size decisions in past reviews is not prejudged.

For each indicator, the Fund's "size gap" is estimated as the difference between the current level of Fund resources relative to the indicator, and the reference historical average for that ratio. When assessing the adequacy of Fund resources using these traditional metrics, two aspects stand out: first, the 14th General Review of Quotas (GRQ) which was the most recent adjustment of the size and distribution of quota resources, represented a significant improvement of the Fund's own resources in terms of traditional metrics, restoring some relevant ratios to historical averages; second, going forward, bilateral agreements are projected to expire in 2019-2020; if they are not renewed, the Fund's lending capacity will decline accordingly at that point. NABs have been renewed through November 2022.

---

[1]   Data availability is a constraint when constructing some measures. Additionally, we acknowledge the caveats for using some measures as benchmark indicators (for instance, international reserves, given diverse motivations for accumulation in addition to insurance).

[2]   IMF (2010).

[3]   Due to data collection restrictions, most of the series used start in 1975 (instead of the formal end of the Gold Standard in 1973). External Liabilities start in 1980, given the very volatile figures recorded in the late 70s.

Chart 1

Fund resources to GDP and Reserves

- (a1) [Q+GAB/NAB] to GDP ratio
- (a1) Average (1975-2016)
- (a1) Average (2008-2016)
- Including bilateral arrangements
- (a2) Q to GDP ratio
- (a2) Average (1975-2016)
- (a2) Average (2008-2016)

Quota (and quota + borrowed resources) to GDP ratio (1976-2022)

- (b1) [Q+GAB/NAB] to reserves ratio
- (b1) Average (1975-2016)
- (b1) Average (2008-2016)
- Including bilateral arrangements
- (b2) Q to reserves ratio
- (b2) Average (1975-2016)
- (b2) Average (2008-2016)

Quota (and quota + borrowed resources) to reserves* ratio (1976-2022)

Sources: IFS (bottom panel) and WEO October 2017 databases (both panels).
Note: * including gold.

GDP. The ratios of IMF resources to GDP have remained above historical averages in recent years (see Chart 1, top panel), especially when borrowed resources are considered, showing a positive size gap for both reference periods 1975-2016 (see Chart 3) and 2008-2016 (see Chart 4). The combined effect of the crisis on GDP and the 14th GRQ on Fund resources increased these ratios above reference levels. Nevertheless, based on WEO's GDP projections, the ratios of both quota and total resources to GDP will rapidly decline towards long-term reference levels after the projected expiration of the BBAs, and below those references in the case of the 2008-2016 average.

Chart 2

Fund resources to Current Payments, Financial Inflows and External Liabilities

Legend (top panel):
- (c1) [Q+GAB/NAB] to capital inflows ratio
- (c1) Average (1975-2016)
- (c1) Average (2008-2016)
- Including bilateral arrangements
- (c2) Q to capital inflows ratio
- (c2) Average (1975-2016)
- (c2) Average (2008-2016)

Quota (and quota + borrowed resources) to capital inflows ratio (1976-2022)

Legend (middle panel):
- (d1) [Q+GAB/NAB] to current payment ratio
- (d1) Average (1975-2016)
- (d1) Average (2008-2016)
- Including bilateral arrangements
- (d2) Q to current payments ratio
- (d2) Average (1975-2016)
- (d2) Average (2008-2016)

Quota (and quota + borrowed resources) to current payments* ratio (1976-2022)

Legend (bottom panel):
- (e1) [Q+GAB/NAB] to external liabilities ratio
- (e1) Average (1980-2016)
- (e1) Average (2008-2016)
- Including bilateral arrangements
- (e2) Q to external liabilities ratio
- (e2) Average (1980-2016)
- (e2) Average (2008-2016)

Quota (and quota + borrowed resources) to external liabilities ratio (1980-2016)**

Sources: IFS and WEO Oct 2017 databases.
Notes: Capital inflows includes Financial Account liabilities from Direct investment, Portfolio investment and other debt instruments (top panel). * Debit from: goods and services and primary and secondary balances. Primary and secondary debits in 2017-2022 are estimated following the trend of its net balances. ** Total IIP Liabilities.
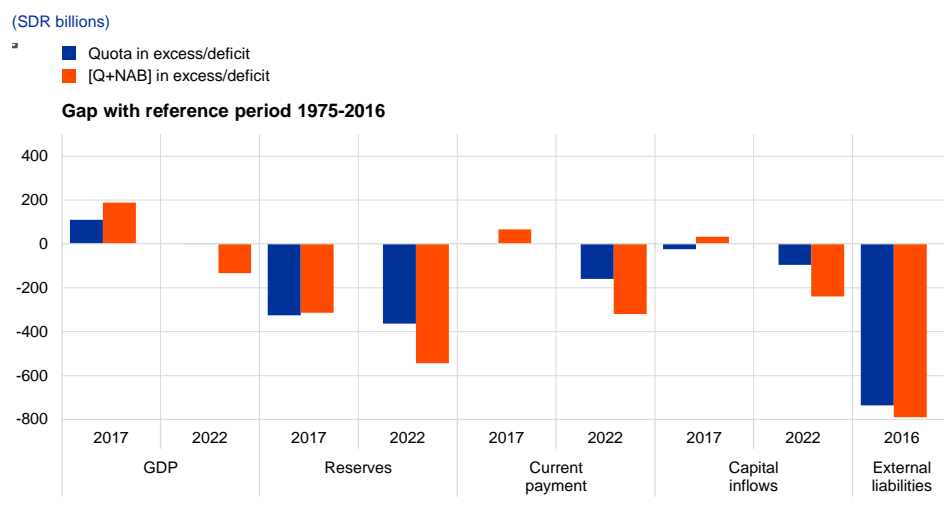
International Reserves. The ratios of IMF resources to FX international reserves have also picked up from historic lows since the Global Financial Crisis due to the increase in quota and borrowed resources (see Chart 1, bottom panel); so even if the ratios are below long-term historical averages they are above the 2008-2016 reference level (see Charts 3 and 4). Otherwise, the declining trend of these ratios reflects the rapid build-up of FX reserves. It has to be emphasised that the use of FX reserves to benchmark the size of the Fund is not straightforward as both are part of the GFSN and their relative movements may well signal changes in the preference for self-insurance vs. Fund support. This has to be taken into consideration when assessing these ratios.

Financial inflows and current payments. The size of the Fund relative to gross financial inflows and current payments shows significant historical fluctuations. In 2017, these ratios were in line with reference averages (see Chart 2), resulting in small positive size gaps compared to historical averages (see Chart 3), and a positive gap compared to the 2008-2016 average (see Chart 4).

External liabilities. Finally, as with previous metrics, the ratio of resources to gross external liabilities – an indicator of the scale of external balance sheet risks – has recovered recently, but in this case, it remains lower than the historical average (see Chart 2), resulting in a large negative gap (see Chart 3). In relation to the 2008-2016 average, the gap would be positive (see Chart 4).

Chart 3

Size Gap of the Fund (Q and Q+NAB) in 2017 and 2022*

(SDR billions)

ª

■ Quota in excess/deficit
■ [Q+NAB] in excess/deficit

Gap with reference period 1975-2016

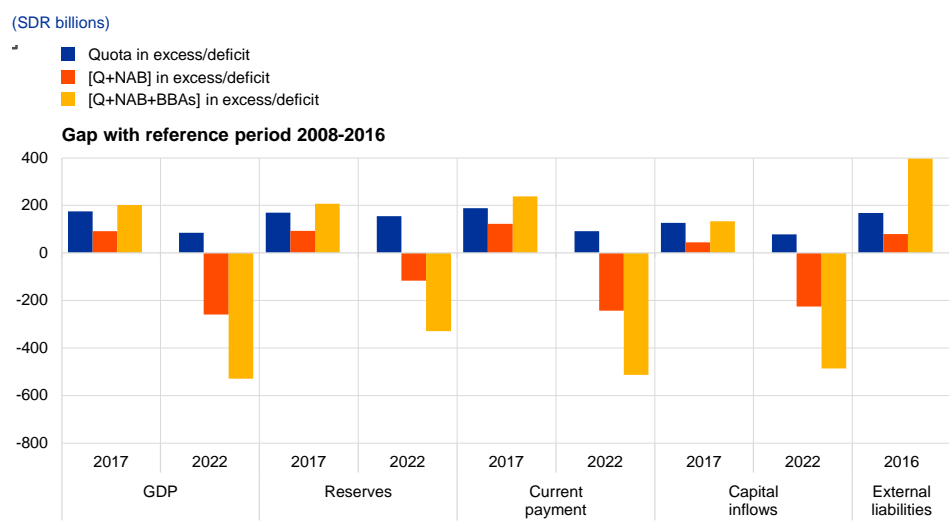

Sources: IFS, WEO October 2017 and own calculations.
Notes: *Each bar represents the size gap of the Fund, calculated as the difference between the current (projected) size of the Fund in each year, and a reference value based on ratios' historical (1975-2016) averages for each of the X axis variables. A positive (negative) bar means a surplus (deficit) of resources relative to the historical reference value. External liabilities gaps refer exclusively to December 2016, latest data available. Total size Q+NAB is SDR 657,842 bn in December 2017 and falls to 447,026 bn in 2022 after the expiration of the NAB.

The assessment of the size of Fund resources in terms of traditional benchmarks depends both on the reference period and the specific indicator chosen. From a long-term historical perspective (1975-2016), the current size of the Fund is above reference levels in terms of GDP and BoP inflows. However, current resources are below historical averages in terms of external liabilities, which is

indicative of the increased degree of global financial interconnections. And this is also the case of international reserves, although increased self-insurance may suggest less need for IMF resources. Going forward, after the expiration of BBAs, the different ratios are projected to decline over the medium term. Ratios calculated against GDP and BoP-inflow indicators would decline and converge rapidly towards reference levels after the expiration of the BBAs, and significantly negative size gaps would open in terms of reserves and external liabilities.

Chart 4

Size Gap of the Fund (Q; Q+NAB; Q+NAB+BBAs) in 2017 and 2022*

(SDR billions)

■ Quota in excess/deficit
■ [Q+NAB] in excess/deficit
■ [Q+NAB+BBAs] in excess/deficit

Gap with reference period 2008-2016

Source: IFS, WEO Oct 2017 and own calculations.
Notes: *Each bar represents the size gap of the Fund, calculated as the difference between the current (projected) size of the Fund in each year, and a reference value based on ratios' 2008-2016 averages for each of the X axis variables. A positive (negative) bar means a surplus (deficit) of resources relative to the historical reference value. External liabilities gaps refer exclusively to December 2016, latest data available.

3 Programme characteristics and implications for the size of the Fund

Recent years since the crisis have seen important changes in the characteristics of IMF programmes. This section provides an update of current programme trends taking into account the developments over the past years (see Annex A for updated tables).[4] A few key points are worth stressing when comparing the pre-crisis, crisis and post-crisis episodes.[5]

- **There has been a decline in the size of total Fund commitments since the crisis period (2008-2012).** In the past couple of years, the overall amount of resources committed to new programmes related to non-concessional (i.e. on competitive terms as opposed to credit lines with low-income countries) loans declined with respect to the very high levels seen earlier (see Table 2). In 2016 and 2017, new programme funding excluding precautionary lines was 18.0 and 1.0 billion SDR respectively, well below the level recorded in 2010 of SDR 59.8 billion (see Annex A).[6] Precautionary lines are credit arrangements under which the member agrees to meet specific conditions although it has indicated its intention not to make use of the arrangement. They are generally considerably larger than a non-precautionary IMF programme such as a stand-by arrangement (SBA).

- **The size of the countries receiving IMF loans has also decreased, reflecting less IMF involvement in advanced economies.** The share of world GDP of countries supported by non-concessional loans declined by around half since the crisis. This decline reflects the fact that there were no advanced economies (AEs) in the list of countries supported by new non-concessional loans since Cyprus' Extended Fund Facility (EFF) programme in 2013 (not considering here the Greek "approval in principle" SBA in 2017 nor the precautionary lines).

- **There is also a predominance, in terms of size, of precautionary lines concentrated in a few countries.** The resources committed to new programmes in recent years were predominantly applied to precautionary lines (the so-called FCL and PLL), although none of these lines have been disbursed to date. These facilities represented almost 82 percent of new committed resources in the whole of the post-crisis period, while it was about 57 percent of total committed resources in the crisis period (2008-2012). These resources

---

[4] The new IMF programme for Argentina was approved in June 2018 after the finalisation of this paper.

[5] Time partition, that is the assignment of any programme to a year, was made only on the basis of the first programme year.

[6] These figures do not reveal the amount of actually disbursed resources but the programme commitments. Further, a simple sum across a given time period of the resources allocated to IMF programmes would overestimate the actual amount of resources committed to programmes in the final year of the time period, since within a given time period, IMF programs can replace other programmes. This has also occurred systematically with precautionary lines.

continued to be highly concentrated, as revealed by the very small number of precautionary lines. The largest IMF programme in terms of resources committed, classified by the first programme year, has always been a precautionary line since 2009.

- **The reform of the exceptional access lending framework in early 2016 may result in a lower number of large IMF programmes.** As part of the package that sealed the ratification of the 2010 Reforms, the IMF Executive Board agreed to the elimination of the "systemic exemption" introduced in 2010. This reduces the IMF's flexibility to lend to countries whose debt is assessed to be sustainable but not with high probability in the presence of spillover and contagion risks, an exemption that was used, most notably, in the case of the 2010 Stand-By Arrangement with Greece. The removal of the exemption and an expectation that similar cases would lean more heavily on the private sector, through debt reprofiling or other sources of financing, would limit the involvement and financial risks of the IMF in comparable cases.

Table 2

IMF programme size characteristics

(summary table)

		2003-2007	2008-2012	2013-2017
Non-concessional, non-precautionary loans	Total number of programmes	25	37	24
	Total amount (SDR billions)	24,448	169,191	52,721
	Supported countries' share of world GDP (yearly average)	0.78	0.86	0.41
Precautionary non-concessional loans	Total number of programmes	0	11	11
	Total amount (SDR billions)	-	221,461	235,229
	Supported countries' share of world GDP (yearly average)	-	2.47	1,60
Total	**Total number of programmes**	**25**	**48**	**35**
	Total amount (SDR billions)	**24,448**	**390,652**	**287,950**

Sources: IMF MONA database, WEO, own calculations.

In any case, while the average size of programmes and the number of commitments has abated compared to the crisis period, it is too early to talk about a "clear trend". In the five-year period after the crisis (2013-2017) the number of non-concessional/non-precautionary programmes fell back to pre-crisis levels, and although the average size of those programmes is still double the pre-crisis period, it is markedly below the crisis peak. Indeed, current programme characteristics would not signal the need for additional IMF resources. Table 3 gives the result of a simple exercise, projecting the programme characteristics of 2010 and 2015/2017 in terms of committed resources under non-concessional programmes as percentage to world GDP, to the WEO world GDP forecasts for 2018/2019. If the number and size of programmes remained unchanged in the forthcoming years relative to the period 2015-2017, the Fund would have sufficient resources available to meet the demand in the years 2018/2019 (also taking into account growth of world GDP), as total lending would amount to USD 118 billion. However, this call on IMF resources corresponds to a situation of cyclical upturn in the global economy and

new crisis peaks may be ahead in view of existing global risks. From that perspective, it seems too early to conclude that the current programme characteristics represent a "clear trend". If future IMF lending would revert to the levels seen in 2010 at the time of the GFC, the size of programmes in the two years 2018/2019 could be around USD 440 billion (see Table 3).

Table 3

Projected usage of IMF resources based on programme size characteristics

	Scenario 1 (2010 levels)	Scenario 2 (2015-17 levels)
Ratio between the amount of committed resources and the supported countries' GDP	6.1%	3.4%
Ratio between the supported countries' GDP and the World GDP	4.1%	2.0%
Estimated financing needs in 2018/2019 (USD billion)	440.3	118.1

Sources: IMF MONA database, WEO, own calculations.
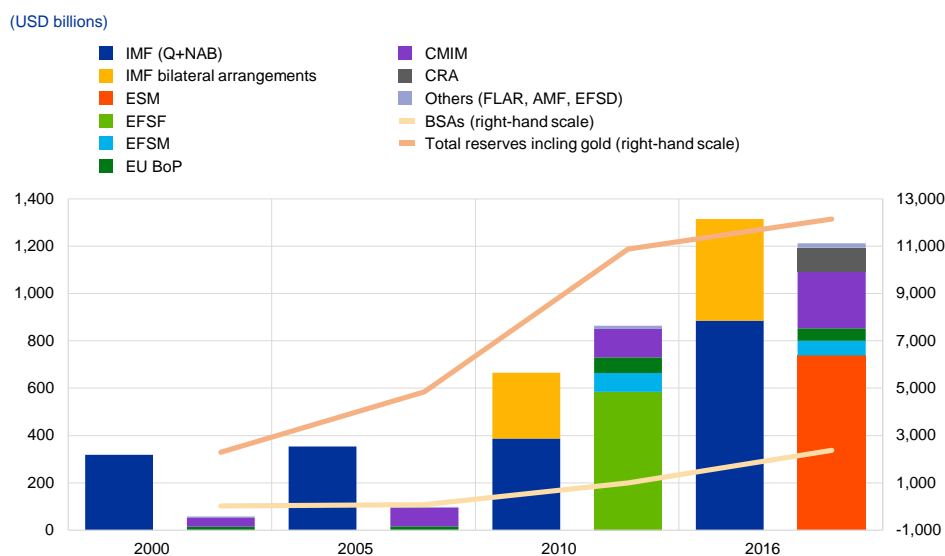Note: Recurring programmes only count once to compute relevant averages.

4 Other resources: reserves, RFAs, and swap lines

Since 2009, the Global Financial Safety Net (GFSN) has expanded significantly, making available sizable additional resources, which are complementary to the IMF. While they are not accessible to all countries, their use by Regional Financing Arrangement (RFA) countries can reduce the related calls on IMF resources and indirectly preserve IMF liquidity available also for non-RFA member countries. Two layers of the GFSN have shown particularly high growth. First, international reserves, due in part to countries' increased preference for self-insurance in case of a balance of payments crisis. Nevertheless, countries avoid using too much of their reserves in case of need. Furthermore, the market turmoil surrounding China in 2015 also showed how fast these buffers can get depleted in case of a severe crisis. Second, regional financing arrangements (RFAs), which provide additional finance for their member countries. In addition, central banks have opened bilateral swap lines mainly, although not only, to ensure short-term liquidity of financial institutions in foreign currency.[7] However, countries do not have the same access to all these layers of the GFSN. This is the case especially for many EMEs but also for Low Income Countries (LICs). Yet, many of the LICs have access to Poverty Reduction and Growth Trust (PRGT) facilities and Multilateral Development Banks (MDB) liquidity.

Aggregate RFAs' resources are now somewhat larger than the Fund's (excluding bilateral loans). Chart 5 summarises the size of the IMF compared to the main RFAs, reserves and swap lines. Before 2009, the IMF was in practice the main multilateral layer of the GFSN. Due to the growth of RFAs' and the IMF´s borrowed resources since the onset of the global financial crisis, the relative quota size of the IMF has been declining, and it has only caught up to some extent when the 14th Quota review was implemented.

---

[7]   People's Bank of China swap lines would have a broader goal of spurring trade, promoting financial stability and helping boost internationalisation of the yuan.

Chart 5

Size of the layers of the GFSN

(USD billions)

- ■ IMF (Q+NAB)
- ■ IMF bilateral arrangements
- ■ ESM
- ■ EFSF
- ■ EFSM
- ■ EU BoP
- ■ CMIM
- ■ CRA
- ■ Others (FLAR, AMF, EFSD)
- — BSAs (right-hand scale)
- — Total reserves incling gold (right-hand scale)

Sources: IMF, RFAs Annual Reports and own calculations.
Notes: For IMF and RFAs, size is gross total resources, including capital, quotas and borrowed resources Latest data on reserves is at end 2016. Exchange rates taken at end year in period 2000-2016. EFSF is included in 2010 bar (agreed in 2010 and entered into force in 2011) and ESM in 2015 bar (entered into force in 2012).
Glossary: BSAs (Bilateral Swap Agreements), ESM (European Stability Mechanism), EFSF (European Financial Stability Facility), EFSM (European Financial Stabilisation Mechanism), CMIM (Chiang Mai Initiative Multilateralisation), CRA (Contingency Reserves Arrangement), AMF (Arab Monetary Fund), FLAR (Fondo Latinoamericano de Reservas), EFSD (Eurasian Fund for Stabilization and Development), EU BoP (Balance of Pauments EU loans programme).
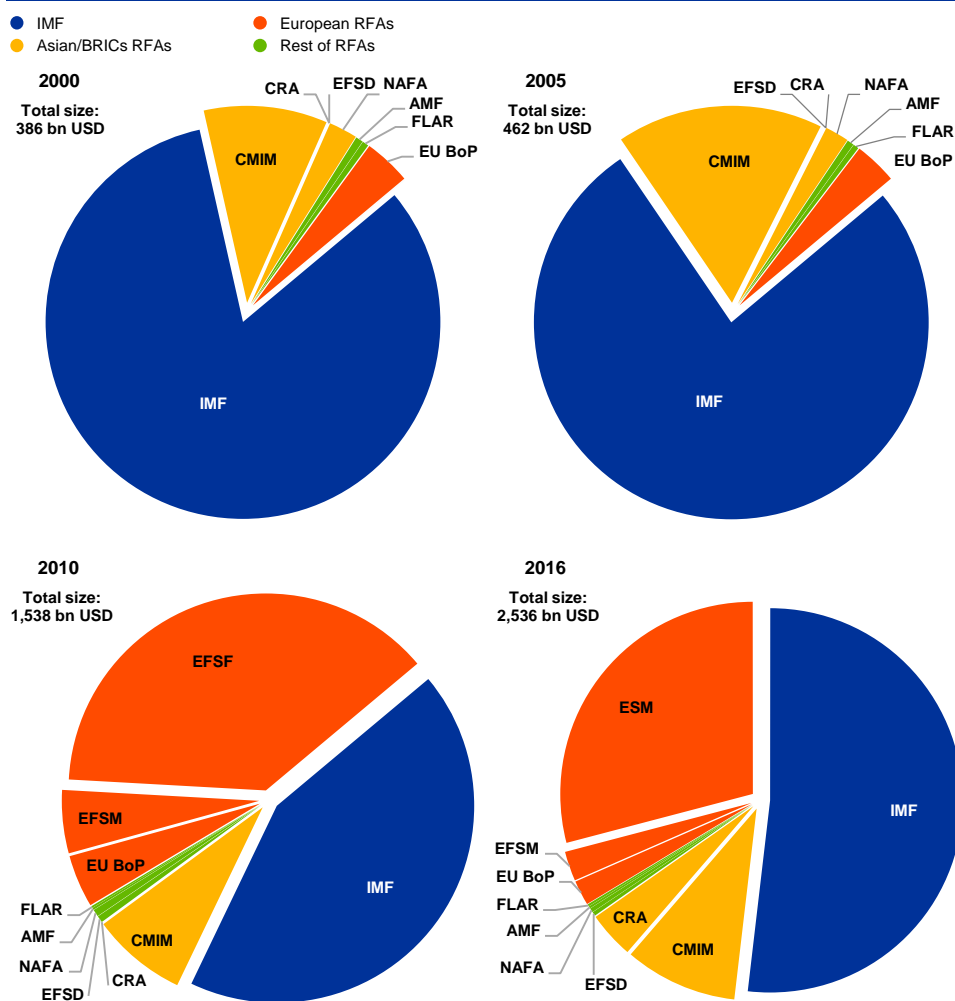
It is important to stress that RFAs' programmes are linked to a large extent to an IMF programme when there is a balance of payment need (ECB, 2018). Chart 6 compares the size of the IMF with that of the most important RFAs.

Central bank swap lines have also come to play an increasingly important role in the global financial safety net. However, in view of central bank mandates, in most cases swap lines tend to be focused on providing liquidity to the banking sector in order to protect financial stability, rather than on traditional balance of payments financing. This means one should refrain from adding them directly to the other sources of liquidity. Since 2008, when the Federal Reserve extended swap lines to 14 AE and EME central banks, swap lines have increased significantly in number and value. Swap lines now exist among AE central banks, between AEs and EMEs, and between EME central banks. They exist for a range of motivations, some for provision of foreign exchange liquidity to central banks, some to support the internationalisation of the RMB, others for regional political and economic reasons. It is important to keep in mind that swap lines are not available to all countries in the same way as IMF loans.

Chart 6

IMF and RFAs relative sizes (2000-2016)

- IMF (blue)
- Asian/BRICs RFAs (yellow)
- European RFAs (orange)
- Rest of RFAs (green)

2000
Total size: 386 bn USD

CRA, EFSD, NAFA, AMF, FLAR, EU BoP, CMIM, IMF

2005
Total size: 462 bn USD

EFSD, CRA, NAFA, AMF, FLAR, EU BoP, CMIM, IMF

2010
Total size: 1,538 bn USD

EFSF, EFSM, EU BoP, FLAR, AMF, NAFA, EFSD, CRA, CMIM, IMF

2016
Total size: 2,536 bn USD

ESM, EFSM, EU BoP, FLAR, AMF, NAFA, EFSD, CRA, CMIM, IMF

Sources: IMF, RFAs websites and CRA Treaty.
Notes: latest data on reserves is at end 2016. Exchange rates taken at end year in 2000-2016. IMF size includes quota, NAB and bilateral agreements. EFSF is included in 2010 (it was agreed in 2010 and entered into force in 2011) and ESM is included in 2016 (it entered into force in 2012).

In conclusion, IMF resources have been complemented with other layers of the GFSN providing altogether a larger and stronger global safety net. Most countries have access to the IMF and reserves while others have access to additional elements of the GFSN, such as the RFAs, that have a regional focus. A number of EMEs and LICs do not have access to this layer. Reserves and swap lines have grown since the crisis as well, but they might prove inadequate to stem a severe crisis, in the case of the former, or are often not available to address balance of payments crises, in the case of the latter. While additional layers could probably account for much of the liquidity need in "normal times", a strong IMF at the centre of the GFSN remains imperative to backstop future crises of greater magnitude – as also the next section will show.

5 Scenario analysis

In this section, we provide estimates of potential calls on IMF resources based on potential financing needs of advanced and emerging market economies that are assumed to experience a shock over 2018-2019. We assume a sovereign debt shock for AEs and a balance of payments one for EMEs.[8] Of course, this does not rule out the possibility of a debt crisis in EMEs or a balance of payments crisis in AEs. We calculate the potential financing needs by simulating a shock for individual countries and then aggregating up to the country group level. Since it is a partial equilibrium exercise, each country is treated independently and we do not consider spillovers among countries, or the possible feedback on other macroeconomic variables (such as GDP) of the simulated shocks, nor the consequent policy responses (for example, the announcement of a programme with the IMF). The details of the methodologies used for computing the potential calls on IMF resources are explained in detail in Annex B.

For ease of presentation and interpretation, we chose to present two main different scenarios based on the intensity of the shock: a moderate scenario and a severe one. Additionally, a complete set of results for different scenarios is presented as sensitivity analyses in Annex C. The analysis considers the types of shock that are more likely to affect each country group, simulating a balance of payment shock for EMEs and a sovereign debt shock for AEs instead of considering the same global scenario for all countries. Most parameters are calibrated on historical post-crisis experience rather than assumed exogenously.

5.1 Advanced Economies

The sovereign debt shock for AEs is based on the methodology used in Denbee et al. (2016). The shock envisages: (i) a reduced willingness of foreign investors to rollover maturing debt and to fund fiscal deficits and, at least in the severe scenario, (ii) a widening of the fiscal deficit, calibrated on historical experience.

The sample of countries considered in the exercise is taken from the list of advanced economies that report data on maturing debt over the next two years in the IMF Fiscal Monitor. To make an adjustment for vulnerability, we exclude all reserve issuers (apart from euro area countries) and countries that are currently AAA rated by all 3 major ratings agencies. This leaves a sample of 16 countries.

In the scenarios, we assume that foreign investors are willing to rollover 20% of (i) their maturing sovereign debt over two years and (ii) to finance 20% of any new debt issued to finance the fiscal deficit.[9] Domestic investors are assumed to be willing to rollover all the maturing sovereign debt that they own and in addition fund a

---

[8]   Here we follow an approach similar to Denbee at all (2016).

[9]   Annex C provides robustness tests with alternative assumptions.

portion of the fiscal deficit increase, without substituting for foreign investors. We then assess two scenarios using different assumptions for the fiscal balance based on the past post-crisis experience.

We use the Laeven and Valencia (2012) database to date sovereign debt crises and calculate the distribution of the percentage change in the fiscal balance over the two years following the crisis. The parameters of the scenarios are described in Table 4. As the table shows, in the moderate scenario, the fiscal deficit narrows but in the severe shock fiscal deficits widen significantly.

Table 4

Simulation parameters and results

(USD billions)

Rollover rate of maturing external debt	t t+1	20% 20%	20% 20%
% Change in the Fiscal Balance	t t+1	30.1 10.6	-54.2 -93.4
			Moderate shock	**Severe shock**
Using reserves up to 50% stock decrease	Total financing needs (number of countries)		947.2 16	1050.4 16
	Funded by reserves (number of countries)		271.9 16	271.9 16
	Funded by RFAs (number of countries)		453.7 12	453.7 12
	Remaining funding needs[1] (number of countries)		221.7 11	324.8 11
	Impact on IMF available resources		-241.8	-241.8
	Adjusted IMF available resources		565.2	565.2
			Moderate shock	**Severe shock**
Using reserves up to 100% of ST debt and max 25% stock decrease	Total financing needs (number of countries)		947.2 16	1050.4 16
	Funded by reserves (number of countries)		24.3 3	24.3 3
	Funded by RFAs (number of countries)		453.7 12	453.7 12
	Remaining funding needs[2] (number of countries)		469.2 13	572.4 13
	Impact on IMF available resources		-245.4	-245.4
	Adjusted IMF available resources		561.6	561.6

(1) To be covered by the IMF.
(2) Relaxing the reserve assumption to 80% of short-term debt and a maximum 40% of stock decrease has no effect on the results.

The financing needs are assumed to be addressed first by running down, up to a certain point, FX reserves, second from RFAs where present, and third from IMF resources. As shown in Table 4, the potential financing needs that the IMF has to satisfy, once FX reserve and RFAs resources have been taken into account would range between USD 220 and USD 572 billion. This compares with current IMF

resources of USD 807 billion (see Table 1).[10] Details on the methodology used in the AE scenarios are provided in Annex B.

- **Moderate shock.** This scenario uses the median value of the percent change in the fiscal deficit in previous crises (as calculated by Denbee et al., 2016). In this case, the overall financing needs are USD 950 billion and are mostly covered by the ESM (USD 450 billion) which is the main AE RFA for the countries in the sample. Since most AEs hold limited FX reserves, the estimates are quite sensitive to the assumptions on reserve usage. If we assume countries use up to a 100 percent of their short-term debt subject to a maximum usage of 25 percent, the financing needs would amount to USD 469 billion. Still, IMF current total available resources would be enough to cover the financing needs under this scenario.[11]

- **Severe shock.** Compared with the baseline scenario, the severe shock scenario uses the 25th percentile of the historical change in the fiscal deficit, while the other parameters are left unchanged. This entails higher fiscal deficits and thus higher overall financing needs. However, FX reserve and RFA usage do not change significantly as the financing needs are concentrated in the same set of countries as in the moderate scenario. The potential call on IMF resources would increase to around USD 572 billion (when countries are allowed to use reserves up to 100 percent of the short-term debt metric subject to a maximum usage of 25 percent). In this case, the IMF available resources would slightly fall short of the potential demand.

Overall, our analysis suggests that in order for the IMF to be able to cover the majority of potential AEs sovereign debt crisis scenarios, its overall resources would need to remain at current levels.

5.2 Emerging Market Economies

The balance of payment shock for EMEs assumes only a partial rollover of long- and short-term external debt coupled with a change in the Foreign Direct Investment (FDI) inflows (see Table 5). This sudden stop in capital inflows is assumed to be partially accommodated by a reduction (increase) in the current account deficit (surplus) and a reduction in residents' net capital outflows. As in the advanced country scenarios, IMF financing (in addition to the resources already committed under the existing precautionary lines) is assumed to be the last resort after running down FX reserves and accessing, where available, RFAs. The scenarios proposed differ according to the assumed rollover rates. As shown in Table 6, the potential financing needs that the IMF would need to satisfy range

---

[10] As explained in the Foreword section, these are calculated as the sum of end-2017 FCC (USD 312.5 billion) plus inactivated borrowed resources, excluding 20% prudential balance (USD 495.4 billion). Available at IMF. Please note that current IMF total resources are slightly higher because of the approval of some new bilateral borrowing agreements.

[11] As explained in the foreword section, the definition of IMF available resources used in the shock-scenario analyses refers to the uncommitted lending capacity.

between USD 310 and 660 billion. Details on the methodology used in the EME scenarios are provided in Annex B.

Table 5

Simulation parameters

(percentage points)

Variable		Baseline shock	Severe shock
Rollover rate of ST external debt	t t+1t	0.8 0.8	0.7 0.7
Rollover rate of LT external debt	t t+1	0.7 0.7	0.6 0.6
FDI inflows	t t+1	7.9 10.2	7.9 10.2
Current account adjustment	t t+1	23.8 27.3	23.8 27.3
FDI outflows	t t+1	-23.8 -5.7	-23.8 -5.7
Portfolio outflows	t t+1	37.2 -30.3	37.2 -30.3
Other investments outflows	t t+1	-54.7 -19.4	-54.7 -19.4

- **Moderate shock.** This scenario uses rollover rates between 0.7 and 0.8, the median value of the historical distribution of current account adjustment and changes in FDI inflows and FDI, portfolio and other outflows (as calculated by Denbee et al., 2016). In this case, the overall financing needs amount to around USD 1,300 billion and are mostly covered by FX reserves (almost USD 1,000 billion), while RFAs' contribution is much smaller (between USD 15 and USD 40 billion). The financing need from the IMF, as expected, is higher (lower) when considering the stricter (looser) criteria for reserve use. Current IMF resources (including the activation of borrowed resources) would be more than sufficient to cover the financing needs under this scenario.

- **Severe shock.** Compared with the moderate shock scenario, the severe shock one implies a smaller rollover of external debt, while the other parameters are left unchanged. The potential call on IMF resources would increase to a maximum of around USD 650 billion. In this case, the current IMF resources would be close fitting to cover the potential demand.

Table 6

Simulation results

(USD billions)

		Baseline shock	Severe shock
Using reserves up to 100% of ST debt and max 30% stock decrease	Total financing needs (number of countries)	1361.7 44	1901.8 44
	Funded by reserves (number of countries)	991.0 38	1249.3 38
	Funded by RFAs (number of countries)	24.4 6	101.1 9
	Remaining funding needs (number of countries)	343.8 21	530.3 25
	Impact on IMF available resources	-67.9	-154.4
	Adjusted IMF available resources	739.1	652.6
		Baseline shock	**Severe shock**
Using reserves up to 100% of ARA metric and max 25% stock decrease	Total financing needs (number of countries)	1293.2 33	1804.2 33
	Funded by reserves (number of countries)	878.3 19	981.5 19
	Funded by RFAs (number of countries)	41.3 8	107.8 9
	Remaining funding needs (number of countries)	333.1 17	653.6 19
	Impact on IMF available resources	-74.3	-160.8
	Adjusted IMF available resources	732.7	646.2
		Baseline shock	**Severe shock**
Using reserves up to 80% of ARA metric and max 40% stock decrease	Total financing needs (number of countries)	1293.2 33	1804.2 33
	Funded by reserves (number of countries)	962.2 25	1314.2 25
	Funded by RFAs (number of countries)	17.5 6	39.9 6
	Remaining funding needs (number of countries)	310.5 14	428.9 17
	Impact on IMF available resources	-74.3	-74.3
	Adjusted IMF available resources	732.7	732.7

Sensitivity checks on these scenarios were also carried out (see Annex C). It should be noted that both scenarios assume an improvement in the current account balance and decline in residents' capital outflows. Should those adjustments not materialise, the resulting financing needs would be higher, as shown in Annex C. In addition, the sensitivity analysis also highlights the importance of the assumed rundown in FX reserves. Given the high level of reserves on average in EMEs, a change in the adequacy metric can change the results significantly.

Overall, our EME scenarios suggest that to cover potential demand IMF resources would need to stay at least at current levels.

6   Conclusions

The IMF stands at the core of the GFSN as the key international institution for surveillance and balance of payments support in crisis situations. During the past decade, the GFSN has witnessed a significant expansion in the number of layers and the amount of resources available for crisis prevention and resolution, especially through international reserves accumulation, central bank swap lines and regional financing arrangements. For a number of countries, there are more resources available in a balance of payments crisis than just those of the IMF and own reserves. Indeed, FX reserves should be considered as the first line of defence in terms of financing.[12] RFAs provide another complementary source of financing for a number of countries; the lack of conditionality and supervisory functions in some regional arrangements make them a suboptimal tool for crisis prevention and resolution. The Fund continues to play a central role at the core of the GFSN, providing the only truly financial backstop for crisis management at the global level and being essential to the credibility of the GFSN. This is why a strong and well-funded IMF is a centrepiece of a strong and credible GFSN.

Turning to the analysis carried out in this report, the traditional indicator analysis is not conclusive on the adequacy of the Fund's current resources. However, some results point to a sizable deterioration in the medium term. Comparing traditional indicators with long-term historical averages yields a mixed assessment at present: the Fund's current resources would appear sufficient in terms of GDP or capital-inflow metrics. However, the Fund's resources look insufficient compared with other indicators such as external liabilities that capture the increasing size of global financial risks.

In the same vein, at this stage current programme characteristics would not signal the need for additional IMF resources, but this situation may change going forward. Current programme characteristics correspond to a phase of cyclical upturn and it is too early to talk about a "clear trend". New crisis peaks may be ahead of us, given the risks related to the normalisation of unconventional monetary policies, the geopolitical environment, record levels of debt globally and financial stability risks. Indeed, if future IMF lending would revert to levels seen in 2010 at the time of the GFC, the size of programmes could reach two thirds of current quota resources.

Finally, the analysis of adverse shock-scenarios suggests that the IMF's current overall resources are enough to cover remaining financing gaps in most moderate sudden stop scenarios in EMEs or sovereign debt shock scenarios in advanced countries. However, current Fund resources would be hardly sufficient to cover more severe scenarios. These estimates are very sensitive to the assumptions made on debt rollover rates and on the cushion provided from accumulated FX reserves. At the pessimistic end of these assumptions, the IMF

---

[12]   Sound macro policies and strong frameworks are the first line of defence in terms of policies.

resources would not be enough to cover the potential demand for financing. While a severe adverse shock scenario might be seen as more unlikely, it should be kept in mind that the safety net provided by the IMF has also an important crisis prevention function in that its resource buffer provides confidence. This is particularly important as the nature and size of the next crisis in an increasingly interlinked global financial system is difficult to predict.

Furthermore, the following caveats are worth mentioning:

- In assessing the appropriate size of the IMF, separate shocks have been used for AEs and EMEs. The different nature of these shocks makes it preferable to consider them separately. Indeed, it would be extremely unlikely that many AEs and EMEs would simultaneously have calls on IMF resources (there is no historical precedent for this). Still, it cannot be excluded that systemic crisis in AEs – or in EMEs – could rapidly spill over into other regions, making the shock more severe and therefore increasing the need for Fund resources by more than suggested by the separate shocks.

- Given the uneven coverage of the additional layers of protection that the GFSN provides, if shocks were asymmetric and biased to less-protected/more protected countries, the call for IMF funding could be higher/lower than suggested above. Additionally, the take up of IMF precautionary facilities, which could help countries without RFA access, has been highly concentrated in very few countries to date.

Based on the results of the different methodologies applied in this report to provide a quantitative assessment of the appropriate size of the Fund, a prudent approach would call for maintaining the Fund's total resources at their current levels (Table 7 shows a comparison of the different results). In this respect, it should be recalled that the Fund's relative size is projected to decline markedly over coming years, as the Fund's borrowed resources expire.

However, this report only presents a quantitative analysis that needs to be complemented by other considerations and qualitative assessments – such as the strengthening of domestic and international resilience by stronger regulation and supervision after the GFC, and the ability of the IMF and its stakeholders to react quickly in crisis situations, assuming continued preparedness to cooperate – in order to derive any conclusions on the appropriate level of IMF resources after the expiration of borrowed resources.

Table 7

Comparing results

Approach*	Total financing needs	Remaining IMF funding needs (after Reserves & RFAs)[1]	Available IMF resources (adjusted)[2]	Remaining funding gap (after IMF)
Extrapolating current programme trends to 2018/2019				
2010 levels		440.3		
2015-17 levels		118.1		
Main shock scenarios[3]				
Moderate AEs	947.2	345.45	563.4	0
Moderate EMEs	1,310.3	323.1	734.8	0
Total Moderate[4]	2,257.5	668.5	491.4	177.1
Severe AEs	1,050.4	448.6	563.4	0
Severe EMEs	1,836.7	537.6	677.2	0
Total Severe[4]	2,887.1	986.2	434.3	551.9

Sources: European Commission, Haver Analytics, World Bank and ECB calculations.
Notes: All data in USD billion.
(1) Funding needs after drawdown of international FX reserves and use of RFA financing.
(2) Adjusting the FCC for countries with BoP crisis and therefore, leaving the TFP.
(3) Average results of main shock scenarios assuming different uses of reserves. For AEs, we consider using reserves up to (i) a 50% reduction; and (ii) 100% of ST debt and a 25% reduction. For EMEs, (i) 30% of ST debt and a 30% reduction; (ii) 100% of ARA metric and a 25% reduction; and (iii) 80% of ARA metric and maximum 40% stock decrease.
(4) For informative purpose only. Country-group shock-scenario results cannot be simply added to simulate a global shock.

References

Arslanalp, S. and Tsuda, T. (2014), *"Tracking global demand for advanced economy sovereign debt"*, *IMF Economic Review*, No 62.

Denbee, E., Jung, C. and Paternó, F. (2016), *"Stitching together the global financial safety net"*, *Bank of England Financial Stability Paper*, No 36.

European Central Bank (ECB) (2018), *"Strengthening the Global Financial Safety Net. Moving relations between the IMF and Regional Financing Arrangements forward"*, *ECB Occasional Paper Series*, No 207.

European Central Bank (ECB), "The layers of the global financial safety net: taking stock", *Economic Bulletin*, Issue 5 / 2016.

International Monetary Fund (IMF) (2010), "XIV General Review of Quotas – The size of the Fund – Initial Considerations", Washington, DC.

International Monetary Fund (2018), IMF Financial Operations 2018, Washington, DC.

Laeven, L. and Valencia, F. (2012), "Systemic banking crises database: an update", *IMF Working Paper*, WP/12/163.

Stracca, L. and Scheubel, B. (2016), "What do we know about the global financial safety net? Rationale, data and possible evolution", *ECB Occasional Paper Series*, No. 177, September.

Annexes

A   Tables on IMF programme size developments

The following tables provide an extension of the summary table in chapter 3 of the report.

Table A.1

Number of programmes	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-concessional	9	6	6	1	3	8	16	11	7	6	7	7	5	11	5
- of which precautionary lines (FCL and PLL)	0	0	0	0	0	0	3	3	3	2	2	2	2	3	2
Concessional loans	10	7	8	10	7	11	8	14	7	12	3	4	7	7	8
Total	19	13	14	11	10	19	24	25	14	18	10	11	12	18	13

Total amount (SDR mln)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Non-concessional	13,678	1,217	8,798	30	725	32,499	75,487	107,310	98,149	77,208	34,667	61,992	30,301	91,112	96,878
- of which precautionary lines (FCL and PLL)	-	-	-	-	-	-	52,184	47,540	70,328	51,409	25,870	50,527	16,870	73,073	68,889
Concessional loans	1,286	534	187	624	674	1,192	1,440	1,462	1,609	1,666	429	649	1,494	2,404	1,492
Total	14,964	1,752	8,985	654	1,399	33,691	76,927	108,772	99,758	78,874	35,096	62,641	31,795	93,516	71,370

Non concessional, non-precautionary loans (i.e. SBA and EFF) programme characteristics

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Number of programmes	9	6	6	1	3	8	13	8	4	4	5	5	3	8	3
Total size	13,678	1,217	8,798	30	725	32,499	23,303	59,770	27,821	25,798	8,797	11,465	13,431	18,039	989
Average size (SDR mln)	1,520	203	1,466	30	242	4,062	1,793	7,471	6,955	6,450	1,759	2,293	4,477	2,255	330
Maximum size (SDR mln)	8,981	412	6,662	30	475	11,000	11,443	26,433	23,742	23,785	4,393	10,976	12,348	8,597	464
Average size (% quota)	131	31	218	30	39	704	472	965	849	861	357	311	450	447	352
Maximum size (% quota)	424	45	691	30	50	1,200	1,111	3,212	2,306	2,159	563	800	900	911	615
Supported countries' share of world GDP	1.27	0.65	1.61	0.02	0.35	0.94	0.92	1.27	0.74	0.40	0.66	0.22	0.18	0.93	0.05

Sources: IMF MONA database, WEO, own calculations.

B Methodology

B.1 Advanced economies

For the calculation of the potential call on IMF resources by AEs, we use the sample of countries for which data on maturing debt are published in the Fiscal Monitor. To adjust for vulnerability, we exclude all countries that are currently AAA rated by all 3 major ratings agencies and are not reserve issuers (excluding euro area countries); this leaves a sample of 16 countries. The exercise involves the following steps.

Step 1. Sovereign Debt Crisis in AEs. A sovereign debt crisis lasting two years (2018-2019) is characterised by the following assumptions:

1. A change in the fiscal balance based on historical experience.

2. Partial rollover rate of maturing external debt and partial external financing of the fiscal deficit.

3. Full rollover of maturing debt held by residents and full rollover of the domestic portion of the fiscal deficit.

4. Domestic investors are not willing to fund the rollover of sovereign debt previously held by foreign investors.

The scenarios are calibrated on historical experience. We use the Laeven and Valencia (2012) database to date sovereign debt crises and calculate the distribution of the percentage change in the fiscal balance over the two years following the crisis. The parameters of the scenarios are described in table 4.

Step 2. Domestic adjustment. Domestic adjustment is calibrated through the change in the fiscal balance. In response to the sovereign debt crisis, countries are assumed to change their fiscal deficits in line with historical experience.

Step 3. Calculation of total financing needs. We apply a shock where the 16 countries considered partially lose access to external financing for their sovereign debt. This affects the refinancing of maturing debt and the issuance of new debt to finance the government's fiscal deficit. We provide estimates for foreign rollover rates of 0%, 20% and 40% and implicitly assume a rollover rate of 100% on borrowing by residents. But we assume that domestic residents are not willing to step in to replace foreign investors. We also assume that the domestic central bank does not intervene to buy newly issued sovereign debt.

For each of the stressed countries, we calculate the sovereign financing needs as the sum of the maturing sovereign debt and the fiscal deficit over the 2018-2019 period. Historically, in the median case, the fiscal balance improves in the wake of a sovereign crisis (Table 4). In the severe scenario, the fiscal deficit increases. This is calibrated using the 25th percentile from the historical episode. We then multiply the

total financing needs by the share of the outstanding debt stock held by foreign investors.

Step 4. Use of reserves. When a country faces a financing gap need, it can rundown up to a certain level its FX reserves. The maximum amount of usable reserves is calculated using two alternatives to provide a sensitivity analysis on the potential demand on IMF. Countries can rundown reserves:

1. by up to 50% of their initial stock (as in Denbee et al. 2016);

2. up to 100% of their short-term external debt level, with a maximum reduction of 25%;

Step 5. Use of RFAs. The remaining financing needs after reserves have been used are covered by RFA resources, when available, up to each country's borrowing limits. When no official borrowing limits apply countries are allowed unlimited claims on their RFA subject to the overall financing constraint of their RFA.

Step 6. Adjusting available IMF resources. Countries that are left with a remaining financing gap are considered unable to contribute to IMF resources, since they would no longer participate in the Financial Transaction Plan. Therefore their contributions through quotas, NAB and bilateral borrowing agreements (when applicable) are subtracted to IMF's available resources.

Parameters. These scenarios use parameters calibrated by Denbee et al. (2016) based on the Laeven and Valencia (2012) crisis database. Those parameters are used to calculate the percentage change in the relevant flow in 2018-2019 compared with 2017.

Data. We use the IMF's October 2017 Fiscal Monitor forecast for financing needs as our baseline and Arslanalp and Tsuda (2014, October 2017 data update) on the external share of countries' government financing at Q2 2017. The Fiscal Monitor provides data on the maturing external debt of 26 AEs. From this sample, we exclude 3 reserve issuers and 7 countries that are rated AAA by all three major ratings agencies. Data on IMF available quota are taken from the Financing IMF Transaction Quarterly Report for the period May-July 2017. For the exchange rate and the IMF Forward Commitment capacity (FCC), we use the last daily and weekly data available for 2017.

Scenario description. In the main text of this report we present two scenarios, accounting for a moderate and a severe shock. In the moderate shock, the fiscal deficit is calibrated on the median of the distribution of past post-crisis episodes. For the severe shock we use the 25th percentile of the distribution.

Financing sources. A country's first line of defence in the face of a financing gap is its own FX reserves. We then consider each country's RFA membership and the relative borrowing limits. There are two RFAs which could provide financing to AEs: the European Stability Mechanism and the Chiang Mai Initiative Multilateralisation.

B.2 Emerging Market economies

For the EMEs scenarios, we use a set of between 33 and 44 countries from the WEO database, for which the relevant data for the exercise are available.[13] The calculation of the potential call on IMF resources by EMEs involves the following steps.

Step 1. Sudden stops in capital inflows. The shocks performed (moderate and severe) take the form of a sudden stop lasting two years (2018-2019), characterised by the following assumptions:

- Only a partial rollover rate of short-term external debt.[14]

- Only a partial rollover rate of long-term external debt

- Change in FDI inflows

Step 2. Domestic adjustment. It takes four forms:

1. an improvement in the current account balance and

2. a decline in domestic investors' outflows: FDI,

3. portfolio and

4. other investment.

Step 3. Calculation of total financing needs. The implied variation in the country's reserve balance is calculated using the balance of payment identity.

Step 4. Use of reserves. When a country faces a financing gap, FX reserves can be rundown up until a certain level. The maximum amount of usable reserves is calculated using three alternatives to provide a sensitivity analysis on the potential demand on IMF financing.[15] Countries can use reserves up to:

1. 100% of their short-term external debt level, with a maximum decrease of 30%

2. 100% of the reserve adequacy metric (ARA metric) calculated by the IMF (on 2017 data), with a maximum decrease of 25%

---

[13] The larger set of countries comprises: Algeria, Angola, Argentina, Armenia, Belarus, Belize, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Cabo Verde, China, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Georgia, Grenada, Guatemala, India, Indonesia, Kazakhstan, Lebanon, Macedonia, Malaysia, Maldives, Mauritius, Mexico, Morocco, Panama, Paraguay, Peru, Philippines, Romania, Serbia, South Africa, Sri Lanka, St. Lucia, St. Vincent and the Grenadines, Swaziland, Tunisia, Turkey, Ukraine.

[14] In particular, we apply the partial rollover rates on total short-term external debt and on the principal repayments on long-term external debt. The short-term debt which is not rolled over in the first year is subtracted from the stock in the second year.

[15] The total financing needs and the underlying number of countries are different when using the first metric for reserve adequacy with respect to the other two, because data availability on reserve adequacy changes. In addition, it may happen that the number of countries using IMF resources is greater than that of countries using reserves, since it may be that a country does not have available reserves (according to the relevant metric) and it directly resorts to the IMF.

3. 80% of the ARA metric (on 2017 data), with a maximum decrease of 40%

Step 5. Use of RFAs. The remaining financing needs after reserves have been used are covered by RFA resources, when available, up to each country's borrowing limits.

Step 6. Adjusting available IMF resources. Countries that are left with a remaining financing gap are considered unable to contribute to IMF resources, since they would no longer participate in the Financial Transaction Plan. Therefore, their contributions through quotas, NAB and bilateral borrowing agreements (when applicable) are subtracted to IMF's available resources.

Parameters. These scenarios use parameters calibrated by Denbee et al. (2016) on the historical experiences of EMEs balance of payment crisis on all flows and adjustments, except the external debt rollover rates, which take values between 0.6 and 0.8 (Table 5).[16] Those parameters are used to calculate the percentage change in the relevant flow in 2018-19 compared with 2017.[17]

Data. We use mostly the October 2017 IMF World Economic Outlook (WEO) data, except for one variable (principal repayments on long-term external debt), which is taken from the 2017 World Bank International Debt Statistics (IDS) database. The WEO database contains information for 95 EMEs (which are not Low Income Countries), but not all relevant data are available for all countries, hence our simulations comprise between 33 and 45 countries, depending on the reserve adequacy metric considered. The reserve metric based on short-term external debt only is calculated on the basis of WEO 2017 data, while data on IMF ARA metrics are taken from the IMF website and refer to 2017 data, adjusted for the presence of capital control measures.[18] As for AEs scenarios, data on IMF available quota are taken from the Financing IMF Transaction Quarterly Report for the period May-July 2017. For the exchange rate and the IMF Forward Commitment capacity (FCC), we use the last daily and weekly data available for 2017.

Scenario description. In the main text we present two scenarios, accounting for a moderate and a severe shock, the severity of the shock is dictated by the rollover rates of external debt. The reaction of the other flows is set at the median value of the historic distribution of the parameters in past post-crisis situations, as calculated by Denbee et al. (2016). In both scenarios, the FDI capital inflows slightly increase (by 7.9 percent in the first year and 10.2 percent in the second year of the crisis), reflecting the fact that FDI investors tend to take a longer view of EMEs growth potential and their investments show less volatility.

Financing sources. A country's first line of defence in face of a financing gap are its own FX reserves. After that, if a country has an IMF precautionary facility (e.g. the Flexible Credit Line and the Precautionary and Liquidity Line), it can use it up to its

---

[16] The calibration of rollover rates is not possible due to the lack of data on the behaviour of external debt flows during the past crisis.

[17] When the parameter for one specific item is set to zero, we assume no change in the underlying flow with respect to 2017 data.

[18] Available at IMF.

limits. We then consider each country's RFA membership and the relative borrowing limits. There are five RFAs which could provide financing to EMEs: the Chiang Mai initiative Multilateralisation, the BRICS Contingency Reserve Arrangement, the FLAR, the Arab Monetary Fund and the EU Balance of Payments facility.

C Scenario analysis: Robustness exercises

C.1 Advanced economies

Table C.1 provides a set of robustness tests using different assumptions of the rollover rates on external debt. As the results show, the estimates are highly sensitive to the rollover rate assumptions. In an extreme scenario with a 0% rollover rate and limited use of reserves, IMF financing needs are USD 830 billion. Current IMF resources are not large enough to fully fund this scenario. On the other hand, a very benign scenario with a mild fiscal deficit shock, rollover rate of 40% and extensive use of reserves (up to 50% of total stock) is fully funded by reserves and RFAs, with no calls on the fund in this scenario.

Table C.1

Variable		1	2	3	4	5	6
Rollover rate of maturing external debt t t+1		0 0	0 0	0.2 0.2	0.2 0.2	0.4 0.4	0.4 0.4
% Change in the Fiscal Balance t t+1		30.1 10.6	-54.2 -93.4	30.1 10.6	-54.2 -93.4	30.1 10.6	-54.2 -93.4
		1	**2**	**3**	**4**	**5**	**6**
Using reserves up to 50% stock decrease	Total financing needs (number of countries)	1184.0 16	1313.0 16	947.2 16	1050.4 16	710.4 16	787.8 16
	Funded by reserves (number of countries)	279.4 16	279.4 16	271.9 16	271.9 16	264.4 16	264.4 16
	Funded by RFAs (number of countries)	453.7 12	453.7 12	453.7 12	453.7 12	446.1 11	453.7 11
	Remaining funding needs (number of countries)	451.0 12	579.9 12	221.7 11	324.8 11	0.0 0	69.7 11
	Impact on IMF resources	-242.1	-242.1	-241.8	-241.8	0	-241.8
	Total available IMF resources	565.9	565.9	566.2	566.2	808.0	566.2
		1	**2**	**3**	**4**	**5**	**6**
Using reserves up to 100% of ST debt and max 25% stock decrease	Total financing needs (number of countries)	1184.0 16	1313.0 16	947.2 16	1050.4 16	710.4 16	787.8 16
	Funded by reserves (number of countries)	30.4 3	30.4 3	24.3 3	24.3 3	18.2 3	18.2 3
	Funded by RFAs (number of countries)	453.7 12	453.7 12	453.7 12	453.7 12	453.7 12	453.7 12
	Remaining funding needs (number of countries)	700.0 13	828.9 13	469.2 13	572.4 13	238.5 13	315.9 13
	Impact on IMF resources	-245.4	-245.4	-245.4	-245.4	-245.4	-245.4
	Total available IMF resources	562.6	562.6	562.6	562.6	562.6	562.6

C.2   Emerging Market economies

Our analysis encompassed different set of hypothesis on the crisis definition and on the domestic reaction to it; in addition, we run a battery of scenarios using a different method for computing the impact of the shock on the balance of payment variables.

Table C.2 shows a set of baseline and a set of severe scenarios, whereas the severity is dictated by the rollover rate and within each set the scenarios are differentiated by the extent of domestic response to the shock; there is no domestic response (scenarios 1 and 4), current account adjustment (2 and 5) and current account adjustment coupled by a full response in FDI, portfolio and other investment outflows (3 and 6, which correspond to the scenarios presented in the main text). In the full set of scenarios, the potential IMF demand varies from USD 300 up to 1,200 billion and there are multiple scenarios in which IMF resources would not suffice to cover the potential needs of the membership (scenarios 1, 4 and 5).

In Table C.3 we change the method of calculation of the stressed variables and the calibrated parameters change accordingly, again based on Denbee et al. (2016). Instead of focusing on the percentage change of each balance of payments variable during the sudden stop episodes, here we look at the percentage deviation from the IMF WEO forecasted values for balance of payments variables in the year prior to the shock. In this case we no longer use partial rollover rates on external debt, but apply the calibrated parameters at portfolio, FDI and other inflows. The deviation of portfolio and other inflows is set at the median value of the historical distribution in the first three scenarios and at the 25th percentile of the same distribution in scenarios 4 to 6; the other parameters are set at their median values. As a result, there is an extremely benign scenario (no. 2) where domestic adjustment almost fully compensates for the sudden stop, and other cases where IMF resources would be enough or more than enough to cover the potential demand.

Table C.2

Variable		1	2	3	4	5	6
Rollover rate of ST external debt	t	0.8	0.8	0.8	0.7	0.7	0.7
	t+1	0.8	0.8	0.8	0.7	0.7	0.7
Rollover rate of LT external debt	t	0.7	0.7	0.7	0.6	0.6	0.6
	t+1	0.7	0.7	0.7	0.6	0.6	0.6
FDI inflows	t		7.9	7.9		7.9	7.9
	t+1		10.2	10.2		10.2	10.2
Current account adjustment	t		23.8	23.8		23.8	23.8
	t+1		27.3	27.3		27.3	27.3
FDI outflows	t			-23.8			-23.8
	t+1			-5.7			-5.7
Portfolio outflows	t			37.2			37.2
	t+1			-30.3			-30.3
Other investments outflows	t			-54.7			-54.7
	t+1			-19.4			-19.4

		1	2	3	4	5	6
Using reserves up to 100% of ST debt and max 30% stock decrease	Total financing needs	2067.3	1743.6	1361.7	2637.3	2283.9	1901.8
	(number of countries)	52	45	44	52	46	44
	Funded by reserves	1309.7	1240.3	991.0	1382.5	1297.6	1249.3
	(number of countries)	46	39	38	46	40	38
	Funded by RFAs	124.6	91.6	24.4	138.9	109.6	101.1
	(number of countries)	12	10	6	14	10	9
	Remaining funding needs	593.2	397.6	343.8	1058.6	841.8	530.3
	(number of countries)	31	24	21	35	26	25
	Impact on IMF resources	-186.7	-154.4	-67.9	-189.0	-154.4	-154.4
	Total available IMF resources	621.3	653.6	740.1	619	653.6	653.6

		1	2	3	4	5	6
Using reserves up to 100% of ARA metric and max 25% stock decrease	Total financing needs	1977.3	1672.5	1293.2	2517.9	2183.6	1804.2
	(number of countries)	37	33	33	37	33	33
	Funded by reserves	1018.5	972.9	878.3	1082.8	1018.4	981.5
	(number of countries)	22	19	19	22	19	19
	Funded by RFAs	137.6	104.6	41.3	146.3	127.4	107.8
	(number of countries)	12	9	8	14	11	9
	Remaining funding needs	743.0	540.8	333.1	1193.8	962.8	653.6
	(number of countries)	26	19	17	27	19	19
	Impact on IMF resources	-189.1	-160.8	-74.3	-216.6	-186.9	-160.8
	Total available IMF resources	618.9	647.2	733.7	591.4	621.1	647.2

		1	2	3	4	5	6
Using reserves up to 80 of ARA metric and max 40% stock decrease	Total financing needs	1977.3	1672.5	1293.2	2517.9	2183.6	1804.2
	(number of countries)	37	33	33	37	33	33
	Funded by reserves	1464.9	1269.4	962.2	1682.3	1574.6	1314.2
	(number of countries)	29	25	25	29	25	25
	Funded by RFAs	40.5	27.0	17.5	110.7	85.7	39.9
	(number of countries)	8	6	6	9	8	6
	Remaining funding needs	432.0	360.3	310.5	663.7	488.3	428.9
	(number of countries)	16	15	14	18	17	17
	Impact on IMF resources	-74.3	-74.3	-74.3	-160.8	-160.8	-74.3
	Total available IMF resources	732.7	732.7	732.7	646.2	646.2	732.7

Table C.3

Variable		1	2	3	4	5	6
Portfolio inflows	t	-132	-132	-132	-236	-236	-236
	t+1	-92	-92	-92	-162	-162	-162
Other investments inflows	t	-132	-132	-132	-236	-236	-236
	t+1	-92	-92	-92	-162	-162	-162
FDI inflows	t		62.5	62.5		62.5	62.5
	t+1		26.7	26.7		26.78	26.78
Current account adjustment	t		58.9	58.9		58.9	58.9
	t+1		79	79		79	79
FDI outflows	t			67.1			67.1
	t+1			22			22
Portfolio outflows	t			-22.8			-22.8
	t+1			-21.9			-21.9
Other investments outflows	t			101			101
	t+1			-28.2			-28.2

		1	2	3	4	5	6
Using reserves up to 100% of ST debt and max 30% stock decrease	Total financing needs	1118.7	314.6	650.3	1970.5	933.4	1361.6
	(number of countries)	65	16	26	66	38	44
	Funded by reserves	822.9	238.1	516.4	1343.1	632.1	994.0
	(number of countries)	58	12	22	59	32	38
	Funded by RFAs	20.5	4.8	9.4	48.6	13.5	17.2
	(number of countries)	11	6	6	17	8	9
	Remaining funding needs	275.2	71.7	124.6	554.5	287.7	350.4
	(number of countries)	29	8	10	38	18	20
	Impact on IMF resources	-25.2	-15.0	-15.0	-58.8	-15.0	-15.0
	Total available IMF resources	782.8	793	793	749.2	793	793

		1	2	3	4	5	6
Using reserves up to 100% of ARA metric and max 25% stock decrease	Total financing needs	991.7	263.2	564.9	1751.9	799.0	1191.2
	(number of countries)	42	9	16	42	25	27
	Funded by reserves	708.4	217.8	479.3	1022.4	566.2	837.2
	(number of countries)	27	3	8	27	14	16
	Funded by RFAs	25.5	10.8	13.0	129.5	16.2	85.9
	(number of countries)	9	3	4	15	6	8
	Remaining funding needs	238.6	34.5	72.6	537.9	216.6	268.1
	(number of countries)	20	6	8	28	11	13
	Impact on IMF resources	-61.8	-52.9	-52.9	-177.0	-52.9	-148.3
	Total available IMF resources	746.2	755.1	755.1	631	755.1	659.7

		1	2	3	4	5	6
Using reserves up to 80 of ARA metric and max 40% stock decrease	Total financing needs	991.7	263.2	564.9	1751.9	799.0	1191.2
	(number of countries)	42	9	16	42	25	27
	Funded by reserves	762.6	226.0	490.8	1272.0	584.3	929.2
	(number of countries)	34	5	12	34	19	21
	Funded by RFAs	15.9	10.8	10.8	24.9	10.8	15.8
	(number of countries)	6	3	3	7	3	4
	Remaining funding needs	213.2	26.5	63.3	429.2	203.9	246.2
	(number of countries)	16	5	6	19	11	11
	Impact on IMF resources	-56.9	-52.9	-52.9	-56.9	-52.9	-52.9
	Total available IMF resources	751.1	755.1	755.1	751.1	755.1	755.1

Abbreviations

AE	Advanced economy
BBA	Bilateral borrowing agreement
ECB	European Central Bank
EFF	Extended Fund Facility
EME	Emerging market economy
EMDCs	Emerging Markets and Developing Countries
ESCB	European System of Central Banks
FCL	Flexible Credit Line
FDI	Foreign Direct Investment
FX	Foreign exchange
GFSN	Global financial safety net
GRQ	General Review of Quotas
IMF	International Monetary Fund
IRC	International Relations Committee
LICs	Low Income Countries
PLL	Precautionary and Liquidity Line
RFA	Regional financing arrangement
SBA	Stand-by arrangement
WEO	World Economic Outlook

For a glossary of IMF terms see the IMF's Glossary of Selected Financial Terms.

Authors

The following members of the Task Force on IMF issues of the International Relations Committee (IRC) of the ESCB have contributed to this report:

Pilar L´Hotellerie-Fallois (chair of the Task Force)
Banco de España, Madrid, Spain; email: plhotellerie@bde.es

Menno Broos
De Nederlandsche Bank, Amsterdam, Netherlands, email: m.l.f.broos@dnb.nl

Sonsoles Gallego Herrero
Banco de España, Madrid, Spain; email: sonsoles.gallego@bde.es

Isabel Garrido Chamorro
Banco de España, Madrid, Spain; email: igarrido@bde.es

Fernando López Vicente
Banco de España, Madrid, Spain; email: fernando.lopez@bde.es

Mayukh Mukhopadhyay
Bank of England, London, United Kingdom

Claudia Maurini
Banca d'Italia, Rome, Italy; email: claudia.maurini@bancaditalia.it

Benjamin Vonessen
European Central Bank, Frankfurt am Main, Germany; email: benjamin.vonessen@ecb.europa.eu