IMF POLICY PAPER

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ADEQUACY OF FUND RESOURCES—FURTHER CONSIDERATIONS

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- The **Paper**, prepared by IMF staff and completed on July 31, 2017 for the Committee of the Whole's consideration on September 15, 2017.

- The **Chairman's Concluding Remarks**, which reflect the Chairman's understanding of the views expressed during the September 15, 2017 meeting of the Committee of the Whole.

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**International Monetary Fund
Washington, D.C.**

ADEQUACY OF FUND RESOURCES—FURTHER
CONSIDERATIONS

EXECUTIVE SUMMARY

This paper is part of the workplan on the 15th General Review of Quotas (15th Review). It is a companion paper to *Quota Formula and Realigning Shares*, recognizing that issues relating to the size of the Fund, quota increases and their distribution, and a new quota formula, will ultimately need to be considered as a package in concluding the 15th Review. Experience suggests that further deliberations will be needed before the issues presented in this paper can begin to be narrowed down. Staff does not make any proposals in this paper, but the analysis continues to suggest that the current overall lending capacity of the Fund should be seen as a minimum.

The paper provides a two-pillar framework for assessing the adequacy of Fund resources, building on the staff paper discussed by the Board in March 2016. The first pillar presents quantitative analysis, using three approaches to provide indicative ranges for the adequacy of Fund resources. The traditional metric approach is employed as a starting point, complemented by access-based and global scenarios approaches. The first approach suggests that the ratio of current quotas to GDP is below its historical norm, but that the gap is filled if borrowed resources are factored in. All other traditional metrics suggest a significant resource gap—even including borrowed resources. Results from the access and scenario-based approaches indicate a relatively wide range of estimates for the lending capacity of the Fund, depending on the pervasiveness and intensity of crises and on access-based considerations.

The second pillar of the framework is qualitative in nature. The paper argues that high interconnectedness is the overriding qualitative consideration, and the interaction of interconnectedness with ongoing and new transitions is likely to increase the risk of systemic stress. At the same time, vulnerabilities have increased and countries have less room for policy maneuver. While interconnectedness calls for global solutions, the Global Financial Safety Net (GFSN) has become more multilayered and regional. Other considerations—including changes to Fund policies, confidence impacts, and moral hazard—are also discussed.

The paper also provides information to support a discussion on the mix of Fund resources. As underscored by the membership, the Fund should remain a quota-based institution. The Fund has a long history of supplementing its primary resource

base—quotas—with standing borrowing facilities (the GAB and the NAB). This structure has served the Fund well. However, the overall share of borrowed resources, including bilateral borrowing, remains high by historical standards. In this context, the paper presents several elements relevant for a discussion on the composition of Fund resources. These include in the quantitative section an assessment of how the various estimates are covered by current quotas and borrowed resources, and, a discussion of the implications of different financing sources across various dimensions such as governance, resource mobilization, and burden sharing. The paper also highlights the importance of ensuring that the Fund has sufficient resources *ex ante* before a crisis hits.

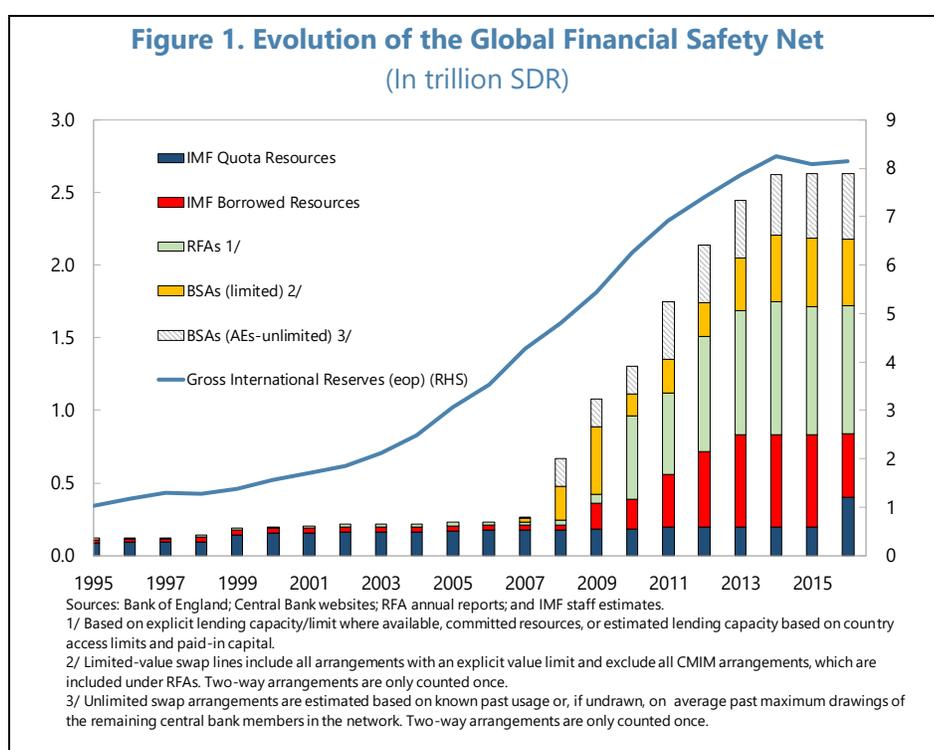| Approved By	Prepared by the Finance and Strategy, Policy, and Review Departments.
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CONTENTS

TABLES

ANNEXES

INTRODUCTION AND CONTEXT

1.   This paper is part of the workplan on the 15th General Review of Quotas (15th Review).[1] It is a companion paper to *Quota Formula and Realigning Shares*, recognizing that issues related to the size of the Fund, quota increases and their distribution, and a new quota formula will ultimately need to be considered as a package for concluding the 15th Review. In earlier informal discussions, Directors have expressed divergent views on the size and composition of the Fund's resources. While most Directors reiterated the need to at least maintain the Fund's current lending capacity, some Directors saw room for reducing it. Also, despite a broad consensus that the Fund should remain a quota-based institution, there is no agreement at this point on the appropriate mix of quota and borrowed resources going forward. Experience suggests that achieving broad consensus on these issues will be challenging, and will require a spirit of compromise with the goal of ensuring that the Fund's resources and governance structure continue to keep pace with global developments, thereby helping to preserve international stability.

2.   The Fund remains central to the Global Financial Safety Net (GFSN).[2] The GFSN has grown significantly since the global financial crisis (GFC) and the number of participants providing financing increased.[3] While the Fund's resources have also increased markedly,

Figure 1. Evolution of the Global Financial Safety Net
(In trillion SDR)

Sources: Bank of England; Central Bank websites; RFA annual reports; and IMF staff estimates.
1/ Based on explicit lending capacity/limit where available, committed resources, or estimated lending capacity based on country access limits and paid-in capital.
2/ Limited-value swap lines include all arrangements with an explicit value limit and exclude all CMIM arrangements, which are included under RFAs. Two-way arrangements are only counted once.
3/ Unlimited swap arrangements are estimated based on known past usage or, if undrawn, on average past maximum drawings of the remaining central bank members in the network. Two-way arrangements are only counted once.

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[1] The Board of Governors has called on the Executive Board to work expeditiously on the 15th Review in line with existing Executive Board understandings and guidance provided by the IMFC on October 8, 2016 (Board of Governors Resolution 72-1 adopted on December 5, 2016).

[2] The GFSN includes (i) reserves; (ii) official arrangements—the IMF, regional financing arrangements and bilateral swaps; and (iii) market instruments. Multilateral Development Banks (MDBs) are not considered part of the GFSN, because they serve a different purpose—providing financing for development purposes; in general, they do not provide balance of payments financing.

[3] See *Strengthening the International Monetary System—A Stocktaking* (February 22, 2016); *Adequacy of the Global Financial Safety Net* (March 10, 2016); *Adequacy of the Global Financial Safety Net—Considerations for Fund Toolkit Reform* (September 30, 2016).

the IMFC has repeated its commitment to a strong, quota-based, and adequately resourced IMF to preserve its role at the center of the GFSN, most recently on April 22, 2017; this call was reiterated by G20 Leaders at the Hamburg Summit on July 7–8.[4] Indeed, with its near-universal membership and a wide array of lending instruments, the Fund has retained its central role by providing for efficient risk sharing and reserve pooling at the global level, which helps promote economic and financial stability in an increasingly interconnected world. The Fund also continues to consider reforms of its toolkit to meet the evolving needs of its members in an evolving global system.[5]

3.   The Fund needs to remain appropriately sized to fulfill its role in the GFSN. The GFC happened at a time when there had not been a general quota increase in ten years, effectively

leaving the Fund substantially under-resourced (Figure 2). The membership responded forcefully at the time by providing a large increase in Fund resources through Bilateral Borrowing Agreements (BBAs) and an expansion of the New Arrangement to Borrow (NAB).[6] The Fund's quota resources were doubled under the 14th Review— the largest quota increase in the history of the Fund—although the net impact on the Fund's overall lending capacity was small due to the corresponding rollback of the NAB. The membership also acted in the

Figure 2. Entry into Effect and Size of General Quota Increases by Decade
(In percent)

Source: IMF staff calculations.
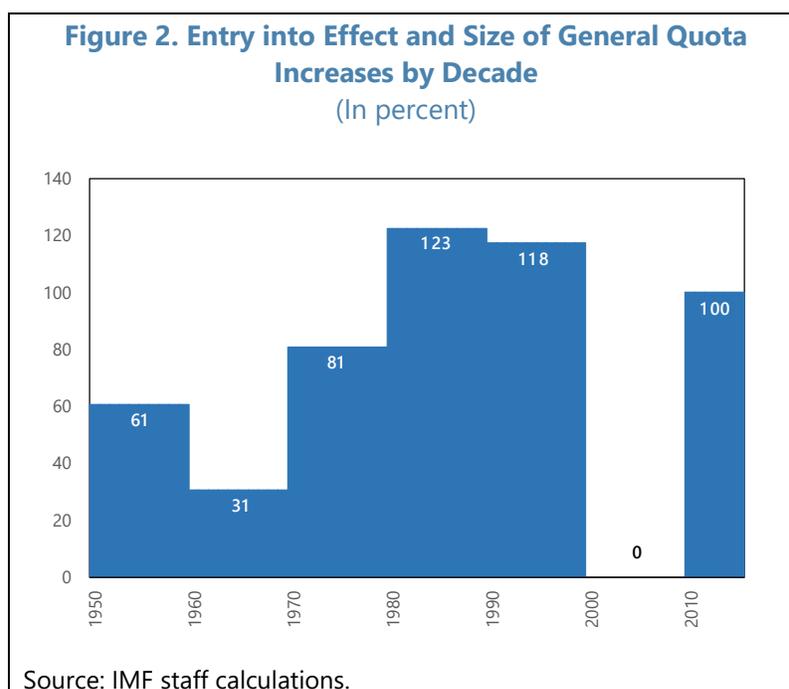
past year to maintain the Fund's lending capacity, first by maintaining access to bilateral borrowing, and second by renewing the NAB for another 5-year period.[7] That said, entering the GFC under-

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[4] See *Communiqué of the Thirty-Fifth Meeting of the International Monetary and Financial Committee* (IMFC), April 2017, and *G20 Leaders' Declaration*, Hamburg, July 7–8, 2017.

[5] See *Adequacy of the Global Financial Safety Net—Proposal for a Policy Coordination Instrument* (May 31, 2017) and *Adequacy of the Global Financial Safety Net—Review of the Flexible Credit Line and Precautionary and Liquidity Line, and Proposals for Toolkit Reform* (June 1, 2017).

[6] See *Adequacy of Fund Resources—Preliminary Considerations* (March 11, 2016) —Box 1 in particular—for more details on the resource mobilization effort since 2009.

[7] In August 2016, the Board approved maintaining access to bilateral borrowing under a new improved framework that built closely on the 2012 borrowing framework. Furthermore, in November 2016, after consultation with NAB participants, the Board approved the renewal of the NAB Decision for another five years through November 2022; see *New Arrangements to Borrow—Proposed Renewal of and Modifications to the NAB Decision* (October 21, 2016). The General Arrangements to Borrow (GAB) are also subject to periodic renewals, and the current GAB period (continued)

resourced had a cost in terms of initially weakening confidence in the ability of the Fund to play its normal role in supporting members' efforts to address their balance of payments needs. A key lesson of the GFC has been that, in order to fulfill its functions effectively, the IMF needs to be appropriately sized, with sufficient resources to play a catalytic role in assisting members to meet their actual, potential, or prospective financing needs, thereby supporting market confidence.[8]

4.   Without further action, the Fund's lending capacity will decline by end-2019 or end-2020 at the latest. The Fund's current overall lending capacity (about SDR 693 billion or almost $1 trillion—see Box 1) is being boosted by the 2016 BBAs, which will expire at end-2019, or end-2020 at the latest (if the Executive Board approves and creditors consent to a maximum one-year extension). The NAB Decision was recently renewed through November 2022.

5.   Against this background, the paper provides a framework for assessing the adequacy of Fund resources. It takes the Fund's role in the current GFSN as a starting point and assumes that other elements of the GFSN are permanent and operational, at least for the horizon covered by the 15th Review. Building on "Adequacy of Fund Resources—Preliminary Considerations" of March 2016 ("March paper"),[9] the paper provides further methodological details, updates the relevant datasets and reflects on issues raised by Directors during the informal Board discussion in March 2016, bilateral outreach earlier this year, and at the June 2017 staff briefing of the Executive Board. Its framework rests on two pillars. The first pillar comprises quantitative analysis, using three complementary methodologies to provide indicative quantitative ranges for the adequacy of Fund resources. Because a decision on the size of the Fund cannot rest only on a mechanical quantitative exercise, the second pillar discusses broader qualitative considerations on the size and optimal composition of Fund resources.

6.   Given the early stage of the discussions on the 15th Review, this paper does not present any proposals. It is recognized that further deliberations on the size of the Fund and its composition will be needed before the issues under discussion can begin to be narrowed down. This paper is expected to provide input to Directors for making a judgment on the appropriate size of the Fund and quota increases. Based on Directors' guidance, staff in a follow-up paper will look at possible landing zones for the Fund's size and quota resources.

7.   The paper is organized as follows. The next section describes the first pillar of the framework and updates the results of the three methodologies. The subsequent section discusses key qualitative considerations that form the second pillar. It also includes some preliminary considerations on the composition (quotas and borrowing) of Fund resources. The final section concludes with issues for discussion.

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ends in December next year. A decision to renew the GAB needs to be taken, 12 months before the end date, by December 2017. The GAB can be used only if activation of the NAB is not supported by NAB participants, so it does not provide additional resources to the NAB.

[8] See *IMF Response to the Financial and Economic Crisis*, Independent Evaluation Office (IEO), October 27, 2014. See also *Need as a Condition for the Use of Fund Resources* (December 15, 1994), which sets out that a Fund arrangement may be approved on the basis of actual, potential, or prospective balance of payment need.

[9] See *Adequacy of Fund Resources—Preliminary Considerations* (March 11, 2016).

Box 1. The Fund's Resource Envelope

The *Fund's total resources* currently include the following elements:

- As a **quota-based institution**, quotas are the primary source of financing for lending.
- **Two standing borrowing arrangements** supplement quotas: (i) the New Arrangements to Borrow (NAB) is the main recourse after quotas, and was introduced in 1998; and (ii) the General Arrangements to Borrow (GAB), which was introduced in 1962. The GAB can be used only when NAB activation is not supported by NAB participants.
- **Bilateral borrowing** through the 2012 and 2016 Borrowing Agreements (BBAs) serves as temporary backstop to quotas and the NAB.

Lending capacity **is the most relevant metric for assessing the overall adequacy of the Fund's resources as it represents the usable resources potentially available for non-concessional lending:**

- For **quota** resources, it comprises quota resources of members in the Financial Transactions Plan (FTP), i.e., members with a balance of payments position deemed sufficiently strong to provide resources to other members in need. A prudential balance of 20 percent is set aside to ensure that members' reserve tranche positions[1] are liquid and can be counted as reserve assets.
- Lending capacity of **NAB** resources is the total amount of NAB credit arrangements, minus the credit arrangements of participants that have not yet adhered to the NAB Decision or are not currently in the FTP, and minus a prudential balance of 20 percent that is needed to ensure full encashability of NAB claims.
- For 2012/16 **Borrowing Agreements**, the lending capacity is the total amount of effective bilateral agreements minus a prudential balance of 20 percent to ensure full encashability of bilateral borrowing claims.

The *Forward Commitment Capacity (FCC)* measures resources that are available to finance new commitments over the next 12 months. It is relevant to monitor the Fund's liquidity at any point in time. It is equal to usable resources that are uncommitted, plus repurchases one-year forward, less repayments of borrowing due one-year forward, and less the prudential balance. The FCC currently contains only quota resources given the NAB deactivation in February, 2016. The Bilateral Borrowing Agreements are not included in the FCC as they can be activated only if (i) the NAB is activated, and (ii) the modified FCC (i.e., the FCC stemming from quotas and NAB resources) falls below SDR 100 billion.

Fund's Key Financial Indicators [1/] [2/]
(In SDR billion)

	Total Fund Resources	Lending Capacity	Forward Commitment Capacity
Quotas	477	320	210
NAB	182	143	-
Bilateral Borrowing Agreements	288	230	-
Total	**947**	**693**	**210**

Source: IMF Finance Department.

1/ As of May 31, 2017. Assumes that quota payments of all members have been completed.
2/ Estimates only. Reflects NAB deactivation and available NAB resources for undrawn balances under NAB eligible commitments based on a 1:1 financing ratio of NAB to quota resources.

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1/ The Reserve Tranche Position (RTP) is a liquid claim on the IMF by a member, received in exchange for the reserve asset portion of its quota payment or for the use of its currency. For further details see the IMF's financing mechanism in IMF Financial Operations (November 2016).

THE SIZE OF THE FUND

FIRST PILLAR: QUANTITATIVE ANALYSIS

This section provides a variety of quantitative approaches to assess potential calls on Fund resources and their composition, including a discussion of their pros and cons. Given the uncertainties inherent in projecting the potential demand for Fund resources, these approaches deliver a wide range of results and should not be regarded as providing a definitive answer on what is the right size of the Fund. Rather they aim to inform judgment of Directors on possible landing zones.

8.   **This section details the quantitative pillar of the framework, building on earlier analyses.** A variety of complementary approaches are used, building and improving on the March paper:

- **A metric-based assessment** of Fund resources relative to (i) key traditional proxies for demand such as global GDP, trade, and capital flows, and (ii) members' external financing needs. This approach estimates the additional resources needed, if any, to restore these ratios to their reference levels.

- **An access-based assessment**, using two methods to identify members that could potentially require Fund financial assistance. A range of potential financing needs are then calculated, using past patterns of demand for Fund resources.

- **Global shock scenarios**, using simulations based on a range of historical systemic crises.

9.   **The approaches are complementary as they look at the question of the size of the Fund from different angles.** The metric-based approach is based on both quotas and *total Fund resources* (also referred to as the size of the Fund, and comprising quotas, the NAB/GAB, and BBAs), while the other two approaches are based on the *Fund's lending capacity* (also referred to as Fund financing).[10] The metric-based approach provides a historical perspective on the evolution of the size of the Fund (and of its quota resources) relative to key global indicators. Both the access-based approach and the global shock scenario try to identify in a granular exercise which members could require support under a range of crises scenarios. The access-based approach assesses the probability of a member requiring a Fund arrangement and then uses the average size of past programs to determine the potential call on Fund resources. The global scenario relies on the staff's Vulnerability Exercises to identify vulnerable member countries and then provides a country-specific estimation of their potential call on Fund resources.

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[10] See Box 1 for the relationship between the Fund's total resources and lending capacity.

INTERNATIONAL MONETARY FUND   **9**

A. Traditional Metrics

10.   Key potential demand indicators have been an important starting point in past assessments.[11] They offer only a partial picture, but nonetheless provide useful benchmarks. In past General Reviews of Quotas, assessments have typically included ratios relating the Fund's resource envelope to global economic indicators. Based on these ratios, this section estimates additional resources needed to restore them to their reference levels (defined as the average of these ratios at the time of the past four quota reviews when there was an agreement on a quota increase, namely, the 8th, 9th, 11th and 14th Reviews).[12] This section also presents indicators for two different reference periods: the current period 2012–16 and the period 2015–19 based on projections of the April 2017 World Economic Outlook (WEO) baseline. Such forward-looking measures are helpful, given the agreed timetable for the 15th Review and the often-considerable lag between agreement on quota increases and when they become effective.

11.   In general, substantial increases in quotas—and to a lesser extent in total Fund resources—would be required to restore ratios in line with their reference levels. The required increases for the current period are slightly above those shown in the March paper for the period 2011–15 (Table 1 and Tables AI.1 and AI.2 in Annex I for more detail):

- **GDP.** GDP has been a key economic reference in past quota reviews. Since the 8th Review, all reviews where a quota increase was agreed restored the ratio of quotas to GDP to a similar level (1.2–1.3 percent). Since the last (14th) Review, the quota-to-GDP ratio has declined to levels prevalent at the 10th Review in the mid-1990s. Restoring this ratio in line with its reference level would require a 31 percent increase in quotas for 2012–16 and a 47 percent increase for 2015–19. The large increase in Fund borrowing since the GFC has raised the ratio of overall Fund resources to GDP to slightly above the relevant reference ratio.

- **Trade and capital flows.** Past assessments have also taken into account indicators related to external flows such as current payments and capital flows. Although past quota increases have not restored these ratios to their reference levels, these indicators appear more relevant to potential resource needs going forward. In particular, as discussed further in the second pillar section below, high interconnectedness, financial deepening, and growing sovereign-financial sector inter-linkages suggest that an economy's potential financing needs are imperfectly captured by GDP alone. Given the rapid expansion of these other indicators, and notwithstanding their recent slowdown, the decline in Fund quotas relative to these indicators is steeper than relative to GDP. Restoring the quota ratios in line with their reference levels would require broadly doubling quotas for 2012–16 and nearly tripling them for 2015–19. The increases required to restore the ratio of total Fund resources to these indicators are lower, but still large.

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[11] See, for example, *Fourteenth General Review of Quotas—The Size of the Fund—Initial Considerations* (March 15, 2010). The 14th Review also used scenario-based analysis to inform the discussion on the adequacy of the Fund's resources.

[12] The four Reviews were concluded in 1983, 1990, 1998, and 2010 respectively.

Table 1. Additional Resources Required to Restore Fund Resources 1/

A.   Additional Resources Required to Restore Quotas Relative to Economic Indicators

	Additional quotas required (in SDR billion)			Percent increase from current quotas		
	Mar-16	Aug-17		Mar-16	Aug-17	
Reference period	*(2011-15)*	*(2012-16)*	*(2015-19)*	*(2011-15)*	*(2012-16)*	*(2015-19)*
GDP	124	149	222	26	31	47
Current Payments	481	545	835	101	114	175
Capital Inflows to EMDCs	850	944	1,176	178	198	246
EFN	701	721	808	147	151	169
Average	*539*	*590*	*760*	*113*	*124*	*159*

B.   Additional Resources Required to Restore Total Resources Relative to Economic Indicators 2/

	Additional resources required (in SDR billion)			Percent increase from current resources		
	Mar-16	Aug-17		Mar-16	Aug-17	
Reference period	*(2011-15)*	*(2012-16)*	*(2015-19)*	*(2011-15)*	*(2012-16)*	*(2015-19)*
GDP	(194)	(152)	(90)	(21)	(16)	(10)
Current Payments	224	314	636	24	34	69
Capital Inflows To EMDCs	642	765	1,012	70	83	110
EFN	536	574	654	58	62	71
Average	*302*	*375*	*553*	*33*	*41*	*60*

Source: IMF Finance Department, WEO, and IFS.

1/ Amounts needed to restore the ratios to the average level of the last Reviews with quota increases (8th, 9th, 11th and 14th). In part B, the implied changes are relative to the current envelope of quotas, NAB, and BBAs.

2/ Relative to total Fund resources (SDR 947billion). See Box 1 for details how to translate the total resources to the lending capacity.

- **Past borrowers' external financing needs (EFNs)**.[13] The ratio of Fund quotas to EFNs is projected to decline to a historical low of about 22 percent in 2019, compared to about 45 percent in 2000. Restoring this ratio to the average level prevailing at the time of agreement on the 11th and 14th Reviews would require increasing quotas by 151 percent for 2012–16 and by 169 percent for 2015–19. The required increase in Fund resources to restore this ratio to its reference level would be 62 to 71 percent.[14]

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[13] This analysis is based on estimates for 94 members that have had GRA arrangements and outright disbursements since 1990, for which data are available. Gross financing needs are estimated using WEO data as the sum of current account deficits net of grants, medium- and long-term debt amortization, arrears repayments, and reserve accumulation. EFNs are calculated by adjusting gross financing needs to include short-term debt but to exclude reserve accumulation by countries with reserves exceeding short-term debt; and countries with negative gross needs.

[14] The decline of Fund resources relative to other economic indicators is also sizable. The GFC highlighted the relevance of gross external liabilities and broad money as sources of external vulnerability. Specifically, a rapid build-up of gross external liabilities could increase the risk of balance sheet stress and liquidity crises. Sharp changes in

(continued)

Figure 3. Evolution of Fund Resources Relative to Economic Indicators 1/

(In percent)

A. GDP
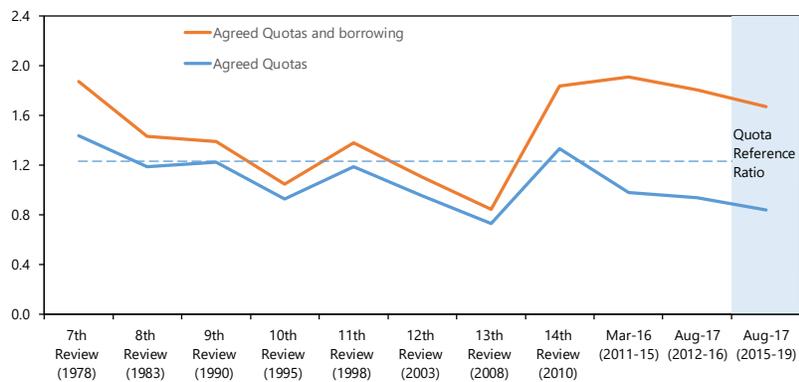
B. Current Payments
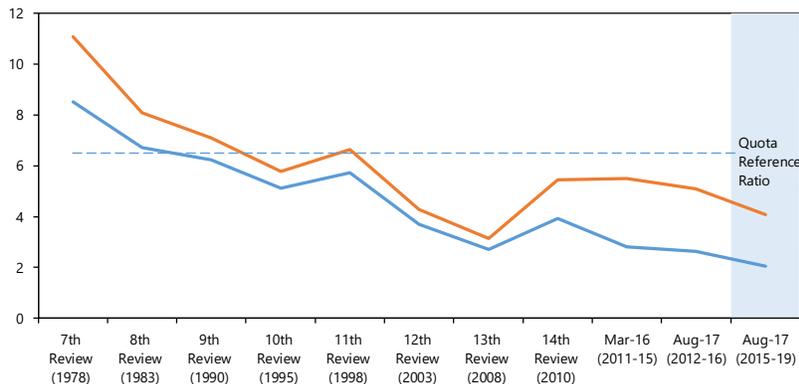
C. Capital Inflows to EMDC
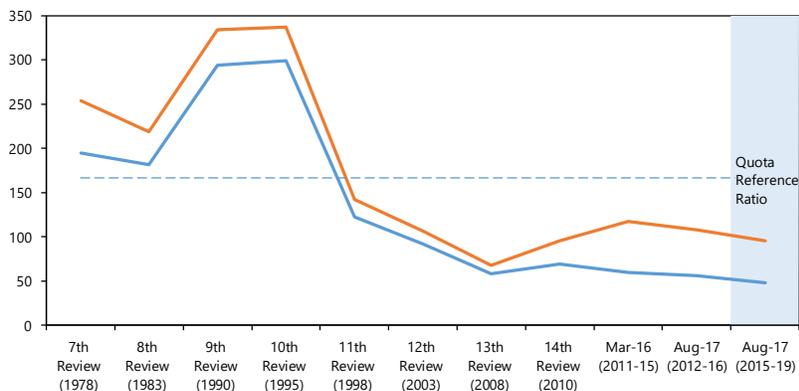
Source: WEO database and IMF staff calculations.

1/ Assumes that the current total resources are maintained beyond 2017.

broad money (typically M2) can also capture the risk of capital flight and capital account crises. And reserves are an indicator of the need for a larger international liquidity pool. These indicators though are not considered key in guiding the analysis of Fund resources given that the time series are not consistent and, in the case of reserves, concerns about accumulation for non-precautionary motives (see the March 2016 paper).

B. Access-Based Simulations

12.   The access-based simulations follow a two-step approach. In the first step, two different approaches are used to identify members that might require Fund financial assistance. In the second step, plausible assumptions on the size of such financial assistance are applied to generate a matrix of estimates for the impact on the Fund's overall lending capacity.

Step 1: Identification of Members

Approach A—Large borrower scenarios

13.   Two scenarios look at potential crises during which larger past borrowers would request Fund resources. This approach recognizes that, in contrast with previous crises, most members seeking financial assistance during the GFC were small, in terms of their share in global GDP.[15] But with many members now facing several sources of vulnerabilities—lower policy buffers, lower growth, post-crisis legacies, and lower commodity prices[16]—there is no assurance that future crises will be limited to smaller members. The two scenarios are based on a sample of all members that had a Fund GRA arrangement or requested outright disbursements since 1990, ranked by their 2020 GDP as a proxy for their size. They assume that the following members would have a Fund arrangement, based on an actual, potential, or prospective Balance of Payments (BoP) needs:

- The 12 largest members among the sample, with 12 being the average number of new arrangements per year since 1990.

- The 32 largest members among the sample, with 32 being the number of members that had a Fund arrangement during the past two crises lending cycles (1996–98 and 2008–10).

Approach B—Panel logit scenarios[17]

14.   As an alternative approach, econometric modeling can provide a direct measure of the likelihood that a member may require Fund assistance in a crisis. A binary response model for panel data for 94 members is estimated to gauge the effects of various economic and financial variables on General Resources Account (GRA) lending.[18] The model is used to generate estimated probabilities that a member has a GRA arrangement in a given year, under a downside scenario. The

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[15] Many large emerging markets entered the crisis with sizable policy buffers and some of them benefitted from the prolonged boom in commodity prices, which extended through much of the crisis period.

[16] The recent internal Vulnerability Exercise suggests that the number of Emerging Markets and Developing Countries (EMDC) at medium risk or higher has doubled relative to 2006.

[17] For further details, see Annex II and J. Poulain and J. Reynaud, 2017, *IMF Lending in an Interconnected World,* IMF Working Paper WP/17/155.

[18] The panel dataset covers advanced, emerging, and frontier market economies over the period 1992–2014, for a total of 105 GRA arrangements. This data set corresponds to all non-LIC members for which data were available.

choice of independent variables builds on the literature on this topic[19] and includes country-specific as well as global variables:

- **Member-specific variables**: External financing needs, GDP growth, GDP per capita, credit-to-GDP gap, variation of the bilateral nominal exchange rate versus the U.S. dollar, government stability, and a measure of interconnectedness. All variables are statistically significant and have the expected sign. For instance, the probability of having a GRA arrangement increases when external financing needs or credit-to-GDP gaps increase, or when GDP growth of the member or its partners (interconnectedness variable) drops. Reflecting calls from Directors to better reflect the growing role of Regional Financing Arrangements (RFAs) in the GFSN, the model includes a dummy variable that controls for whether a member has access to an RFA.

- **Global variables**: The significance of U.S. interest rate variations, and of the VIX—a proxy for risk aversion—confirm the intuition that a sustained tightening of global monetary conditions or high volatility are associated with an increase in the probability of requiring an arrangement with the Fund for members that built up vulnerabilities during periods of easy financial conditions. The model also suggests that sustained drops in the oil price create a global environment that increases the probabilities of Fund arrangements.

15.   **The model is used to generate probabilities for each member under a global volatility shock scenario.** The shock assumes that the VIX index would reach an average level of 30 during the year of the shock. This level is below the average VIX level observed over the period 2008–09 (see Annex II). It is further assumed that all other variables remain unchanged. In practice, a global volatility shock would likely be accompanied—among other things—by a drop in GDP growth and an increase in external financing needs, which would both increase the probability that a member may request Fund financing. That said, required policy adjustment and the stigma of approaching the Fund for financing would work in the opposite direction.

16.   **Finally, three lending scenarios are built using different probability thresholds.** To determine which members are flagged by the model, a threshold is chosen such that if a member has a predicted probability in any given year that is greater than the threshold, the member is assumed to have a new arrangement during that year. The main approach to threshold determination in the literature is to calculate the threshold that minimizes the loss function of Type I and Type II errors. A standard way of computing such a function is to assign an equal weight to both types of errors, which sets the threshold to 4.8 percent. Ratios of 2:1 and 3:1 are used for alternative scenarios to penalize false positives (Type II errors) more than missed programs (Type I errors).[20] These ratios set the threshold to 6.4 percent and 16.1 percent respectively. Goodness of fit measures are summarized in Annex II.

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[19] For a review of the literature, see for instance *Modeling Aggregate Use of Fund Resources—Analytical Approaches and Medium-Term Projections*, IMF Working Paper WP/07/70, A. Ghosh and others, March 2007.

[20] Penalizing false positives results in smaller estimates for the need for Fund resources compared with equal weights for both types of errors.

Step 2: Arrangement Size

17.   The next step is to make assumptions regarding the size of members' financing needs. Different scenarios can be built based on the historical distribution of arrangement sizes as a share of members' GDP. Table 2 shows average and standard deviations of the annual series over different periods. It suggests that on average, the size of Fund arrangements (as a share of a member's GDP) has tended to increase over time, as also underscored in Box 2. With crises evolving from stresses on the current to the capital account, this could imply larger arrangement sizes in the future, unless the Fund or other tools are effective in limiting contagion.

Table 2. Size of GRA Arrangements (In percent of a member's GDP)		
	Average	Average +1STD
Last 20 years	3.5	6.2
Last 15 years	4.1	7.0
Last 10 years	5.3	8.0
Since 2008	5.8	8.1
Source: IMF staff estimates.		

18.   The results are summarized in a matrix. Table 3 summarizes potential calls on Fund financing under the different scenarios and assumptions discussed in this section. The rows correspond to the five scenarios discussed in Step 1, identifying the members hit by a crisis (ordered by their impact on the size of the Fund). The first rows correspond to large global crises, while the last row reflects a much more limited crisis event. The latter in particularly is likely to underestimate potential calls on Fund financing in a sizable crisis, especially in cases where some of the larger past borrowers were to experience a need for Fund financing. The columns show different assumptions for the size of arrangements, ranging from 4 to 8 percent of members' GDP in one-percentage point increments. It is worth noting that normal access limits of 435 percent of quota correspond on average to 6.9–7.4 percent of members' GDP identified by the panel logit approach depending on the threshold; and 3.9 and 4.9 percent of GDP for the top 12 and top 32 past borrowers, respectively. For ease of comparison, cells in dark green flag scenarios that could potentially be covered by the Fund's current lending capacity using quota resources only; in green, using quotas and the NAB; and in light green, using quotas, NAB, and BBAs. Scenarios in white exceed the current overall lending capacity. All these scenarios are based on the Fund's overall lending capacity and do not take account of existing loan commitments, which reduce the Fund's resources available for new commitments as reflected in the FCC.

C.   Global Scenarios

19.   The global scenarios provide a bottom-up approach to assess potential financing needs of the membership. The scenarios are not a global equilibrium model, but rather a stress test of the global economy based on a granular exercise for members that have been identified as vulnerable by the staff's Winter 2017 Vulnerability Exercise; and assumptions on how members respond to a global crisis that are calibrated to be in line with the average response during past crises. To derive the Fund's implied lending capacity, the model calculates the potential demand for financing by vulnerable members in the event of a global crisis, taking into account domestic adjustment in response to the crisis; and the supply of financing from non-Fund sources, including members' international reserves, and, where applicable, contributions from RFAs and bilateral swap arrangements (BSAs).

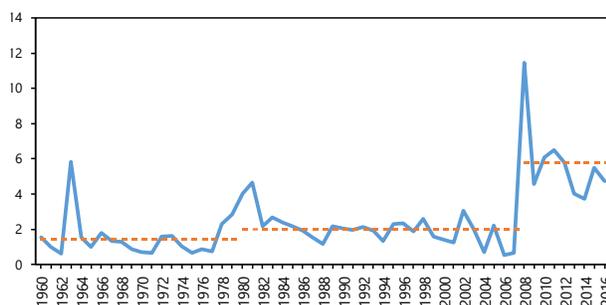## Box 2. Trends in GRA Arrangement Size and Credit Outstanding

The average size of programs has increased relative to GDP, with a particularly noticeable increase during the GFC. From 1960 to 1976 the average size of a new program hovered around 1.5 percent of GDP. At the onset of the international debt crisis in the early 1980s, it shifted up to 2.0 percent of GDP. And the average size saw a further, more rapid, increase at the onset of the GFC: the average program size since 2008 is about 5.8 percent of GDP. This also reflects the shift from current to capital account crisis.

The largest programs have seen the fastest increase in size. Looking closer at the distribution of programs, the increase in size has been most pronounced in the upper tail of the distribution. Specifically, the size of programs in the 75th percentile has grown more than the median size and has seen an increase from around 2 percent of GDP around 1990 to about 6.5 percent of GDP in 2015.

The tail of the distribution sizes has become fatter toward larger programs. The figure on the right side shows how the distribution of new GRA programs has evolved over time. From being relatively compressed close to the average size in 1960–79, the distribution has gradually become more dispersed with an increasing probability of observing programs in the tail. While only 21 percent of all programs were larger than the average during 1960–79, the corresponding number was 34 percent during 2008–16.

Average Program Size in Percent of GDP

Distribution of Program Size in Percent of GDP

Distribution of Program Size in Percent of GDP

The length of arrangements and the maturity of credit outstanding are also increasing. After having been rather constant at 12 months, the duration began to increase in the mid-1970s and the average expected program duration in 2016 stood at 32.6 months. The average maturity followed a declining trend until around 2010 but has since increased sharply to over 6½ years.
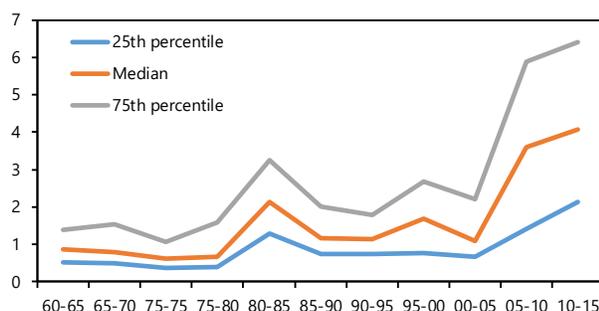
Box 2. Trends in GRA Arrangement Size and Credit Outstanding (concluded)

Average Maturity of GRA Credit Outstanding: 1995–2017 (in years)
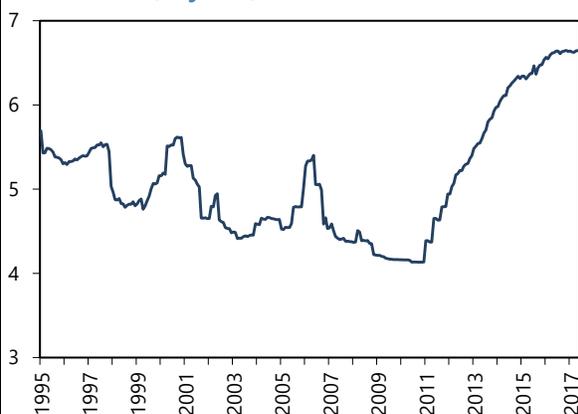
Average GRA program duration, 1995–2016 (in years)

Source: IMF Finance Department

Table 3. Potential Calls on Fund Financing Under the Access-Based Approach 1/
(In SDR billions)

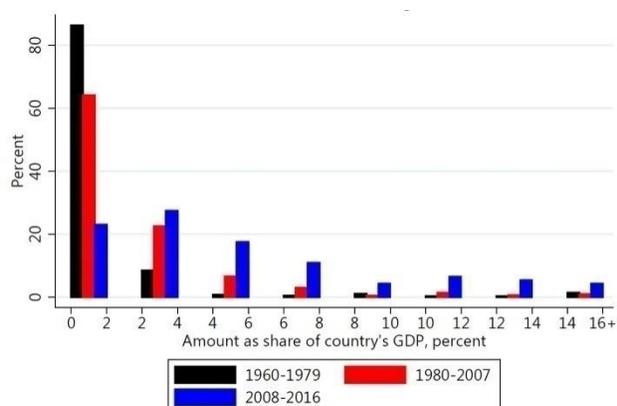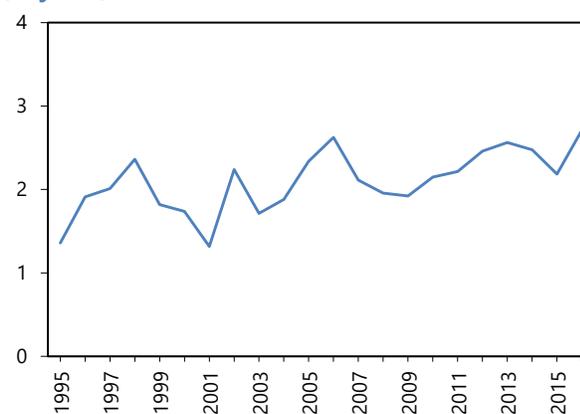| Scenarios [3]	Arrangement Size as Percent of Member's GDP [2]				
	4	5	6	7	8
a. 1:1 Threshold (4.8 percent)	588	735	882	1,029	1,176
b. Top 32 Past Borrowers	462	578	694	809	925
c. 2:1 Threshold (6.4 percent)	460	575	690	805	920
d. Top 12 Past Borrowers	371	464	557	650	743
e. 3:1 Threshold (16.1 percent)	282	352	423	493	564

Sources: Staff estimates based on data from IMF Finance Department, WEO, IFS, WDI, BIS, Federal Reserve Bank of St Louis, U.S. Energy Information Administration, U.S. Federal Reserve, CBOE and ICRG.
1/ Cells in dark green flag scenarios that can be covered by the Fund's current lending capacity using quota resources only; in green, using quotas and the NAB; and in light green, using quotas, the NAB, and BBAs. Scenarios in white exceed the current overall lending capacity. In all cases, the scenarios and shading abstract from existing loan commitments.
2/ See Table 2 to map these sizes to the historical distribution of arrangement sizes.
3/ Scenarios a, c and e use the panel logit approach. Scenarios b and d are explained in paragraph 13.

Demand for Financing

20.   Potential financing needs of members are determined in a three-step approach.

- **First step: Pervasiveness of the crisis.** Members are selected based on thresholds for crisis probabilities, which are estimated in the staff's Vulnerability Exercises for advanced economies (AEs), emerging markets (EMs), and low-income countries (LICs).[21] The lower the threshold, the

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[21] The vulnerability exercise estimates crisis probabilities based on a non-parametric, threshold-based, signal extraction approach (for details on the methodology see *Assessing Country Risk: Selected Approaches*, Technical Notes and Manuals No. 17/08). For AEs, a crisis is defined as a financial crisis as discussed in Laeven and Valencia,

larger the number of members experiencing a crisis and thus the more pervasive the crisis. As in the March paper, four systemic crisis scenarios—members with crisis probabilities of more than 1, 3, 5, and 10 percent in a given year—are considered. The scenarios range from an extremely pervasive global systemic crisis affecting a large number of members (crisis probability of 1 percent) to a crisis that would affect only a relatively small subset of the membership (crisis probability of 10 percent; Table AIII.1, where fewer members would potentially require Fund financing than during the GFC). While it may not be likely that all members would come to the Fund in one year, the probability of this happening is substantially larger over a longer period. For instance, for a member with an annual crisis probability of 1 percent, under unchanged policies over five years, this probability would increase to almost 5 percent. As a result, additional members may seek Fund financing over time while credit remains outstanding for members with balance of payments needs during year one of a crisis, and these considerations strengthen the plausibility of the scenarios.

- **Second step: Severity of the crisis.** For members identified in the first step, potential financing needs are estimated based on the severity of a crisis and its impact on: (i) FDI inflows; (ii) rollover rates for short-term and medium-term debt; and, for EMs only (iii) deposit outflows. The crisis is assumed to persist for two years (2017–18) with declining intensity (see Annex III). For EMs, the severity of a crisis is calibrated based on the empirical distribution of financial crises over the past 30 years using Kernel density estimators.[22] Simulations are then provided for crisis broadly in the 90th, 85th, 75th, and 65th percentiles of the distribution. The higher the percentile, the higher is the severity of the crisis with all countries being hit by the same size shock. As an example, a crisis in the 75th percentile would imply, for an EM, that its FDI declines by 20 percent in both crisis years; its rollover rate for short-term debt is 80 percent in the first year and 85 percent in the second year (for medium-term debt, the rates are 50 percent and 65 percent, respectively); and that it would experience deposit outflows of 5 percent in the first year of the crisis.

- **Third step: Domestic adjustment.** This step is new compared with the March paper. Responding to suggestions from Directors, the model now allows for a member's policy response to the crisis. Specifically, a member is expected to make a fiscal adjustment of 1.4 percent of GDP (0.7 percent of GDP each year), consistent with the average adjustment in members with Fund-supported programs during 2002–14.[23] The model assumes, for simplicity,

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Systemic Banking Crises Database: An Update, IMF WP/12/163; for EMs and frontier economies, a crisis is defined as a sudden-stop where there are significant declines in private net capital flows as discussed in *Assessing Underlying Vulnerabilities and Crisis Risks in Emerging Market Countries—A New Approach* (September 17, 2007); for LICs, a crisis is defined as a sudden-growth decline. The sample includes low-income economies that are eligible for blending GRA and PRGT resources.

[22] Data are insufficient for using kernel density estimators for AEs. Given the greater depth and resilience of debt markets as well as significant foreign assets and alternative financing backstops, debt roll-over rates are assumed to be higher than for EMs. For LICs, the model assumes the same distribution as for EMs.

[23] Data are based on average fiscal adjustment during the first two years of a Fund Arrangement in 90 members using GRA resources during 2002–14 (Source: Monitoring of Fund Arrangements (MONA) database). Similarly, the Market Access Country Debt Sustainability Analysis suggests an average fiscal adjustment of 0.5 percent of GDP each year, based on data for 40 advanced and emerging economies during 1990–2011.

that the adjustment translates into an external adjustment of the same magnitude, which is larger than the expected typical fiscal-external multiplier and is meant to capture also other factors contributing to the external adjustment.

Figure 4. Financing Global Crisis Scenario

Source: IMF staff.
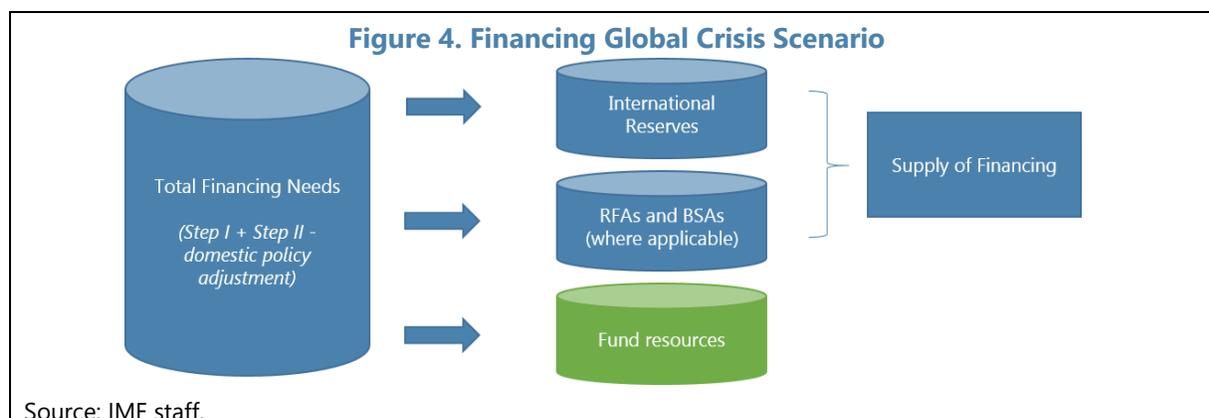
21.   The demand for financing depends on the pervasiveness and intensity of a crisis.[24] In the scenarios considered in Table 4, it ranges from SDR 186 to SDR 2,237 billion. In Scenario "d" where the crisis is the least pervasive and the shocks are the smallest (65th percentile), the demand for financing needs is the smallest. At the other extreme is the most pervasive and intense crisis in the upper right corner. These estimates are somewhat lower than the ones presented in the March paper, mostly because the model now assumes that a member undertakes policy adjustment (there are also changes in the member groups based on the updated vulnerability exercises but that does not materially affect the estimates).

Table 4. Total Demand for Financing in Various Stress Scenarios
(In SDR billions)

	Crisis Intensity (percentile)			
	65th	75th	85th	90th
a. Extremely pervasive global systemic crisis	768	1,209	1,787	2,237
b. Very pervasive systemic crisis	583	885	1,302	1,653
c. Pervasive systemic crisis	440	674	1,002	1,286
d. Systemic crisis	186	287	398	468

Source: IMF staff estimates.

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[24] The demand for financing could, in principle, also be affected by the exchange rate regime of a member. While the exchange rate regime can affect whether members are judged as vulnerable, the role of exchange rate flexibility on the current account adjustment is not captured in the models. For example, exchange rate depreciation may contain some of the calculated financing shortfall in those countries whose domestic borrowers are well-hedged or whose external debt is denominated in domestic currency (high FX-denominated debt remains an issue in many countries). However, in some of the pervasive global crisis scenarios that are modeled here, the room for exchange rates to play this stabilizing role may be more limited as many countries would face large shocks and external adjustment needs at the same time.

Supply of non-Fund financing

22. **Non-Fund financing would be expected to cover a significant part of the potential financing needs.** First, members can draw on their international reserves. Some members also have access to RFAs or BSAs. In the following, the paper discusses access to such resources, including constraints and conditions. The calculations do not include multilateral and regional development banks: while they primarily provide financing for development purposes, their balance of payments assistance to members in crises has typically been relatively small.[25] Also, even though official bilateral borrowing by members can be significant,[26] it is not included as it usually is agreed on an ad-hoc basis and therefore difficult to forecast (i.e., there are no set rules or triggers for such arrangements). Last but not least, private borrowing by a member in a crisis is implicitly included through the assumptions on debt roll-over.

23. **As a first step, the model assumes that countries make use of their international reserves.** Reserves can reduce the likelihood of balance of payments pressures through their signaling effect and can also be used for intervention against sudden stops, capital flight, and deleveraging.[27] However, central banks are often reluctant to resort to a heavy use of reserves during crises, as this could send a negative signal to markets, and tend to rebuild their reserves after initial losses.[28] Indeed, during the GFC, nine of the largest EMs refrained entirely from using reserves, and many reaccumulated most of their reserve losses within one year.[29] As in the March paper, the model assumes that a member would not use reserves beyond 25 percent of its pre-crisis level (consistent with the share members used during the GFC). It also assumes that EMs maintain reserves at 100 percent of the Fund's metric for assessing reserve adequacy (ARA) and that AEs and LICs maintain reserves at 100 percent of short-term debt (see Annex III for further discussion and paragraph 29 on robustness checks). In other words, a member would use reserves until it either loses more than 25 percent or reaches the relevant metric threshold.

24. **The model incorporates resources from RFAs.** After using its reserves, a member might still have a financing gap. As in the March paper, the model then incorporates financing from RFAs, specifically the Arab Monetary Fund (AMF), the BRICs Contingent Reserve Arrangement (CRA), the Chiang-Mai Initiative Multilateralization (CMIM), the EURASIA Fund for Stabilization and Development (EFSD), the European Union-Balance of Payments (EU-BoP) facility, the European Stability Mechanism (ESM), and the Latin American Reserve Fund (FLAR). Given the wide disparity in

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[25] The annual average of budget support loans during the past three years (2014–16) from the World Bank, the African Development Bank, the Asian Development Bank and the Interamerican Development Bank was about $14 billion. The other MDBs primarily finance projects.

[26] See Figure 3 in *Collaboration Between Regional Financing Arrangements and the IMF* (June 29, 2017). Non-RFA financing ranged from 5 to 66 percent in relevant Fund programs over the period 2000–16.

[27] See IMF (2013), *Assessing Reserve Adequacy—Further Considerations*, IMF Policy Paper.

[28] Aizenman, J., and Y. Sun, 2009, *The financial crisis and sizable international reserves depletion: From 'fear of floating' to the 'fear of losing international reserves'?,* NBER Working Paper No. 15308.

[29] Shafik, M., 2015, *Fixing the global financial safety net: lessons from central banking,* Speech at the David Hume Institute, Edinburgh, Scotland, September 22, 2015.

the modalities of RFAs, specific assumptions—including the maximum access amount and burden sharing with the Fund—are applied.[30] For each member, the model checks whether it is a member of an RFA and then applies the rules of the relevant RFA (see Annex III). A caveat to this calculation is the continued uncertainty about the availability of RFA resources in case of a systemic crisis. In particular, risk pooling at a regional level may not work for crises affecting an entire region. Also, most of the RFAs remain untested and RFAs might find it difficult to impose conditionality on members if adjustment is warranted (possibly requiring the involvement of the Fund).[31]

Figure 5. Regional Financing Arrangements

▇ ESM (US$736 bn)	▇ FLAR (US$9 bn)	▇ EFSD (US$8.5 bn)	▇ AMF (US$11.8 bn)
▇ EU BoP only (US$56 bn)	▇ CMIM (US$240 bn)	▨ BRICS CRA (US$100 bn)	
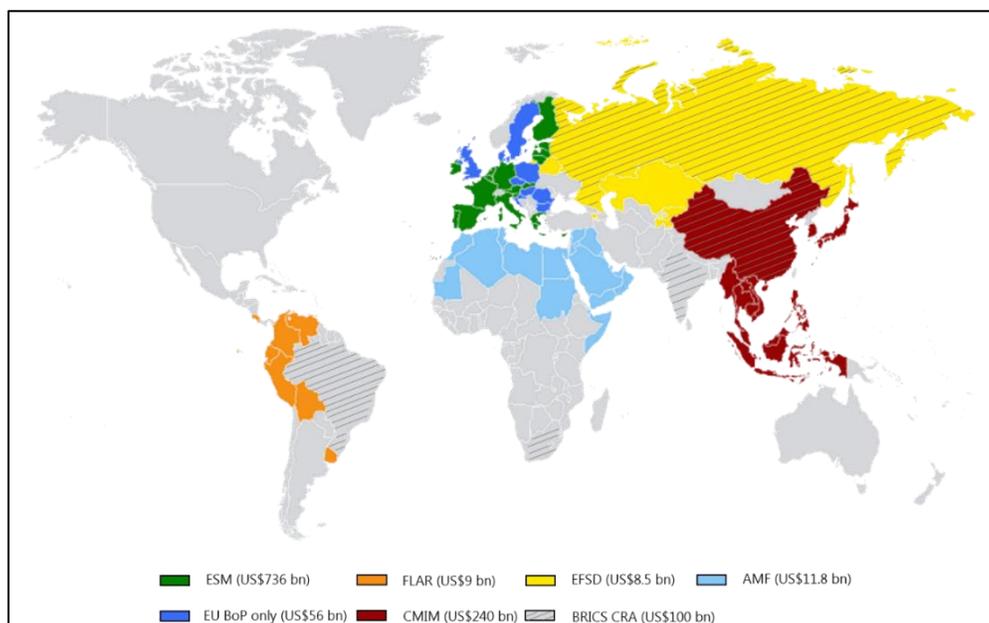
Source: IMF staff estimates.
Note: The lending capacity of the RFAs (indicated in brackets) is the explicit capacity/limit where available (Euro Area and EU facilities, CMIM), committed resources (BRIC CRA), or the estimated capacity based on member access limit and paid-in capital (AMF, EFSD, FLAR). The ESM figure also includes outstanding loans under the European Financial Stability Facility.

25.   Active bilateral swap lines are also included. In line with the March paper, the model takes into account standing unlimited BSAs among major central banks, although most beneficiaries do not have any financing needs in the simulations. The remaining agreements are largely renminbi (RMB) swaps extended by China. Since these BSAs have been established largely to facilitate trade and provide liquidity for offshore RMB transactions, it is not clear whether or how quickly they could be activated during a global crisis; the model therefore excludes them.

26.   The supply of financing by non-Fund sources depends on the crisis scenario. As financing needs vary across the scenarios, so will the members' use of reserves, access to RFAs, and

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[30] See *Collaboration Between Regional Financing Arrangements and the IMF* (June 29, 2017).

[31] Some RFAs, such as the CMIM or CRA, require a Fund-supported program for access to financing above a certain threshold.

drawdown of BSAs. On average, the use of international reserves, RFAs, and BSAs could jointly cover over one-third of global financial needs (Table 5), which is similar to the March paper.

Table 5. Supply of Non-Fund Financing in Various Stress Scenarios (In SDR billion)				
	Crisis Intensity (percentile)			
	65th	75th	85th	90th
a. Extremely pervasive global systemic crisis	372	582	775	846
b. Very pervasive systemic crisis	190	352	511	588
c. Pervasive systemic crisis	130	275	396	456
d. Systemic crisis	43	90	100	101
Source: IMF staff estimates.				

Financing needs to be covered by the Fund

27.   In the final step, the model calculates the potential calls on Fund financing, as the difference between demand and supply. This is a purely mechanical calculation for modeling purposes and does not imply in any way that in practice Fund financing should be regarded as a residual. Note that only a subset of members identified in the first step will have a financing gap requiring Fund assistance. The potential call on Fund financing is then presented in matrix form, depending on the pervasiveness and intensity of a crisis (Table 6). It ranges from SDR 143 billon (lower left corner) to SDR 1,391 billion (upper right corner).

28.   The estimates of potential calls on Fund financing are lower than in the March 2016 paper, reflecting mostly that the model now includes members' policy response. Compared with the March paper, the lower estimates as shown in Table 6 reflect mainly the now-assumed domestic policy response. It should be noted, however, that the assumed fiscal contraction of 1.4 percent of GDP, while similar to the average for Fund-supported programs in 2002–14, would probably not be plausible (and advisable) during a global crisis scenario, when global demand is likely to be already very weak. To provide a benchmark, the GFC could have been in scenario "a" or "b" and the 85th to 90th percentile (in terms of FDI and roll-over of debt) had it not been for many members using large buffers (primarily low public debt and to a smaller extent high international reserves), which significantly reduced their financing needs. Also, the stimulus provided by many AEs and some large EMs and a commodity price boom buffeted a significant part of the membership. As a result, fewer members were affected and the GFC eventually was located toward the lower right corner. With the buffers now more depleted, including in some of the larger countries, and the high interconnectedness discussed in the next section, it seems plausible that a new crisis similar to the GFC would likely involve more and larger countries.

Table 6. Potential Calls on Fund Financing in Various Stress Scenarios 1/
(In SDR billion)

Financing gap (billions of SDRs)

	Crisis Intensity (percentile)			
	65th	75th	85th	90th
a. Extremely pervasive global systemic crisis	396	627	1,011	1,391
b. Very pervasive systemic crisis	393	533	791	1,065
c. Pervasive systemic crisis	310	399	606	830
d. Systemic crisis	143	197	298	367

Source: IMF staff estimates.
1/ Cells in dark green flag scenarios that can be covered by the Fund's current lending capacity using quota resources only; in green, using quotas and the NAB; and in light green, using quotas, the NAB, and BBAs. Scenarios in white exceed the current lending capacity. In all cases, the scenarios and shading abstract from existing loan commitments.

29.   The model results are relatively robust to alternative assumptions (see Annex III):

- **Self-insurance.** Assuming a crisis in the 75th intensity percentile, relaxing the assumptions on the maximum level of reserve use, from 25 to 35 or 75 percent of total reserves, could reduce potential calls on Fund financing by up to SDR 53 billion, depending on the pervasiveness of the crisis (Table AIII.4 panel 1). Scenarios with a less pervasive crisis are not affected because members with financing needs hold already very low reserves. Relaxing the assumption on ARA to 80 percent of the metric, would lower potential calls on Fund financing by SDR 4 billion in the less pervasive crisis scenario and SDR 125 billion in the most pervasive adverse crisis scenario (Table AIII.4 panel 2)

- **Fiscal adjustment.** Assuming a stronger domestic policy response—an adjustment of 2 percent of GDP over the two crisis years compared with 1.4 percent of GDP during recent adjustment programs—could also substantially reduce potential calls on Fund financing, depending on the pervasiveness of the crisis (Table AIII.5 panel 2 for a crisis with an intensity at the 75th percentile). On the other hand, and as noted above, even the assumed adjustment (1.4 percent of GDP) would probably not be plausible (and advisable) during a pervasive global crisis scenario. Assuming a weaker domestic policy response—an adjustment of 1 percent of GDP over the two crisis years—results in additional calls on Fund financing of up to SDR 79 billon (Table AIII.5 panel 1).

- **Burden sharing between RFAs and the Fund.** While the model takes into account each RFA's specific modalities, a robustness check assumes equal burden sharing for illustrative purposes (Table AIII.6). Assuming a more prominent role of the RFAs in the GFSN where they cover 75 percent of a member's net financing needs would result in somewhat lower potential calls on Fund financing (up to SDR 28 billion depending on crisis pervasiveness for a crisis with an intensity at the 75th percentile). Assuming equal burden sharing between the Fund and RFAs, potential calls on Fund financing would increase by up to SDR 44 billion. If RFAs can cover only 25 percent of the financing needs (for instance, because they are not fully operational), potential calls on Fund financing would increase between SDR 5 and SDR 116 billion, depending on crisis pervasiveness.

D. Summary and Pros and Cons of the Approaches

30.   The quantitative approaches presented in this section point to a broad range of estimates for the size of the Fund. For the ***traditional metrics*** (Table 1), most indicators suggest that Fund resources would have to rise from current levels in order to align these ratios to historical reference points; for GDP, an increase in quotas (but not in total resources) would be needed to restore its ratio to the reference point, as has generally been achieved with quota increases in past reviews of quotas. For the ***access-based approach*** and the ***global scenarios***, the Fund's current overall lending capacity could cover those scenarios presented in Tables 3 and 6 indicated by the shading.[32] The scenarios summarized in these tables indicate calls on Fund financing from as low as SDR 140 billion, to almost ten times this amount. This wide range of scenarios indicates the need for judgment by the membership, as discussed below, including on what type of scenarios Fund financing should cover, and on the mix of quotas versus borrowed resources. Staff will build on the current work in the future based on Directors' views.

31.   While the approaches are complementary, each of them has advantages and disadvantages (Table 7):

- *The metric-based methodology* has been refined over the years, for instance by adding metrics reflecting the growing importance of trade and volatility of capital flows. This methodology is straightforward and easy to understand and replicate. Because it has guided the assessment of the adequacy of Fund financing for several decades, it remains a relevant starting point when assessing the size of the Fund. However, it requires judgment on the reference levels and how structural changes in the global economy affect benchmarks levels for the various ratios.

- *The access-based approach* constitutes a direct estimation of potential calls on Fund financing. The methodology has been expanded with the use of econometric modeling to help identify potential Fund borrowers in a range of downside scenarios. It takes into account several key factors, including interconnectedness and foreign exchange risk. However, the results of the econometric approach are sensitive to the choice of probability threshold.

- *The global scenario analysis* offers granularity as the size of the Fund is determined by financing needs from each relevant member, subject to different degrees of crisis pervasiveness and intensity. On the downside, the model is a simple stress test (as opposed to a general equilibrium model) and some assumptions in the framework might be too stylized. For instance, the intensity of the crises is based on historical data while the nature of crises has evolved over time (see other considerations, Section A). The model does not explicitly take into account contagion, but it does so implicitly by assuming that all members would access Fund financing at the same time.[33] Another limitation of the model is that it maps individual member

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[32] As noted earlier, the Fund's current lending capacity depends importantly on the 2016 BBAs, which are set to expire in 2019 (and 2020 at the latest). Maintaining the Fund's lending capacity in the absence of bilateral borrowing agreements would require a quota increase of about 70 percent.

[33] Data on conditional probabilities are too complex to calculate. Because there are spillovers, and events are not independent, the joint probabilities would depend on the conditional probabilities of one given the others. This would require $n*(n-1)/2$ conditional probabilities plus the conditional probabilities of subsets of members.

probabilities into a global crisis incidence, even though countries may be vulnerable for different reasons. Under the assumption of independent crisis probabilities, the probability of a systemic crisis is less than the crisis probability of each individual member unless the crisis triggers are correlated across countries. Finally, as discussed in the March paper, the implicit assumption that Fund financing is a residual source of financing has some shortcomings.[34]

	Metric Based	Access Based Scenarios	Global Scenarios
Pros	Straightforward	Direct measure	Based on countries' circumstances
	Traditional anchor	Includes large number of variables	Different degrees of crisis intensity and pervasiveness
Cons	Based on historical data	Based on historical data	Based on historical and confidential data
	Mechanical; requires judgment for reference level	Sensitivity to threshold choice	Complex

Table 7. Pros and Cons of Different Scenarios

Source: IMF staff

32.   All approaches are based on historical relationships and therefore would not fully capture some of the major changes in the global economy that have taken place only recently or are expected to take place in the future. These issues are discussed in next section.

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[34] For instance, the Fund may only make its general resources available to a member if that member has a potential, prospective or actual balance of payments need.

SECOND PILLAR: QUALITATIVE CONSIDERATIONS

This section provides qualitative considerations to help the membership form a judgment on the appropriate size of the Fund and quota increases. A range of issues are discussed, including how the evolution of the global economy and the IMS over the next decade may impact the adequate size of the Fund. The section also provides information to support a discussion on the mix of Fund resources.

A. Qualitative Considerations on the Size of Fund Resources

33.   Qualitative considerations on the size of Fund resources are inherently difficult to quantify. This is partly because of their nature but also, for example, because it is too early to assess the impact of some reforms since the GFC. On balance, these considerations can be expected to increase potential calls on Fund resources in future crises as an increasingly connected global economy will pose new challenges and risks to the membership.

34.   High interconnectedness is the overriding qualitative consideration on the size of Fund resources. The interaction of risks and uncertainties related to high interconnectedness with ongoing and new transitions—as well as interlinkages leading to more complex financial markets—are likely to increase the risk of systemic stress. At the same time, vulnerabilities have increased and members have less room for policy maneuver. While interconnectedness calls for more global solutions, the GFSN has become more multilayered and regional. Other considerations—including changes to Fund policies, confidence impacts, and moral hazard—also play an important role as do the interpretations of the quantitative results.

Increased Interconnectedness and Other Global Economic Transitions Create Uncertainty

35.   Increased interconnectedness in the global economic environment is likely to have an impact on the demand for Fund resources along two main dimensions:

- **Structural changes.** Global economic linkages have changed dramatically over the past two decades reflecting an unprecedented rise in cross-border trade and financial flows. Increased integration provides more opportunities for risk diversification, but at the same it tends to increase the risk of spillovers and contagion, and in turn the risk of systemic stress, with possible implications for members' financing needs.

- **Shifting of the center of global economic 'gravity.'** EMDCs' share in global trade increased from 15 percent in 1990 to 36 percent in 2016. While EMDCs are less financially integrated (as measured, for example, by cross-border liabilities),[35] that gap is closing (Figure 6). In a more multipolar world, it is also likely that the composition of global demand for reserves would evolve, which could expose the system to more frequent and more pronounced portfolio shifts.

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[35] See *Strengthening the International Monetary System—A Stocktaking*, IMF Staff Paper (February 22, 2016).
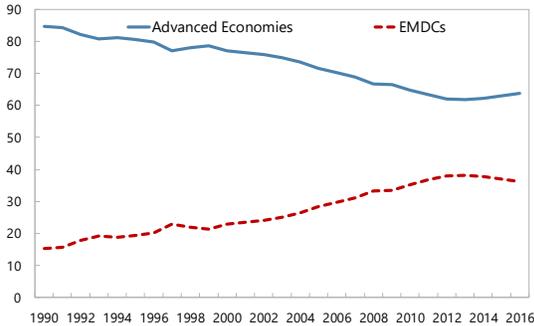
A reliable and predictable GFSN is therefore essential for EMs as they advance in their financial integration.

Figure 6. Ongoing Transitions and Complex Financial Markets

The center of economic gravity is shifting...

....and financial interconnectedness remains high.

Share of Global Trade
(percent)

Sources: IMF, World Economic Outlook; and IMF staff calculations.

Global External Liabilities
(In percent of global GDP)
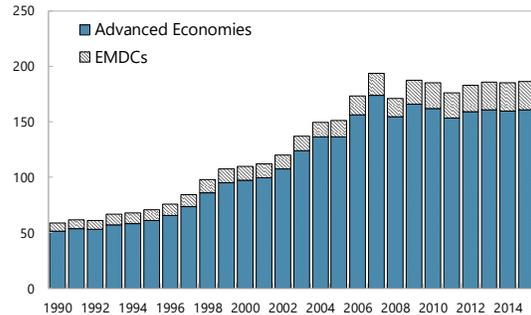
Sources: External Wealth of Nations; IMF, World Economic Outlook; and IMF staff

The nature of intermediation is changing ...

... and capital flows are more volatile.

Cross-Border Liabilities by Counterparty
(In trillions USD)
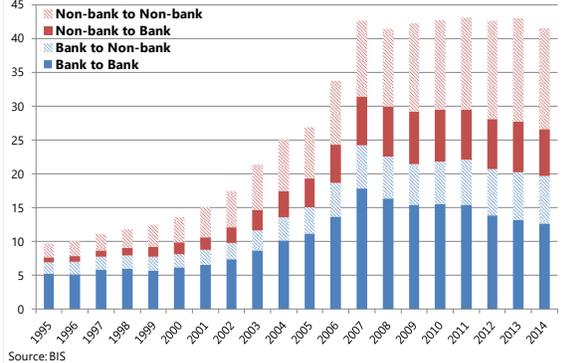
Source: BIS

Capital Flows
(In trillions, U.S. dollars)
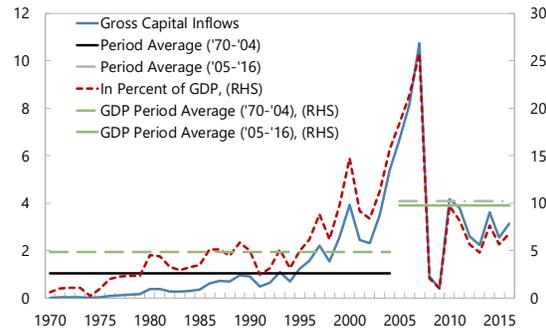
Sources: World Economic Outlook and IMF staff calculations.

36.   The nature of crises therefore continues to evolve. There has been an observed shift in the principal drivers of balance of payments stress from the current account to the capital account. Capital flows increased more than 25-fold between 1980 and 2007, compared to an eight-fold expansion in global trade.[36] While capital flows provide significant benefits, they also carry risks.[37] Moreover, the volatility of global capital flows has increased, particularly for EMDCs. This heightened capital flow volatility combined with amplified and protracted global uncertainty and with increased gross external positions could translate into intensified demand for liquidity backstops. Also, the

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[36] See "*Adequacy of the Global Financial Safety Net*" (March 10, 2016).

[37] See *Capital Flows—Review of Experience with the Institutional View* (November 4, 2016).

historical pattern has been for each successive crisis to be larger than the last, and financing needs could be more persistent than in the past in view of longer program and repayment periods.

37.   Other transitions are likely to work to increase interconnectedness, with implications for systemic risk. Some of the transition risks described last March—such as the unwinding of unconventional monetary policies, rebalancing in China, and the end of the commodity super-cycle—remain relevant, though their timing and outcomes remain uncertain. In addition, there will be new transitions over the medium and long term which are inherently hard to predict, including:

- **Shocks of non-economic origin.** Refugee flows triggered by geopolitical conflicts already have a significant effect on some members and regions and, if left unchecked, could have significant geopolitical and economic spillover effects. Global epidemics (such as Ebola) as well as emerging public health-related concerns such as antimicrobial resistance could present similar challenges. At the same time, enduring demographic challenges—such as aging in many AEs and EMs, or rapid population growth in some developing countries—will have major economic implications and could imply new risks.

- **The mounting economic consequences of climate change.** Climate change could increase the frequency, severity and cost of natural disasters, calling for implementing mitigating measures in member countries at risk and potentially requiring adjustment. The Fund has a role to play in helping its members address those challenges for which macroeconomic policies are an important component of the appropriate policy response.

- **Adjustment to ongoing technological progress and global integration.** In an era of rapid technological change and economic integration, significant efforts will be needed to address dislocations and avoid economic disruptions by ensuring that everyone can benefit. These efforts will likely include both labor market policies and enhanced public support, as social contracts evolve to meet this new reality. Some members may need support, including financial, to design and implement policies to address the effects of technological change and integration.

- **Digital disruptions.** New challenges are emerging because of the rapid growth of digital technologies and increasing cybersecurity risks. The rapid increase in the use of new technologies—and the accompanying new business models—has increased the potential for digital disruption across many industries. The financial sector in particular is facing rapid advances in digital technology—from artificial intelligence to cryptography—and also novel disruptions, such as those relating to virtual currencies, peer-to-peer lending, and high-frequency trading. At the same time, with the heavy reliance of financial institutions on information technology and communication—and the highly interconnected nature of these systems—there has been a rapid rise of cybersecurity risks and their potential to disrupt global financial stability. Cyber-attacks could escalate and lead to a rapidly evolving global crisis.

Interconnected and Complex Financial Markets Require Continued Vigilance

38.   **Global financial cycles are growing in amplitude and duration.** Financial interconnectedness has grown substantially over time and generates a potential spillover channel through which the financial conditions of systemically important members can easily and quickly propagate to the rest of the world.[38] This means that in the event that a crisis trigger disrupts the global financial markets, a wave of correlated crisis could occur. This can translate into sudden and potentially large calls on Fund resources. As interconnection increases, financial frictions pose larger challenges to the international monetary system. They have the potential to contribute to macroeconomic volatility through boom-bust cycles in domestic credit. In a financially-integrated world, capital flows can intensify these cycles, especially given their tendency to be more procyclical than domestic credit. Sharp reversals in capital flows have been associated with feedback loops of financial system distress, forced asset sales and pullbacks in lending, output losses, and further deterioration in balance sheets. Herding and contagion effects can exacerbate these episodes.

39.   **Implementation of the post-crisis global financial regulatory agenda has contributed to a more resilient financial system, but further changes are needed to keep pace with ongoing transitions.** The post-crisis reform agenda has strengthened oversight of the financial system, raised capital and liquidity buffers of individual institutions, and improved cooperation among regulators. This progress has made the global financial system more resilient, especially for banks. But the reform program is not yet complete, with some key aspects unfinished—including on prudential frameworks, cross-border bank resolution, derivatives markets, market infrastructure, and market-based (non-bank) finance. And there are pressures that could stall or even roll back the reform process.[39] Moreover, nonbank financial institutions are participating more in financial intermediation, but they remain largely unregulated**.**

Increased Vulnerabilities, but Reduced Room for Policy Maneuver

40.   **Increased interconnectedness could interact with amplified global vulnerabilities, risking further systemic stress:**

- **Medium-term growth prospects are clouded by weak productivity growth and remaining vulnerabilities.** Crisis legacies—including weak and uncertain economic prospects and sluggish private investment—have held back productivity growth. Vulnerabilities also persist from large public debt, large contingent liabilities including pensions, excessive private indebtedness, impaired corporate and bank balance sheets, and some overheated credit and property markets. Rising global indebtedness also represents an important vulnerability to future crisis, which also limits the future scope for policy adjustment in the event of a crisis, particularly when interest rates begin to normalize. Furthermore, the global economic environment is marked by high

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[38] Over the long term, crisis probabilities appear to increase if the growth in financial interconnectedness outpaces the developments of policies and institutions, and decrease if the reverse occurs.

[39] See Global Financial Stability Report, April 2017.

uncertainty; for instance, the global policy uncertainty index has trended up over the last 5 years (Figure 7).[40] These uncertainties could generate negative spillovers to EMs, prompting capital outflows and increasing financial vulnerabilities.[41]

Figure 7. Global Policy Uncertainty Index

Source : http://www.policyuncertainty.com.

- **Financial vulnerabilities remain elevated.** While financial stability has improved in the last year—with rising equity prices and steeper yield curves mitigating some of the negative side effects of low interest rates for banks and insurance companies—significant vulnerabilities remain. Emerging market risks remain elevated, particularly through higher external financing risks and rising financial vulnerabilities in some members.
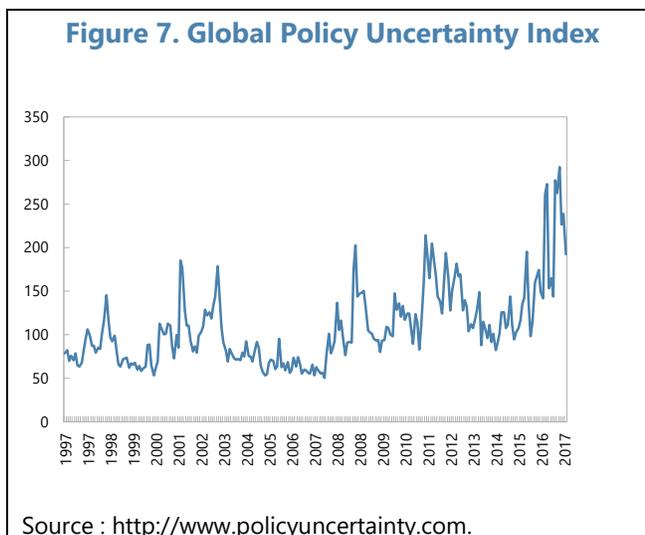
41.   **At the same time, room for policy maneuver has narrowed.** Monetary policy continues to chart an accommodative course in many AEs, often relying on unconventional strategies to help raise inflation expectations and lower the real costs of borrowing for households and firms. With an increase in debt levels, fiscal space is also not available in all members to do more to close the output gap and to share the burden with monetary policy. EMs also face challenges, including commodity exporters where the outlook for export prices remains subdued compared with the past.

42.   **Increased interconnectedness may also have heightened some challenges to external adjustment.** In the recovery from the GFC, real exchange rate adjustments played a limited role in reducing external current account imbalances, with imbalances and subsequent exchange rate movements only loosely related, and a weak response of trade flows to exchange rate movements. While idiosyncratic factors may have played a role in post-crisis developments, some factors may be contributing to a longer-term weakening of adjustment mechanisms:

- **Capital flow volatility.** This has resulted at times in sharp and sudden adjustments in exchange rates and domestic demand.

- **Larger cross-border liability positions.** This can mute the impact of exchange rate movements on economic activity, as the contractionary effects of a depreciation via financial balance sheets can offset the expansionary effects via trade.[42]

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[40] The Global Policy Uncertainty index is calculated based on 'events studies/new papers" in 18 market economies.

[41] See Global Financial Stability Report, April 2017.
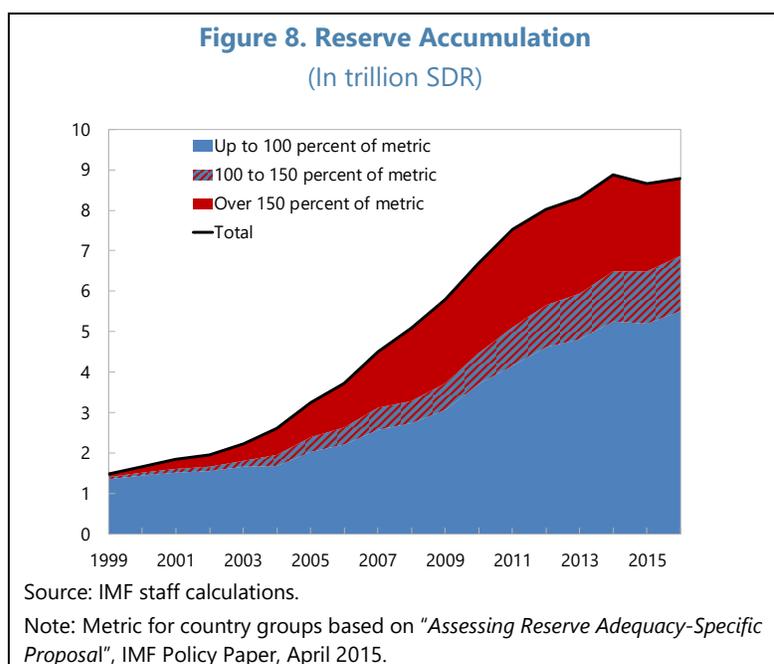
[42] See Kearns, Jonathan, and Nikhil Patel, 2016, "Does the financial channel of exchange rates offset the trade channel?" BIS Quarterly Review (December), 95–113. Serena, Jose Maria, and Ricardo Sousa, 2017, "Does exchange rate depreciation have contractionary effects on firm-level investment?" BIS Working Papers No. 624 (Basle, Bank for International Settlements).

- **Changes in the structure of trade.** The concentration of trade pricing in a small number of dominant currencies can inhibit external adjustment due to an asymmetric short-run response of trade flows to exchange rate movements.[43] Specifically, a depreciation against the dominant currency may reduce imports on impact but not increase exports, as exporters maintain their prices in the dominant currency. This impact can be exacerbated by the rising share globally in trade of EMDCs, where the dollar is more widely used in pricing. There is also an open debate as to whether the relationship between real exchange rate adjustment and trade flows has been weakened by the build-up of global value chains.

Interconnectedness Calls for More Global Solutions

43. **While interconnectedness calls for a more global approach, the GFSN has become more multilayered and regional.**

- **The GFSN has expanded and became more multilayered since the GFC.** The growing relative importance of BSAs and RFAs—some of which are untested—has led to a more decentralized and uncertain safety net. This took place against the backdrop of an inadequately resourced Fund, and has led to the need to increase collaboration between the layers. Inadequate predictability of some GFSN resources (in particular BSAs and RFAs) and the lack of reliable coverage for the full duration of shocks (most elements provide time-bound support) also incentivize an over-accumulation of reserves

Figure 8. Reserve Accumulation
(In trillion SDR)

Source: IMF staff calculations.
Note: Metric for country groups based on "*Assessing Reserve Adequacy-Specific Proposal*", IMF Policy Paper, April 2015.

(Figure 8). This self-insurance is not only costly for the members accumulating reserves, but it also entails potential systemic costs and coordination problems that can undermine the resilience of the IMS and reduce global demand (Obstfeld, 2011).

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[43] Gopinath, Gita, 2015, "The International Price System," NBER Working Paper No. 21646 (Cambridge, MA, National Bureau of Economic Research).

Box 3. Collaboration Between Regional Financing Arrangements (RFA) and the IMF

The expansion of the GFSN make collaboration between its elements critical to ensure that the increased resources can be provided expeditiously when they are needed. This Box presents the various avenues for improving IMF-RFA collaboration that have been identified in a recent staff paper (Collaboration Between Regional Financing Arrangements and the IMF, June 29, 2017).

There is scope to improve IMF-RFA collaboration and the use of RFA resources. Collaboration to date has been based on broad non-binding principles endorsed by G-20 leaders. These principles focus on maintaining the independence of respective institutions, respecting the mandates and taking advantage of technical expertise of each institution, promoting early and ongoing cooperation, seeking consistency in lending conditions, fostering evenhandedness, and respecting the IMF's preferred creditor status.

Close collaboration between the Fund and RFAs could enhance their individual effectiveness as well as the effectiveness of the GFSN. Successful collaboration critically depends on the mutual respect of institutional independence, recognition of mandates, technical expertise, and comparative advantage of each institution. There is also a need for a single coherent program owned by the member country, and for a commitment to ongoing and timely information sharing. Developing an operational framework could enhance a coordinated and cooperative dialogue between the Fund and RFAs. Such framework needs to be flexible to accommodate heterogeneity across RFAs and region-specific differences. It could: (i) increase the effective firepower of the GFSN to tackle large-scale crises; (ii) combine the deeper regional knowledge of the RFAs and global expertise of the Fund; and (iii) enhance country ownership (a strength of RFA financing).

Possible forms of collaboration include:

- *Collaboration in lending* to strengthen the global financial safety net by improving its timeliness, effectiveness and credibility in minimizing crisis risk and contagion. The benefits include streamlining the use of available resources governed by many independent actors, especially during crises, preventing facility shopping, and pooling of credit risk. Some potential challenges to such collaboration are the stigma associated with Fund programs, loss of RFA independence in joint lending operations, the substitute nature of many RFAs, and tension between demands for strong adjustment and conditionality.

- *Collaboration in surveillance* will help with the design of sound policies, and strengthen crisis prevention capacity. In general, RFAs do not have their own regular surveillance function (except for CMIM and EU-BoP). Given the IMF's deep and extensive expertise in surveillance, there is clearly large scope for IMF-RFA collaboration in this area. A major benefit of such collaboration is the exchange of knowledge and analysis, with RFAs having a better understanding of regional circumstances and the IMF having a greater surveillance capacity. Key challenges include overcoming informational asymmetries (confidential statistics available to one but not the other institution) and warranting confidentiality assurances.

- *Collaboration in capacity development* will help improve or develop the RFA capabilities for program design, monitoring, and surveillance, and further reinforce IMF-RFA collaboration in lending and surveillance. Currently, there is no widespread engagement with RFAs in this area.

- **The future development of the GFSN, including the size of the Fund, will need to take a holistic view of gaps in the system as well as the role of individual elements.**[44] While the Fund has a catalytic role, given its experience in macroeconomic adjustment, lower susceptibility to political interference and universal risk pooling, the successful mobilization of the GFSN elements in a crisis requires that all elements collaborate effectively to utilize their combined firepower (Box 3). Also, for the Fund to continue to play its catalytic role, it will need sufficient firepower of its own to maintain credibility. In a future crisis, new BSAs could be established and members might rally bilateral support, but this is not a given.

Other considerations

44. **Changes in Fund policies since the GFC aim to strengthen members' resilience and the overall IMS:**

- **Surveillance framework.** Fund bilateral and multilateral surveillance is now better integrated and the analysis of spillovers has been deepened,[45] highlighting the interconnectedness between countries and policies. The Fund is also mainstreaming macro-financial surveillance and has adopted the institutional view on the liberalization and management of capital flows, which provides a basis for consistent advice on policies related to capital flows. And greater attention has been put on the role of macroprudential policies.

- **Risk management.** The Fund has expanded its approach to risk management, including its general surveillance products, which cover global and member-specific risks around the baseline; and specific risk-focused products (for instance, the VE).[46]

- **Lending toolkit.** Since 2009, the Fund has substantially reformed its lending toolkit, including by expanding the range of crisis prevention instruments. As called for by the Executive Board, staff continues to work on a proposal for a new liquidity backstop to provide renewable and reliable liquidity support against potential short-term moderate volatility of capital flows.[47]

- **Changes in debt restructuring rules.** Recent changes in the Fund's policies on debt restructuring could also have implications for the size of the Fund. The reform of the Fund's lending framework with regards to the treatment of sovereign debt—including the removal of the systemic exemption—could for example reduce the demand for Fund financing with the new rules triggering earlier action and aiming at bailing in more creditors. However, the extent of any such effects is difficult to estimate ex ante and may only become evident over time.

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[44] See *Regional Financing Arrangements and the International Monetary Fund,* ADBI Working Paper, No. 394.

[45] See the 2012 Integrated Surveillance Decision (ISD).

[46] See https://www.imf.org/external/np/exr/facts/ewe.htm.

[47] See *The Acting Chair's Summing Up Adequacy of the Global Financial Safety Net—Review of the Flexible Credit Line and Precautionary and Liquidity Line, and Proposals for Toolkit Reform* (July 10, 2017) and *Adequacy of the Global Financial Safety Net—Review of the Flexible Credit Line and Precautionary and Liquidity Line, and Proposal for Toolkit Reform* (June 2, 2017).

Figure 9. Fund Resources Announcements, Uncertainty and Risk

A. Indices of Uncertainty

B. EM Sovereign Spreads. 2008-2010 (in basis points)

C. Euro Area Sovereign Spreads. 2011-2014 (in basis points)
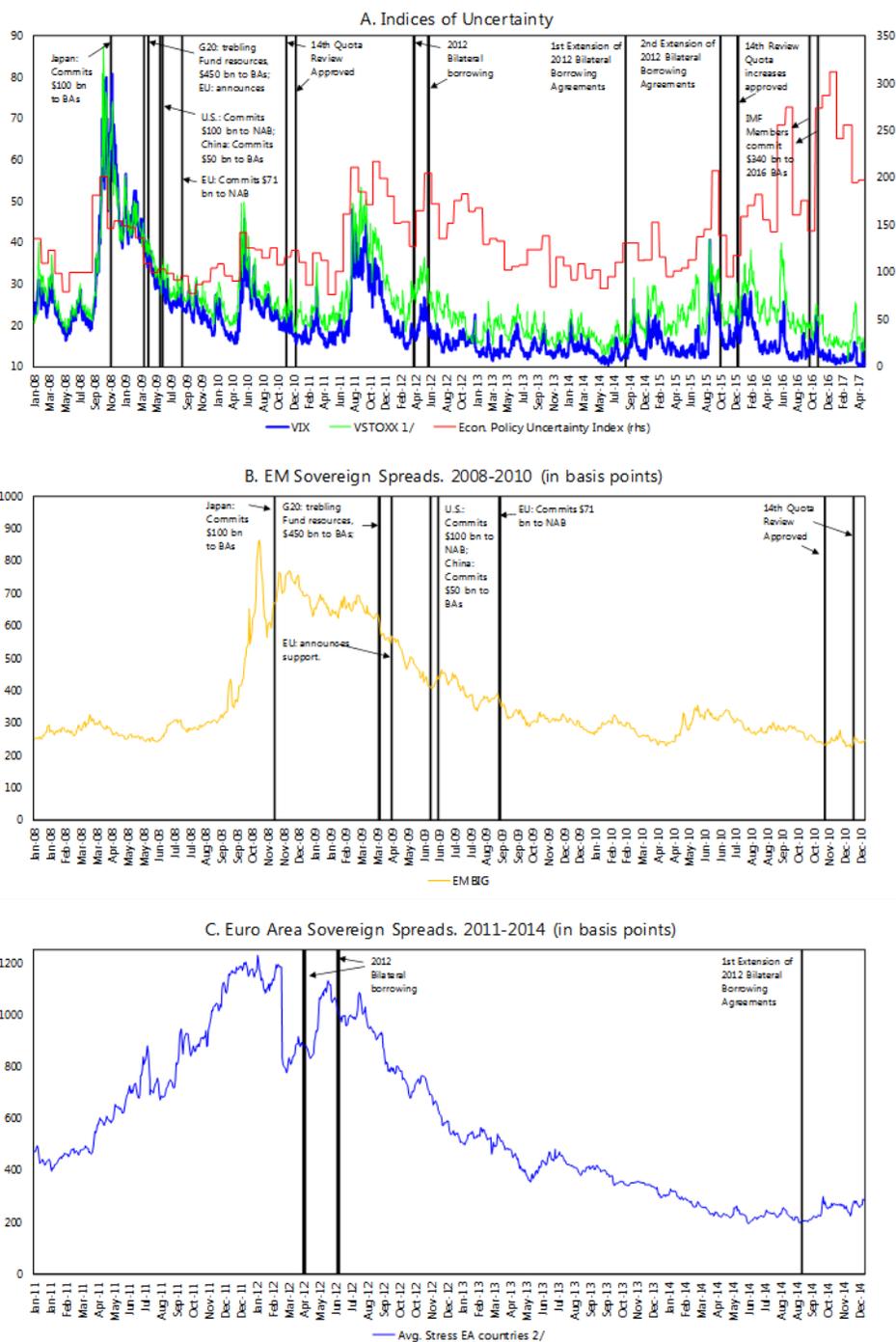
1/ VSTOXX index measures volatility of a set of European option prices at a given maturity.
2 Comprises 10-year spreads for Greece, Portugal, Italy, Spain, and Ireland. Spreads are calculated against German Sovereign yields.
Sources: VIX: Federal Reserve Bank of St Louis; VSTOXX: STOXX; Economic Policy Uncertainty; EMBIG and EU Spreads: Bloomberg.

45.   An adequately resourced Fund can help foster confidence. This has been emphasized consistently by the IMFC and the G20, with the most recent communiqués reiterating the membership's "commitment to maintaining a strong, quota-based, and adequately resourced IMF to preserve its role at the center of the GFSN."[48] An adequately resourced Fund can help reduce risks of spillovers, thus helping prevent negative feedback loops from taking hold and fostering more favorable outcomes in crisis times. Furthermore, it can help address broader weaknesses of the IMS such as global imbalances rooted in excessive reserves buildup. Since the GFC, anecdotal evidence suggests that announcements to expand Fund resources during periods of stress have been associated with drops in uncertainty and easing of credit spreads (Figure 9). There is also empirical work showing that larger Fund resources have a favorable effect on the risk outlook and borrowing costs of emerging markets. [49] One would need to weight carefully whether a reduction in the size of the fund at a time of generally heightened global uncertainties could result in a loss in market confidence.

46.   The risk of moral hazard related to the size of Fund resources appears low. Concerns have been raised at times that expanding Fund resources could lead to excessive risk taking by national authorities in setting policies (debtor moral hazard) or by private creditors underpricing lending risks (creditor moral hazard). It is difficult to find any substantive evidence for these concerns and, indeed, Mussa (1999) argued that the problem of moral hazard has been greatly exaggerated.[50] Also, a strong framework is in place to limit these risks. Specifically:

- A key factor mitigating debtor moral hazard is the design of Fund programs, which include conditionality and provide financing to smoothen adjustment, while ensuring the member's capacity to repay the Fund. The FCL and PLL do not have ex post conditionality, but moral hazard concerns are addressed through strict eligibility criteria in relation to a member's fundamentals, economic policy frameworks and policies, and track record of policy implementation.

- Some recent programs have addressed possible creditor moral hazard, notably coordinating efforts to maintain private banks' exposure (for instance, the so-called 'Vienna Initiative'). The aim was to prevent Fund support from being used to finance outflows to institutions that had been major sources of inflows prior to the crisis.

- There are also strong safeguards against superfluous lending, in particular the requirement of a balance of payments need and Executive Board approval. Indeed, the Fund had very low new lending commitments in the years leading up to the crisis, despite having significant

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[48] *Communique of the Thirty-Fifth Meeting of the IMFC*, April 15, 2017 and *G20 Leaders' Declaration*, July 8, 2017.

[49] See C. Marini, 2017, *The IMF Safety Net and emerging markets' sovereign spreads*, Banca d'Italia Occasional Paper No. 370.

[50] See M. Mussa, 1999, *Reforming the International Financial Architecture: Limiting Moral Hazard and Containing Real Hazard*, in Capital Flows and the International Financial System, ed. by David Gruen and Luke Gower (Sydney: Reserve Bank of Australia), 216–36; Rogoff, Ken, 2002, *Moral Hazard in IMF Loans. How Big a Concern*?, Finance and Development, Vol. 39, No. 3.

uncommitted resources, and the increase in Fund resources provided by the membership since the GFC has not led to a large expansion in Fund lending.

47.   Judgment is also needed to interpret the results provided by the quantitative approaches presented under the first pillar. First, the quantitative approaches themselves provide a broad range of estimates for the size of the Fund, requiring judgment to weigh the different approaches and their respective results. Second, discussions on the adequacy of Fund resources need to consider the state of the world by the mid-2020s as experience has shown that beyond the 2019 deadline for completing the Review, it will likely take some time for any quota increases to become effective and these quota increases will determine the Fund's quota-based resources through the middle of the next decade. As a simple illustration, taking the "global scenario c" at the 75th percentile and applying the GDP deflator through 2021 as projected in the WEO (rather than 2018, which is the basis of the calculation in the scenarios) would result in an increase by 20 percent of potential calls on Fund financing. Third, in a severe crisis scenario, the Fund's lending capacity would decline as members under stress drop out of the Financial Transactions Plan (FTP).[51] This in turn would reduce the Fund's holdings of usable quota resources and the FCC. Access to borrowed resources would also decline if the affected member is a NAB participant or has a bilateral borrowing agreement with the Fund. For example, under the "access-based scenario c," the net reduction in the supply of usable quota resources would be about SDR 65 billion.[52] Fourth, as the models are based on historical data, increasingly longer program periods and duration are incorporated only to some extent.

B. Considerations on the Composition of Fund Resources

48.   The Fund has a long history of supplementing its primary resources—quotas—with standing borrowing facilities.[53] Although quotas have historically been the primary source of financing, the membership has long recognized the merit of backstopping quota resources with a

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[51] If a member in the current FTP is no longer deemed to have a sufficiently strong external position, the member would be excluded from the FTP. The exclusion is subject to a Board decision. This would happen, for example, when an FTP member borrows from the Fund.

[52] Furthermore, access to borrowed resources would be reduced by an additional SDR 60 billion. A further decline in the FCC would potentially be possible if the affected member(s) also purchases its reserve tranche.

[53] The Fund is authorized to borrow to "replenish" its holdings of currencies in the General Resources Account (GRA) that are needed for lending (Article VII, Section 1(i)). The Guidelines for Borrowing by the Fund state that "quota subscriptions are and should remain the basic source of the Fund's financing. However, on a temporary basis, borrowing by the Fund can provide an important supplement to its resources." See *Borrowing by the Fund—Operational Issues* (June 17, 2009) and Decision No. 14367, June 29, 2009. It should be noted that Article VII, Section 1 of the Articles of Agreement gives broad authority for the Fund to borrow, including from private sources. Borrowing by the Fund in capital markets was considered on several occasions over the last 35 years, usually when quota increases and access to borrowing from official sources were uncertain. The Fund did not have to borrow from private sources in the end, mainly because it was able to borrow needed amounts from official sources.

standing borrowing facility such as the GAB and then the NAB, recognizing that it takes time to mobilize new financing when a crisis takes hold.[54] This financing structure has served the Fund well over several decades.[55] During this period, quotas provided the bulk of the resources but the NAB/GAB provided an important supplement. Before the GFC, the share of quotas in the total of quotas plus NAB/GAB was about 84 percent on average over the period 1978–2008.

49.   The share of borrowed resources increased markedly in the wake of the GFC and remains high by historical standards. The large increase in Fund resources agreed in response to the crisis relied initially on borrowing. The share of the

Figure 10. Evolution of Fund Resources 1/
(In billions of SDR, in percent (RHS))

Legend:
- 2012/2016 Borrowing Agreements
- 2009 Borrowing Agreements
- GAB 2/
- NAB
- Quotas
- Borrowing/Total (RHS)

Source: IMF, Finance Department.
1/ Refers to total Fund resources including prudential balances. Most of the 2009 Borrowing Agreements were absorbed into the NAB from 2011 onward. The 2016 Borrowing Agreements have an initial term to end-2019, extendable through end-2020 with creditors' consents.
2/ GAB resources are available only when a proposal for NAB activation is not accepted by NAB participants.

NAB and bilateral borrowing agreements peaked at around 73 percent of total resources in 2013–15, prior to the effectiveness of the 14th Review. The doubling of quotas under the 14th Review in early 2016 and the corresponding rollback of the NAB have reduced the reliance on borrowing, although the share of borrowed resources in the Fund's total resource envelope remains high at about 50 percent.

50.   The membership has stressed consistently that the Fund is and should remain a quota-based institution.[56] Quotas underpin the Fund's finances, governance, and risk management framework. They anchor members' voting power in Fund decisions and represent the amount of

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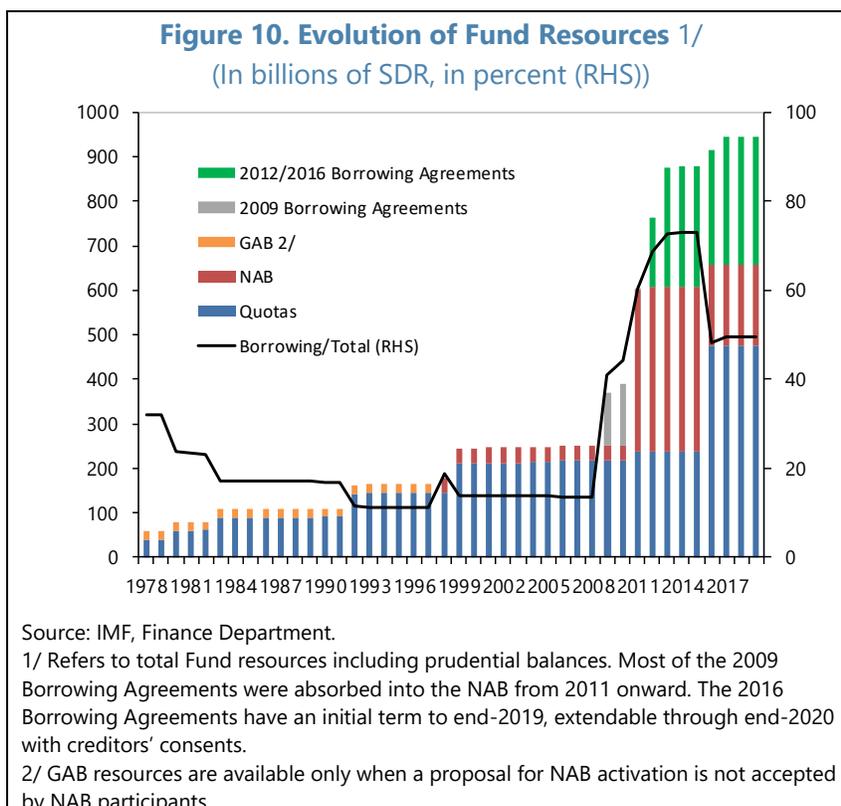
[54] The NAB/GAB, which are subject to relatively infrequent (five-yearly) reviews/renewals and can be activated quickly with streamlined procedures, have important advantages over ad-hoc and temporary bilateral borrowing agreements, which are not intended to be permanent. Also, the Fund's ability to mobilize such resources in a crisis is uncertain.

[55] Paragraph 23 of the GAB decision provides that the Fund may enter into borrowing arrangements in association with the GAB with members, or official institutions of members, that are not GAB participants. The Fund entered into such an arrangement with Saudi Arabia for an amount equivalent to SDR 1.5 billion in 1983, and the agreement remains effective.

[56] See, for instance, *the Communiqué of the Thirty-Fifth Meeting of the International Monetary and Financial Committee* (IMFC), April 2017.

financial resources that members may have to provide to the Fund. Quotas are also linked to the Fund's liquidity and credit risk management tools, as they determine, among other things, normal access to Fund resources and the thresholds for exceptional access procedures, regulate the application of surcharges and commitment fees, determine the proportional allocation of SDRs, and activate post-program monitoring.

51.   Despite some shared features, quota and borrowed resources have distinct implications both for the membership and for the Fund (Table 8).

- **Governance.** As a quota-based institution, members' voting power in Fund decisions is determined by quotas, which is not the case for borrowed resources. General quota increases facilitate periodic realignments of quota shares to ensure that the Fund's governance structure remains reflective of global developments. The NAB and the 2016 BBAs have their own governance framework, including on their activation. Indeed, the governance framework for the BBAs was strengthened in 2016 to give more voice to participating creditors.

- **Permanent versus temporary nature.** Quotas provide permanent resources to the Fund. The Fund has also a long history of borrowing (temporarily) from its membership at times when the institution's current or prospective liquidity was seen as inadequate, often as a bridge to the next quota increase. From members' perspective, the permanent nature of quotas can have different domestic implications (for instance, concerning the political approval process).

- **Participation.** General quota increases cover the entire membership, with broader implications, for example for members' access and resource obligations. Borrowed resources, on the other hand, have historically been provided by a subset of the membership, although there is a large overlap between FTP members and NAB participants. Concerns have been raised over uneven participation in the provision of borrowed resources, given their voluntary nature.

- **Resource mobilization.** Quota increases generally take considerable time to agree and become effective. Borrowed resources have at times been raised more quickly (it took about one year to agree on the 2012 BBAs), but there is no assurance that this will be the case in the future.

- **Resource availability.** Quota resources can be accessed solely based on decisions by the Executive Board, whereas the availability of borrowed resources is typically subject to additional requirements. Specifically, the NAB Decision specifies that the NAB can only be activated if there is a threat to the stability of the IMS. Furthermore, activation requires a majority of 85 percent or more of total credit commitments. As per the guidelines for bilateral borrowing, the BBAs can only be activated if the "modified FCC" (including uncommitted resources under the NAB) is below SDR 100 billion and the activation is approved by creditors representing 85 percent of total commitments under the 2016 BBAs.

- **Burden-sharing.** The use of quota resources helps determine the capacity of the Fund's burden-sharing mechanism that protects the Fund's cash flow against unpaid charges by members in arrears.[57] Since there is no burden-sharing adjustment for the interest paid to

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[57] For more details, see for instance Box 2 of the *Review of the Adequacy of the Fund's Precautionary Balances* (January 22, 2016).

creditors on borrowed resources, the use of borrowed resources reduces the Fund's burden-sharing capacity relative to credit outstanding.

- **Financial characteristics.** Members need to manage foreign reserve liquidity in a broadly similar way whether the Fund draws on quota or borrowed resources (if the latter are activated), as set out in the Fund's periodic FTP and Resource Mobilization Plan, respectively. Both are liquid reserve assets and members can encash them to obtain freely usable currencies or SDRs at short notice solely on representation of a balance of payments need. Members receive remuneration and interest payments from the Fund for their reserve tranche positions and claims on the Fund, calculated based on the SDR interest rate.

Table 8. Comparison of Existing Resources of Financing			
	Quotas	**Borrowed resources**	
		NAB	Bilateral borrowing
Financial characteristics (e.g., liquidity, remuneration)	+ +	+ +	+ +
Governance (quota-based institution)	+ +	+	+
Nature (permanent vs. temporary)	+ +	+	-
Participation (entire membership)	+ +	+	-
Resource mobilization (relatively fast)	-	+	+ +
Resource availability (unconditional)	+ +	-	- -
Burden sharing mechanism (increase capacity)	+	- -	- -

Source: IMF staff.

52.   There are important differences between having resources available ex-ante and mobilizing them ex-post when a crisis has hit. Having resource commitments available ex-ante, before a crisis, can have significant positive effects in boosting market confidence and preventing a crisis from occurring. As long as these resources are not called upon, there are limited financial costs to providing such financing, as they are only contingent commitments. Mobilizing resources ex-post can, however, be costly, as shown through the experience of the Fund entering the GFC clearly under-resourced (see paragraph 3). Also, in an increasingly multipolar world and with more inward looking policies, agreement on boosting Fund resources through additional borrowed resources may be more difficult and time consuming to reach in the future.

SUMMARY AND ISSUES FOR DISCUSSION

53.   The paper provides a two-pillar framework for assessing the adequacy of Fund resources. These two pillars provide input for the consideration of Directors on making a judgment on the appropriate size and composition of Fund resources and on quota increases. The first pillar presents a quantitative analysis, using three approaches to provide indicative ranges for the adequacy of Fund resources. The second pillar of the framework is qualitative in nature and lays out considerations, including on how the global economy and the IMS will evolve in the next decade. The analysis also informs discussions on the composition of Fund resources by reviewing the implications of the different financing sources across various dimensions such as governance, resource mobilization, and burden sharing.

54.   The updated analysis in this paper does not point to a case for revisiting staff's earlier conclusion that the current lending capacity should be seen as a minimum. Most quantitative approaches yield similar results to the March paper. The main exception is the global scenario approach, which now includes a domestic policy response that, however, would not be plausible nor advisable (or advisable to the full extent) in a pervasive global crisis scenario when global demand is likely to be already very weak. The qualitative considerations argue to take a longer-term perspective than was considered in the March 2016 paper, as any quota increases agreed as part of the 15th Review will likely determine the Fund's quota-based resources through at least the middle of the next decade. They highlight the uncertainty about how the IMS will evolve and, with it, the nature of crises in terms of size, contagion and speed. In particular, the greater interconnectedness of countries means that disruptions in global financial markets could lead to a rapid wave of correlated crises. And the GFSN would need to evolve as well, including by growing commensurately in its size. Finally, staff's analysis highlights the important advantages of having resources available ex-ante for boosting market confidence and crisis prevention. In a follow-up paper, based on Directors' guidance, staff will look at possible landing zones for the Fund's size and quota resources.

55.   Directors may wish to comment on the following issues:

- Do Directors broadly agree with the framework set out in the paper—relying on both a quantitative and a qualitative pillar to assess the adequacy of Fund resources?

- What are Directors' views on the quantitative pillar of the framework? Do they see merit in considering the range of approaches that is set out in the paper, covering traditional metrics, access-based approaches, and global scenarios? Do Directors agree that these ranges can provide useful input for assessing the size and composition of Fund resources?

- Do Directors agree with the key qualitative considerations laid out in the paper? What are Directors' views on the relative weights that should be given to the different qualitative considerations, in light of their views on how the global economy and the IMS will evolve? Do Directors support the view that, on balance, the qualitative considerations can be expected to increase the potential calls on Fund resources in future crisis, as an increasingly connected global economy will pose new challenges and risks?

- What are Directors' views on the composition of Fund resources? Do Directors agree that the Fund should remain a quota-based institution? Do Directors concur that a financing structure of quotas, backstopped by a standing borrowing facility such as the GAB/NAB, has served the Fund well over several decades?

Annex I. Additional Information on Global Economic and Financial Metrics and Related Resource Adequacy Indicators

This annex provides further information on the resources that would be required to meet historical levels for various resource adequacy indicators.

- Table AI. 1 shows the quota resources needed relative to economic indicators.

- Table AI.2 shows the total Fund resources needed relative to economic indicators.

Table AI.1 Fund Quotas and Economic Indicators
(In billions of SDRs unless otherwise indicated)

	Seventh Review 1978 1/	Eighth Review 1983 1/	Ninth Review 1990 1/	Tenth Review 1995 1/	Eleventh Review 1998 1/	Twelfth Review 2003 1/	Thirteenth Review 2008 1/	Fourteenth Review 2010 1/	Previous Resources Mar-16	Current Resources Aug-17	Projected Resources Aug-17
Size of Quota Increase, in Percent	50.9	47.5	50.0	0.0	45.0	0.0	0.0	100.0	n.a.	n.a.	n.a.
1 Agreed Quotas 2/ 3/ 4/	61.1	90.0	135.2	146.1	212.0	213.7	217.6	477.0	477.0	477.0	477.0
2. Economic indicators and applicable data periods	1972-76	1976-80	1981-85	1986-90	1990-94	1995-99	2001-05	2004-08	2011-15	2012-16	2015-2019
a. GDP	4,253	7,588	11,083	15,744	17,884	22,442	29,912	35,906	48,889	50,900	56,829
b. Current payments 5/	718	1,341	2,168	2,852	3,700	5,785	8,026	12,112	16,941	18,074	23,210
c. Capital inflows to EMDCs 6/	31	50	46	49	173	233	373	689	795	851	990
d. EFN				200	269	450	552	963	1,834	1,865	2,000
3. Ratio of Quota resources to economic indicators (in percent)											
a. GDP	1.4	1.2	1.2	0.9	1.2	1.0	0.7	1.3	1.0	0.9	0.8
b. Current payments 5/	8.5	6.7	6.2	5.1	5.7	3.7	2.7	3.9	2.8	2.6	2.1
c. Capital inflows to EMDCs 6/	195.1	181.4	293.9	299.0	122.9	91.8	58.4	69.3	60.0	56.0	48.2
d. EFN	n.a.	n.a.	n.a.	73.2	78.9	47.4	39.4	49.6	26.0	25.6	23.8
4. Additional Quota resources needed to restore quotas in 2016 relative to the ratio calculated in the respective column (in billions of SDR)											
Based on data through 2016											
a. GDP	254	127	144	-	126	8	-	199	20	-	-
b. Current payments 5/	1,061	736	650	449	559	191	13	235	32	-	-
c. Capital inflows to EMDCs 6/	1,184	1,067	2,025	2,069	569	305	20	113	34	-	-
d. EFN	n.a.	n.a.	n.a.	888	994	408	258	447	8	-	-

Source: Finance Department

1/ Year in which the quota review was completed, i.e., when the Board of Governors' Resolution on quota increases was approved. The Tenth Review did not provide for
an increase in quotas, and the increase in actual quotas relative to the Ninth Review is due to the increase in the number of members.
2/ Column for Seventh Review includes the special quota increases for China and Saudi Arabia in 1980 and 1981.
3/ Column for Twelfth Review includes China's ad hoc quota increase of SDR 1.682 billion in 2002.
4/ Column for Thirteenth Review includes ad hoc quota increases for China, Mexico, Korea, and Turkey of SDR 3.809 billion in 2006.
5/ Defined as the average of the sum of payments on goods, services, income and current transfers.
6/ Defined as the average of the sum of inflows of direct, portfolio and other investment.

Table AI.2 Fund Resources (Quotas+NAB+BBA) and Economic Indicators
(In billions of SDRs unless otherwise indicated)

	Seventh Review 1978 1/	Eighth Review 1983 1/	Ninth Review 1990 1/	Tenth Review 1995 1/	Eleventh Review 1998 1/	Twelfth Review 2003 1/	Thirteenth Review 2008 1/	Fourteenth Review 2010 1/	Previous Resources Mar-16	Current Resources Aug-17	Projected Resources Aug-17
1. Total Fund resources 2/ 3/ 4/ 5/	79.6	108.5	153.7	164.6	246.0	247.7	251.6	659.4	931.3	918.7	947.0
2. Economic indicators and applicable data periods	1972-76	1976-80	1981-85	1986-90	1990-94	1995-99	2001-05	2004-08	2011-15	2012-16	2015-2019
a. GDP	4,253	7,588	11,083	15,744	17,884	22,442	29,912	35,906	48,889	50,900	56,829
b. Current payments 6/	718	1,341	2,168	2,852	3,700	5,785	8,026	12,112	16,941	18,074	23,210
c. Capital inflows to EMDCs 7/	31	50	46	49	173	233	373	689	795	851	990
d. EFN				200	269	450	552	963	1,834	1,865	2,000
3. Ratio of Fund resources to economic indicators (in percent)											
a. GDP	1.9	1.4	1.4	1.0	1.4	1.1	0.8	1.8	1.9	1.8	1.7
b. Current payments 6/	11.1	8.1	7.1	5.8	6.6	4.3	3.1	5.4	5.5	5.1	4.1
c. Capital inflows to EMDCs 7/	254.1	218.7	334.1	336.9	142.6	106.4	67.5	95.7	117.1	107.9	95.6
d. EFN	n.a.	n.a.	n.a.	82.5	91.5	55.0	45.5	68.5	50.8	49.3	47.3
4. Additional Fund resources needed to restore Fund resources in 2016 relative to the ratio calculated in the respective column (in billions of SDR)											
Based on data through 2016											
a. GDP	34	-	-	-	-	-	-	16	51	-	-
b. Current payments 6/	1,085	544	363	124	283	-	-	65	75	-	-
c. Capital inflows to EMDCs 7/	1,245	943	1,926	1,949	295	-	-	-	78	-	-
d. EFN	n.a.	n.a.	n.a.	619	789	107	-	359	28	-	-

Source: Finance Department

1/ Year in which the quota review was completed, i.e., when the Board of Governors' Resolution on quota increases was approved. The Tenth Review did not provide for
an increase in quotas, and the increase in actual quotas relative to the Ninth Review is due to the increase in the number of members.

2/ Column for Seventh Review includes the special quota increases for China and Saudi Arabia in 1980 and 1981.

3/ Column for Twelfth Review includes China's ad hoc quota increase of SDR 1.682 billion in 2002.

4/ Column for Thirteenth Review includes ad hoc quota increases for China, Mexico, Korea, and Turkey of SDR 3.809 billion in 2006.

5/ Includes the GAB, the NAB, the 2009/10 Borrowing Agreements, and the 2012-16 Borrowing Agreements.

6/ Defined as the average of the sum of payments on goods, services, income and current transfers.

7/ Defined as the average of the sum of inflows of direct, portfolio and other investment.

Annex II. Modeling Fund Financing—Panel Logit Approach

This Annex provides details about the panel logit model used in the access-based approach.

1.   **Econometric modeling can provide a direct measure of the likelihood that a member may require Fund assistance in a crisis.** A binary response model for panel data is estimated to gauge the effects of various economic and financial variables on GRA lending.[1] The model can be seen as a reduced-form estimate of the joint decision by a member country to request a GRA arrangement and by the Fund to agree to such a request. The panel dataset covers 94 advanced, emerging, and frontier market economies over the period 1992–2014, for a total of 105 GRA arrangements.[2] The model is used to generate estimated probabilities that a member has a GRA arrangement in a given year, under a downside scenario.

2.   **The choice of independent variables builds on the literature on this topic.** The model includes country-specific as well as global variables:

- **Country-specific**. All country specific variables are lagged to avoid endogeneity problems. A key driver of whether a member requests and obtains financial assistance is the existence and size of its actual or potential balance of payment need. External financing needs (EFNs) are used as a proxy. EFNs (in percent of GDP) encompass the current account deficit and a measure of reserve coverage, as explained in the quantitative section of the paper. Other variables include GDP growth, GDP per capita, the credit-to-GDP gap (deviation of the credit-to-GDP ratio from its trend), the 12-month variation of the bilateral nominal exchange rate versus the U.S. dollar, government stability,[3] and interconnectedness. The interconnectedness variable measures a country's linkages with other countries:

$$px_{i,t} = \sum_{j \neq i}^{n-i} \frac{x_{j,t}}{\varphi_{j,i,t}}$$

  where $x_{j,t}$ is the GDP growth of trading partner country j and $\varphi_{j,i,t}$ weighs trade flows between countries i and j.

  All variables are statistically significant and have the expected sign. For instance, the probability of having a GRA arrangement increases when external financing needs or credit-to-GDP gaps increase,[4] or when GDP growth of the member or its partners (interconnectedness variable) drops. Reflecting calls from Directors to better reflect the

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[1] Specifically, a logit specification is used. Replacing the logistic distribution function by the standard normal distribution (probit model) gives very similar results. For further details and robustness checks, see *IMF Lending in an Interconnected World*, WP/17/155, Poulain and Reynaud.

[2] This data set corresponds to all non-LIC members for which data are available.

[3]The government stability indicator is taken from the ICRG database; adding this variable improves the fit of the model, although results are not materially different when the variable is omitted.

[4] This is consistent with the fact that although financial deepening brings significant benefits, it can also increase the likelihood of crises as it is often associated with periods of rapid credit growth.

growing role of RFAs in the GFSN, the model includes a dummy variable that controls for whether a member has access to an RFA. It also controls for size and past Fund engagement.

• **Global.** The significance of U.S. interest rate variations, and of the VIX—a proxy for risk aversion—confirm the intuition that a sustained tightening of global monetary conditions or high volatility are associated with an increase in the probability to require an arrangement with the Fund for countries that built up vulnerabilities during periods of easy financial conditions. The model also suggests that sustained drops in the oil price create a global environment that increases the probabilities of Fund arrangements.

Table AII.1. Logit Model Estimation Results

Dependent variable: Start of a GRA Arrangement (dummy)

Independent Variables	dy/dx	Robust SE	
Past program (dummy)	0.306	0.092	***
External Financing Needs	2.331	0.916	**
GDP growth	-0.063	0.026	**
GDP per capita	-0.866	0.218	***
GDP	0.001	0.133	
Credit gap	0.025	0.010	***
Exchange rate variation	-1.496	0.813	*
Government stability	-0.407	0.091	***
Potential contagion	-0.793	0.366	**
3M US int. rate variation	0.370	0.161	**
VIX	0.121	0.034	***
Oil price	-0.023	0.012	*
Access to RFA (dummy)	0.189	0.400	
Pseudo R2	0.504		
Observations	1,597		
Countries	94		
GRA Arrangements	105		
Likelihood ratio (p-value)	0.000		

Notes: the table reports the marginal effects of the panel logit estimation using random effects. A constant is estimated but not reported.

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Source: IMF staff estimates.

3.   The model is then used to generate probabilities for each member under a global volatility shock scenario. The shock assumes that the VIX index would reach an average level of 30 during the year of the shock. This level is significantly below the average VIX level observed over the period 2008–09, but slightly above the level reached during other Fund lending cycles (see Figure AII.1). It is further assumed that all other variables remain unchanged. In practice, a global volatility shock would likely be accompanied—among other things—by a drop in GDP growth and an increase in external financing needs, which would both increase the probability that a member may require Fund financing. That said, required policy adjustment and the stigma of approaching the Fund for financing would work in the opposite direction.

Figure AII.1. Evolution of VIX Index since 1990

Source: CBOE
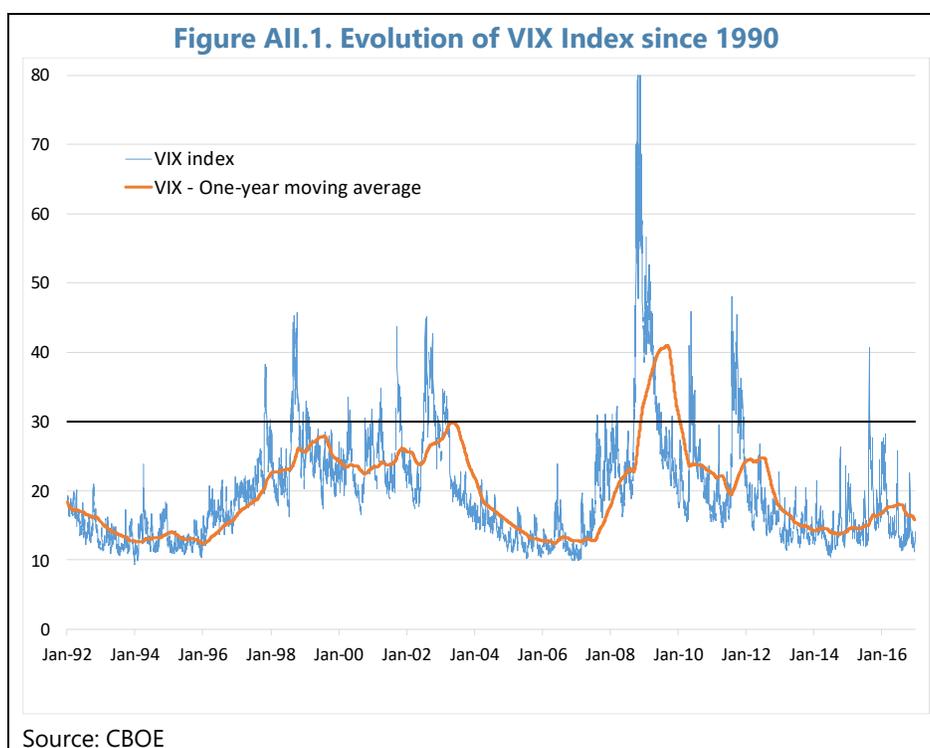
4.   The model predictions eventually depend on probability thresholds. To determine which members are flagged by the model, a threshold is chosen such that if a country has a predicted probability in any given year that is greater than the threshold, the country is assumed to have a new arrangement during that year. The main approach to threshold determination in the literature is to calculate the threshold that minimizes the loss function of Type I and Type II errors.[5] A standard way of computing such function is to assign an equal weight to both types of errors, which sets the threshold to 4.8 percent. Ratios of 2:1 and 3:1 are used for alternative scenarios to penalize false positives (Type II errors) more than missed programs (Type I errors).[6] For example, the threshold that minimizes the loss function using a 2:1 ratio is equal to 6.4 percent. Using this threshold, the model has a rate of false positives of 16 percent and a rate of missed new programs of about 25 percent.

Table AII.2. Goodness of Fit Statistics

Weight Ratio 1/	Threshold	Type I errors (missed new)	Type II errors (false positives)
1:1	4.8%	18.1%	19.4%
2:1	6.4%	24.8%	16.0%
3:1	16.1%	49.5%	6.1%

1/ Ratio of Type II vs Type I errors. A 2:1 ratio gives Type II errors a weight that is twice that of Type I errors.

Source: IMF staff estimates.

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[5] The rate of missed new programs (type I errors) is defined as the ratio of the number of actual new programs that were not predicted over the number of new program observations in the sample. The rate of false positive (type II errors) is defined as the ratio of the number of programs predicted but not realized over the number of non-program observations in the sample.

[6] Penalizing false positives results in smaller estimates for the need for Fund resources compared with equal weights for both types pf errors. It is in this sense a relatively conservative approach.

Annex III. Global Scenarios—Assumptions and Methodology

This Annex provides details about the assumptions and the methodology used in the global scenario model.

A. Demand for Financing

1. The model uses a granular approach to identify countries that are vulnerable to crises. It then shocks individual countries based on information from past crises, takes into account policy responses, and estimates the demand for financing.

2. **The first step—pervasiveness of the crisis**—is to identify members that will face a balance of payment (BOP) shock based on each country's crisis probability threshold estimated in the Fund's vulnerability exercises. This is a bottom up approach and reflects individual countries' circumstances. Four systemic shock scenarios—varying by the degree of pervasiveness (number of countries affected)—are specified:

- The extreme scenario "a" assumes a crisis probability threshold of one percent. In other words, it includes members with at least a one percent probability of having a crisis in a given year. Given that a one-percent crisis probability is relatively low, this is the largest country group, therefore constituting a highly pervasive systemic crisis. As such, it would correspond to a "perfect storm," for instance triggered by multiple potential shocks such as a chronic slowdown in productivity and structural issues, market displacement from asynchronous policy normalization, dislocation due to technological progress and/or geopolitical tensions.[1]

Table AIII.1. Number of Members Included in Various Crisis Scenarios

	Number of members	
	AE	EMDCs
a. Extremely pervasive crises (crisis probability threshold ≥ 1 percent)	27	64
b. Very pervasive systemic crisis (crisis probability threshold ≥ 3 percent)	27	45
c. Pervasive systemic crisis (crisis probability threshold ≥ 5 percent)	26	24
d. Systemic crisis (crisis probability threshold ≥ 10 percent)	0	15

*AE and EMDCs are in line with WEO classification.
Source: IMF staff estimates.

- A moderate scenario "d" considers a far less pervasive funding shock for members with at least a 10 percent probability of crisis. With no advanced economies facing such probability, this scenario affects primarily emerging and frontier economies.

- Two "middle-of-the-road" scenarios "b" and "c" include members with at least a three or five percent probability of crisis, respectively.

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[1] It is important to note that the probability threshold used for the country selection in a scenario is different from the likelihood of that scenario. For example, in scenario "a", all members with at least a 1 percent crisis probability are assumed to face a funding shock. However, the likelihood of the scenario is not at least 1 percent because it depends on the joint probability of all members in the group having a funding shock, which cannot be inferred directly from the univariate crisis probability for each country.

3.   The second step—severity of the crises—simulates how the crises impact each member during 2017–18 to determine its potential financing needs. The severity of these crises is calibrated based on the empirical distribution of historical crises in emerging market economies in the past 30 years using kernel density estimators.[2] Crises periods—1990, 2001, 2009, and 2011—were selected based on: (i) the global financial stress index reaching one standard deviation above its mean; and (ii) domestic demand in AEs breaching one standard deviation. Accordingly, the model provides ranges of global shock assumptions varying by degrees of severity of the shocks with shocks broadly in line with the 90th, 85th, 75th, and 65th percentile of the distribution.[3] For advanced economies, a somewhat less severe impact is assumed as they have deeper and more resilient capital and financial markets as well as significant foreign assets and alternative official financing backstops (Table AIII. 3).

Table AIII.2. Scenario Assumptions

Emerging and Developing Markets

Percent deviation from baseline, unless otherwise indicated

	90th percentile		85th percentile		75th percentile		65th percentile	
	2017	2018	2017	2018	2017	2018	2017	2018
Reduction in FDI inflows	-30	-30	-25	-25	-20	-20	-15	-15
Short-term debt rollover rate (percent)	65	75	70	80	80	85	85	90
Medium and long-term debt rollover rate (percent)	45	60	50	65	60	75	80	85
Outflows of bank deposits	-10	0	-8		-5		-3	0
Floor on reserves (percent of ARA metrics)	100		100		100		100	
Maximum use of reserves (percent of total)	25		25		25		25	

Advanced Economies

Percent deviation from baseline, unless otherwise indicated

	90th percentile		85th percentile		75th percentile		65th percentile	
	2017	2018	2017	2018	2017	2018	2017	2018
Reduction in FDI inflows	-30	-30	-25	-25	-20	-20	-15	-15
Short-term debt rollover rate (percent)	80	90	85	95	90	100	95	100
Medium and long-term debt rollover rate (percent)	65	85	70	90	75	95	85	100
Floor on reserves (percent of ST debt)	100		100		100		100	
Maximum use of reserves (percent of total)	25		25		25		25	

4.   The third step—policy response—takes into account the fiscal adjustment for each country in response to the crisis. This is new compared with the March paper. The model assumes that each country will undergo a domestic adjustment of 0.7 percent of GDP each year (i.e., 1.4 percent of GDP for the entire period). This is consistent with the average fiscal adjustment in Fund-supported programs during 2002–14. By combining steps one to three, potential financing needs are estimated for each degree of pervasiveness and intensity of the crisis. Estimates are derived as follows for each country:

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[2] Kernel density estimation is a non-parametric way to estimate the probability density function of a random variable. Kernel density estimation is a fundamental data smoothing technique.

[3] Due to the limited number of observations in the tail, the shock values are smoothed and adjusted downward in absolute terms (meaning that the shock intensity is reduced) relative to the raw data. Thus, the estimated resource needs are more conservative (smaller) than would have been suggested by the raw estimates.

- Net external financing requirements measured by the difference between external financing needs (current account deficit and debt amortization) and sources (foreign direct investment inflows and total new borrowing); plus

- Additional financing needs to cover potential deposit outflows for emerging markets; minus

- Domestic adjustment.

B.   Financing Sources other than the IMF

Self-insurance

5.   Two assumptions are used in calculating the use of reserves to meet financing needs:

- First, the use of reserves is subject to the constraint that they should remain above 100 percent of the level suggested by the Fund's ARA metric for emerging markets and above 100 percent of short-term debt for advanced economies and low-income countries.

- Second, reserves are assumed not to fall by more than 25 percent relative to their initial level, reflecting the observed reluctance of central banks in practice to draw down reserves substantially.

These assumptions are applied simultaneously, so a country can use its reserves only until they drop by 25 percent or reach the relevant metric threshold.

Role of Regional Financing Arrangements

6.   Given the wide disparity in the modalities, specific assumptions are applied in calculating financing provided by each RFA:

- Assumptions on the burden sharing between different RFAs and the IMF are based on historical data (2000–16). For the ESM and the EU's Balance of Payments assistance, Fund financing is expected to cover 28 percent and 61 percent of the financing gap after the use of reserves, respectively. For the EFSD and the ACF, Fund financing is expected to cover 85 percent and 25 percent, respectively.

- As the BRICS CRA and the CMIM are swap arrangements with 70 percent of access to their resources conditional on the existence of a Fund-supported program, member countries are assumed to first tap into the unconditional part (30 percent) of their access limit. The rest is assumed to be co-financed by the Fund and the RFAs, with the Fund covering 1/3 and the RFAs covering the rest. The amount covered by the RFAs is constrained by the country-specific access limit and the ability of member countries to provide financing for the others.

- Finally, members are assumed to use their full access limit for the FLAR.

Table AIII.3. Regional Financing Arrangements

RFA	Region	No. of countries	Size (SDR billion)	Max access
Arab Monetary Fund (AMF)	Middle East & North Africa	22	2.7	75-200% of paid subscription
BRICS	--	5	74.4	50-100% of committed resources
Chiang-Mai Initiative Multilateralization (CMIM)	Southeast Asia	15	174	50-500% of financial contribution
Eurasian Fund for Stability and Development (EFSD)	Eurasian Union	6	6.3	In proportion to GNI per capita
European Union-Balance of Payments EU-BoP	Non-euro zone	10	-	SDR 35.5 billion
European Stability Mechanism	Eurozone	19	-	SDR 296.3 billion
FLAR	Latin America	8	1.9	100-250% of paid-in capital

Source: Regional Financing Arrangements.

Bilateral Swap Arrangements

7. Active bilateral swap lines are taken into account depending on their specific characteristics and purposes. Standing unlimited BSAs among major central banks (such as the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, the Federal Reserve, and the Swiss National Bank) are included in the analysis but beneficiaries are generally not expected to have a demand for financing according to the simulations. Most bilateral swap lines established during the global crisis between major central banks and EMDCs have expired and are thus not considered. While swap lines established between China and a large number of AEs and EMDCs remain active, they are not counted in the analysis given uncertainties about the scope of possible use in case of a protracted balance of payments need, as noted in the main text.[4]

C.   Robustness Checks

- Table AIII.4 presents robustness checks for different combinations of the use of reserves (25, 35, and 75 percent of countries' reserves) and different thresholds for the ARA metrics (80 and 100 percent). The simulations are done for the 75th percentile of crisis intensity.

- Table AIII.5 presents robustness checks for a larger (2 percent of GDP in total; 1 percent of GDP per year) and a smaller fiscal adjustment (1 percent of GDP in total; 0.5 percent of GDP per year).

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[4] Furthermore, a number of standing or soon-to-expire small swap lines among various central banks—amounting to less than USD 20 billion each—are also excluded from our estimation due to both their small size as well as uncertainties about their long-term availability and scope of possible use when financing needs arise.

- Table AIII.6 presents robustness checks for different options of burden sharing with the IMF's share ranging from 25 to 75 percent of potential financing needs. The simulations are done for the 75th percentile of crisis intensity.

Table AIII.4. Robustness Checks—Use of Reserves

(In SDR billion, difference from the baseline;
Baseline=75th percentile of crisis intensity)

ARA = 100 percent of metric

Use of reserves (percent of total reserves)	25	35	75
a. Extremely pervasive global systemic crisis	0	45	53
b. Very pervasive systemic crisis	0	9	15
c. Pervasive systemic crisis	0	0	0
d. Systemic crisis	0	0	0

ARA = 80 percent of metric

Use of reserves (percent of total reserves)	25	35	75
a. Extremely pervasive global systemic crisis	50	107	125
b. Very pervasive systemic crisis	15	29	38
c. Pervasive systemic crisis	4	6	6
d. Systemic crisis	4	6	6

Note: Numbers are calculated as the difference from the baseline. Positive numbers suggest less potential calls on Fund financing.
Source: IMF staff estimates.

Table AIII.5. Robustness Checks—Fiscal Adjustment

(In SDR billion, difference from the baseline)

Fiscal Adjustment of 0.5 percent of GDP annually

	Crisis Intensity (percentile)			
	65th	75th	85th	90th
a. Extremely pervasive global systemic crisis	-60	-72	-79	-79
b. Very pervasive systemic crisis	-46	-54	-60	-60
c. Pervasive systemic crisis	-39	-46	-47	-47
d. Systemic crisis	-12	-12	-12	-12

Fiscal Adjustment of 1 percent of GDP annually

	Crisis Intensity (percentile)			
	65th	75th	85th	90th
a. Extremely pervasive global systemic crisis	71	88	94	100
b. Very pervasive systemic crisis	51	60	67	72
c. Pervasive systemic crisis	40	51	53	53
d. Systemic crisis	17	18	18	18

Note: Numbers are calculated as the difference from the baseline. Positive numbers suggest less, while negative numbers suggest more potential calls on Fund financing.
Source: IMF staff estimates.

Table AIII.6. Robustness Checks—Burden Sharing			
(In SDR billion, difference from the baseline; Baseline=75th percentile of crisis intensity)			
	IMF share in co-financing with the RFAs		
	25	50	75
a. Extremely pervasive global systemic crisis	28	-40	-116
b. Very pervasive systemic crisis	10	-44	-98
c. Pervasive systemic crisis	9	-43	-95
d. Systemic crisis	1	-2	-5

Note: Numbers are calculated as the difference from the baseline. Positive numbers suggest less, while negative numbers suggest more potential calls on Fund financing.
Source: IMF staff estimates.

The Chairman's Concluding Remarks
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Further Considerations
Committee of the Whole on Review of Quotas Meeting 17/2
September 15, 2017

This second Committee of the Whole meeting on the 15th General Review of Quotas is in line with the work program for the 15th Review that was agreed last year with the goal of completing the review by the Spring Meetings of 2019 and no later than the Annual Meetings of 2019. Today's informal exchange of views covered the *Adequacy of Fund Resources,* and followed the discussion two weeks ago on the *Quota Formula and Realigning Shares*. As many Directors have again stressed, these issues are closely interlinked and will ultimately need to be agreed as a package. Let me offer some brief informal remarks that reflect my understanding of the views expressed in today's discussion.

Our discussion represents a good start. I welcome the continued shared commitment to reach an agreement under the 15th Review within the agreed timetable and the commitment to a strong, quota-based and adequately-resourced IMF at the center of the global financial safety net (GFSN). In a world of increasingly globalized risks, the Fund's expertise, catalytic role, and central financing role remain critical. Directors generally agreed that the 15th Review will have to consider a longer-term perspective, as any quota increases agreed as part of the 15th Review will likely determine the Fund's permanent resources through at least the middle of the next decade.

Directors welcomed the extended two-pillar framework for assessing the adequacy of Fund resources. They appreciated the extensive and more transparent quantitative analysis using three complementary approaches, with updated and improved methodologies, including robustness checks. However, Directors also acknowledged the uncertainties inherent in projecting the Fund's resource needs, underscoring the important role for judgment. In this context, they noted that the scenario analysis produced a wide range of results, including some that would imply a systemic crisis of unprecedented magnitude. A number of Directors noted that upcoming discussions should begin with realistic assumptions of the demand for Fund resources. In this regard, some Directors felt that in an extreme crisis, the analysis should assume greater use of international reserves and other financing sources.

Directors appreciated the analysis of qualitative considerations to complement the quantitative approach and support judgment on the appropriate size of the Fund, including the evolution of the global economy and the international monetary system. They generally

shared the analysis in the paper that ongoing global transitions, together with increased interconnectedness, are creating uncertainty and could lead to spillovers, contagion, and systemic risks, thereby having implications for the adequacy of Fund resources. Many Directors considered that the discussion of the qualitative considerations should give more prominence to factors that could reduce the demand on Fund resources, such as the significant expansion of the GFSN and the reforms implemented since the global financial crisis, including financial regulatory reforms and the progress in strengthening the Fund's surveillance and lending toolkit. Many other Directors considered that coverage by other components of the GFSN is uneven and not a substitute for the Fund.

Directors generally agreed that the historical practice of backstopping quotas with standing borrowing facilities—New Arrangements to Borrow (NAB) and General Arrangements to Borrow (GAB)—has served the Fund well. The critical role played by the bilateral borrowing agreements as the third line of defense for the Fund to respond to the global financial crisis was also underlined. Going forward, however, many Directors argued that quotas should provide the bulk of the Fund's lending resources, while others called for further work on the appropriate mix. There were also calls for maintaining access to existing borrowed resources, although many Directors stressed that it would be important not to pre-suppose future discussions on the possible renewal of the bilateral borrowing agreements.

A range of views was expressed on the appropriate size of quotas and the Fund's overall lending capacity. Many Directors supported, or were open to, a quota increase that would at least maintain the Fund's current lending capacity, and many of these called for an increase in the overall lending capacity. Many others had not yet formed a view, with a few noting that the Fund's current quota and NAB resources appear sufficient to handle a range of scenarios. A few Directors also underlined the political cost to members of quota increases. Many Directors stressed the importance of having resources available *ex-ante* for the Fund to preserve its credibility and effectiveness, while a few others considered that the Fund should be able to raise additional funds quickly should the need arise. In this context, a number of Directors called for well-sequenced discussions, with a clarification on prospects for a quota increase at an early stage.

To conclude, today's meeting has provided useful feedback and clarifications of views. Based on this and the discussion of the quota formula two weeks ago, staff will prepare a progress report to the Board of Governors on the 15th Review, which will be discussed on October 4. Management and staff will also reflect further on how best to take forward the work on the 15th Review in light of the views expressed. I hope that, with a spirit of flexibility, pragmatism, and openness from all sides, we can achieve a compromise that can command broad support from the membership.