INTERNATIONAL MONETARY FUND

ASSESSING RESERVE ADEQUACY—SPECIFIC PROPOSALS

April 2015

IMF staff regularly produces papers proposing new IMF policies, exploring options for reform, or reviewing existing IMF policies and operations. The following documents have been released and are included in this package:

- The **Staff Report** on Assessing Reserve Adequacy—Specific Proposals, prepared by IMF staff and completed on December 19, 2014 for the Executive Board's consideration of Assessing Reserve Adequacy—Specific Proposals at a future date.
- A **Press Release** summarizing the views of the Executive Board as expressed during its January 21, 2015 consideration of the staff report.

The Executive Directors met in an informal session, pending their formal consideration of Assessing Reserve Adequacy—Specific Proposals at a future date. No decisions were taken at this meeting.

International Monetary Fund
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INTERNATIONAL MONETARY FUND

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December 19, 2014

EXECUTIVE SUMMARY

Reserves have a central place in the policy tool kit of most economies, providing insurance against shocks. In conjunction with sound policies, they can help reduce the likelihood of balance of payment crises and preserve economic and financial stability. Reserves, however, can result from both precautionary and non-precautionary policy objectives and institutional settings. While they can bring several important benefits, reserve holdings can sometimes be costly.

This paper brings together recent Fund work on reserve adequacy issues aiming to strengthen their discussion in bilateral surveillance. Despite the ongoing debate on reserve issues, there is little consensus about how to assess reserve holdings in different economies, even though this is an important aspect of a member's external stability assessment. The work stream of which this paper is part aims to fill this gap by outlining a framework for discussing reserve adequacy issues in different economies. In this regard, the paper also forms part of the Fund's response to the 2012 IEO evaluation of the Fund's advice related to international reserves, which recommended, inter alia, that assessments of international reserves in bilateral surveillance reports should be more detailed and reflect country circumstances. To this end, the paper proposes that, where warranted, individual country Article IV reports include a fuller discussion of the authorities' stated objectives (precautionary and non-precautionary) for holding reserves, an assessment of the reserve needs for precautionary purposes, and a discussion of the cost of reserves. The aim would be to ensure evenhandedness so that countries with similar circumstances are assessed in similar ways, while allowing the depth and emphasis of this discussion to vary depending on country conditions and needs.

In terms of reserve holdings for precautionary purposes, the paper argues that considerations underpinning a country's reserve needs depend on its economic and financial structure. Building on recent IMF policy papers and Board discussions on reserve adequacy, the paper suggests that for reserve adequacy purposes countries could be classified based on the depth and liquidity of their markets and flexibility of their economy. In line with this, countries are grouped into mature markets (MMA), deepening financial markets (DFM), and constrained market access (CMA), which largely correspond to the commonly used per capita income classification. Within each group, methodologies are developed to help reserve adequacy assessments for precautionary purposes. Recognizing that no single indicator or model can capture the complex set of factors that determine reserve adequacy, the paper suggests that all relevant indicators be used as a starting point beyond which country specific analysis can further tailor the discussion.

A deeper focus on reserve adequacy issues could help enrich staff's analysis and policy advice. The report's proposals aim to strengthen the discussion on external risks and buffers and the interaction of reserves with other policies and institutional settings. While the emphasis is on bilateral surveillance, the methodology is also applicable outside Fund surveillance work.

Approved By
Siddharth Tiwari

Prepared by a team led by Nathan Porter and Kenji Moriyama, including Ran Bi, Ghada Fayad, Yuan Gao, and Roberto Perrelli (main contributors on emerging markets issues), Shuntaro Hara (main contributor on advanced country issues), Nkunde Mwase (coordinator of the work on low income countries), together with Sibabrata Das, Carla Intal, Christian Gonzales, and Jovana Sljivancanin. Grace Angeles and Gillian Adu provided assistance in the preparation of this document. General guidance was provided by Kalpana Kochhar, Thanos Arvanitis, and Cathy Pattillo.

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I. INTRODUCTION

1. Foreign exchange reserves have a central place in the policy tool kit of most economies. They are held for many different reasons, including to engender confidence in the national currency, counter disorderly market conditions, support the conduct of monetary policy, build assets for intergenerational purposes, or influence the exchange rate. Reserves can bring considerable benefits to the country that holds them but also entail costs as they generally yield lower returns than alternative uses. In addition, sizable and persistent one-sided intervention can move an exchange rate far from its equilibrium, aggravating a country's external imbalances with potential spillovers on other countries. Partly because of the multiple roles played by reserves, but also because of the complexity of quantifying external risks across different countries, assessing the appropriate level of a country's reserves remains very challenging. Nonetheless, whether a country has sufficient reserves is a central part of any external sector assessment and hence a critical part of the Fund's surveillance mandate.

2. The 2012 evaluation by the Fund's Independent Evaluation Office (IEO) found that the discussion in Fund surveillance of issues related to the holding and accumulation of reserves should be deeper.[1] The IEO argued that while the Fund had been at the forefront of research on reserve issues, there had not been sufficient discussion in individual country Article IV reports.[2] In particular, there had been too little emphasis on reserve adequacy issues and on country specificity in reserve discussions, including for advanced economies.

3. Responding to the recommendations made by the IEO, this paper seeks to advance recent work on reserve adequacy, making specific proposals on how these issues could be covered in bilateral surveillance reports. It builds on past Board papers on assessing reserve adequacy (ARA), in particular the IMF (2011a) and IMF (2013b), which henceforth will be referred to as ARA (2011) and ARA (2013), as well as an informal Board discussion in July. While the global financial crisis has heightened recognition of the importance of holding adequate reserves, there has been little consensus about the assessment of an adequate level for precautionary purposes: in particular, little consideration has been given in the literature to the possible needs for advanced economies, and, for emerging and low-income economies, traditional metrics have been narrowly-based and have not guided behavior. This work stream aims to outline the broad parameters of possible guidance to country teams on the coverage of reserve issues in staff reports, which is a key part of the external stability assessment and facilitate informed discussions at the Board. At the same time, it aims to

[1] Independent Evaluation Office, 2012, *International Reserves—IMF Concerns and Country Perspectives*

[2] For instance, the evaluation noted "[t]he topic of reserve adequacy was broached only very rarely in IMF consultations with advanced countries," and "reserve adequacy assessments were more frequent in emerging market countries, in recognition of these countries' greater historical tendency to experience balance of payments difficulties. But even here the assessments often appear to have been perfunctory. … A common message emanating from IMF surveillance was that reserve holdings were "comfortable" or "high." (p. 14).

respond to the IEO recommendations. While the emphasis in this paper is on bilateral surveillance, the analysis could also be relevant outside surveillance work.

4. Within this broader context, and in line with the previous ARA papers, the paper focuses particularly on reserve adequacy for precautionary purposes—that is, on the role of reserves in providing adequate space to country authorities to respond to shocks and prevent disorderly market conditions and undue economic dislocation.[3] While traditionally the focus has been on the reserve needs of low-income and emerging market countries the 2013 ARA paper argued that advanced countries may also need reserves for precautionary purposes. However, the role played by reserves, and hence a country's reserve needs, differ depending on the type and structure of the economy, suggesting that different tools are appropriate to assess reserve adequacy in different types of economies. In general, although not exclusively, more mature (advanced) economies' reserve needs for precautionary purposes center on limiting the risk of market dysfunction from shortages in foreign currency. Countries with market access (emerging market and frontier) have needs to mitigate the risk of crises from potential current and capital account shortfalls, and countries with limited market access need to protect domestic absorption against current account shocks.

5. While this paper is part of the Fund's broader work on monetary and foreign exchange policies, its scope is limited to reserve adequacy issues. The paper does not discuss issues that are tackled in other parts of the Fund's work, including on policy responses to market pressure which is the subject of the upcoming presentation on *The Role of Exchange Rate Intervention: Issues and Experiences*, the appropriateness of foreign exchange intervention in periods of inflows or outflows which is covered by the Fund's institutional view on capital flows, and reserve accumulation in a multilateral context, which is covered by multilateral surveillance products including the Spillovers and External Sector Reports.

6. The paper is structured as follows. First, it outlines the scope of reserve adequacy discussions in Fund surveillance (Section II), retraces the role of reserves in the different types of economies and proposes considerations for classifying economies for reserve adequacy purposes (Section III). It then considers specific proposals for adequacy assessments in different types of economies (Section IV), and discusses considerations for assessing the cost of reserves (Section V). Section VI concludes with issues for discussion.

II. RESERVE ADEQUACY IN FUND SURVEILLANCE

7. As stated in the *Surveillance Guidance Note*, a discussion of a country's reserves holdings is a key element of the external stability assessment. Article IV staff reports would generally report a country's reserves position and include an assessment of whether it is adequate in

[3] To be effective in mitigating crises, reserves must be complemented by sound policies. While reserves remain a critical external buffer, by themselves they cannot eliminate vulnerabilities. In this regard, they do not replace the need for strong policies and institutions, resilient and well buffered financial sector, and flexible economic structures.

view of its specific characteristics and vulnerabilities. The depth of the assessment will depend on the criticality of the issues. Where reserve adequacy issues are important for a member's balance of payments stability and/or global stability, the discussion would be deeper. Greater emphasis on reserve adequacy for precautionary reasons would likely be appropriate where reserves are relatively low, while more emphasis on the non-precautionary motives and cost of reserves would likely be appropriate for countries that have accumulated relatively large reserve holdings as these would likely be a by-product of non-precautionary objectives, (see section B below).

8. Reserve adequacy considerations would help enrich the discussion on external risks and buffers and the interaction of reserves with other policies and institutional settings. In general, where reserve adequacy issues are relevant, there is value in having a regular discussion in Article IV consultations. While the underlying factors that affect reserve holdings may only change gradually over time, regular discussions on these issues would provide an opportunity to reassess the factors underpinning the views of the authorities and staff in light of domestic and external developments, similar to the discussions on other macroeconomic and financial policies. Reserve adequacy considerations could also help deepen discussions on related policies, as reserves are involved in multiple decisions. For example, large and sustained foreign exchange intervention that risks draining reserves below some critical precautionary level would signal that a recalibration of policies is needed. In this respect, a discussion on reserve issues would not only support the assessment of a member's external stability but could also complement the analysis and advice on related policies.

A. Precautionary Motives

9. Assessing the adequacy of reserves for precautionary purposes provides a useful starting point to ground the discussion on reserve issues.[4] In a survey for ARA (2013), about three-quarters of respondent country authorities viewed precautionary liquidity needs as the critical reason to hold reserves. Empirically, there is strong evidence that reserves reduce the likelihood of balance of payments pressure in EMs.[5] In addition, experience during the global financial crisis suggests the usefulness of reserves for advanced market economies (AMs), where some AMs used reserves to limit market pressures and dysfunction. While there is no commonly accepted framework for discussing reserve adequacy for precautionary purposes, several metrics are widely used for reserve adequacy assessments and comparison. The advantage of these metrics is that they are simple rules on the strength (or vulnerability) of a country's reserves position relative to specific risk

[4] For the purpose of this paper, gross reserves are taken to be in line with the definition in IMF (2009, p. 111) "Reserve assets are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy, and serving as a basis for foreign borrowing)." Hence they do not include the authorities' net swap or forward position. While these positions tend to be persistent, and can influence the level of gross reserves if not rolled over, they are not readily available to assist the authorities manage pressures.

[5] See ARA (2013).

factors and can be applied uniformly across economies. However, as discussed in Section IV, some metrics may be more appropriate than others depending on country circumstances. In this regard, metrics can provide a practical starting point beyond which analysis of country specific risk factors could usefully complement the discussion.

10. Ideally, reserve adequacy assessments would encompass a forward looking discussion. In general, reserve adequacy discussions would include an assessment of risks and, thereby, buffers needed to prevent the realization of risks or mitigate their impact. To better inform policy choices, it would be useful to consider how reserve needs could evolve over the medium term, as reserve positions can take time to adjust. In this regard, discussions could draw on the expected evolution of factors that drive the need for reserves, such as changes in export earnings or external liabilities, as well as, anticipated changes in reserves based on pre-determined drains (e.g., maturing forward/swap contracts). Examples of an analysis of the dynamics of the evolution of South Africa and Mexico's reserve adequacy are provided in Annex V.

11. The availability of external buffers beyond reserves should be taken into account in the discussion of reserve adequacy. As discussed in ARA (2013), central bank swap lines and contingent IFI facilities have reserve-like features. For example, in the immediate aftermath of the 2008 crisis, US Federal Reserve swap lines provided several countries with important dollar liquidity. Similarly, IFI credit lines are complements to reserves during periods of heightened stress. The existence of such buffers should be taken into consideration in reserve adequacy discussions. Still, as discussed in ARA (2013), these buffers differ from reserves. While they can perform the role of reserves when activated, their activation may not be automatic and, with a few exceptions (like the standing swap arrangements between major central banks), their availability is not intended to be permanent.

B. Non-Precautionary Motives

12. Where relevant, a discussion on reserve holdings would reflect the authorities' non-precautionary motives to accumulate foreign assets. As noted earlier, non-precautionary objectives, including intangible benefits which may be difficult to quantify, can be important factors for reserve holdings. For example, foreign exchange intervention may be automatic under a fixed exchange regime or, as discussed in other workstreams, may result from actions to achieve an inflation target if other transmission channels (such as credit or interest rate) are ineffective.[6] In addition, foreign assets (held in the form of reserves) can form an important part of a country's savings to ensure intergenerational equity, notably in economies endowed with non-renewable

[6] Assessment on the level of exchange rates, including multilateral consistency and global imbalances, is beyond the scope of this paper.

resources.[7] Last but not least, reserve accumulation can be a by-product of export-led growth strategies that rely on sterilized intervention to enhance external competitiveness.[8] All these factors could have a significant impact on a country's reserve holdings, and in some cases, they could be more important than precautionary motives. To this end, where these issues are important (as discussed in paragraph 7), following staff's discussion with the authorities, Article IV reports should reflect the authorities' primary non-precautionary reasons for reserve accumulation.

C. The Cost of Reserves

13. Where Article IV consultations focus on reserve adequacy issues, the financial and opportunity cost of reserves would likely be an important topic for discussion. The consideration of only one factor—the benefits of reserves (proxied by adequacy) or their cost—would bias the assessment of reserve levels in one direction; hence, any assessment should consider both. Sections IV and V provide a general framework that could be used to support discussions on the cost of reserves.

14. In addition, where reserve accumulation can have important outward spillovers, these should be discussed in bilateral and multilateral reports. The Integrated Surveillance Decision requires Article IV staff reports to discuss outward spillovers where the economic and financial policies of a member do not promote its own internal or external stability and/or where they lead, or may lead, to spillovers deemed significant to influence the effective operation of the international monetary system. In addition to Article IV reports, the outward externalities of reserve holdings should be discussed in multilateral reports—such as the annual Spillovers and External Sector Reports—which permit these issues to be dealt with in a multilaterally consistent way.

15. Summarizing the above discussion, we propose the following:

Proposal for bilateral surveillance: As part of the external stability assessment of a member, Article IV reports would generally include a discussion on reserve adequacy, reflecting the aspects that are relevant for that country. In addition to the adequacy of reserves for precautionary purposes, this discussion, where relevant, would reflect the authorities' stated non-precautionary motives for holding reserves, as well as, the cost of reserves. Staff should use judgment in deciding the depth and emphasis of the discussion depending on country circumstances.

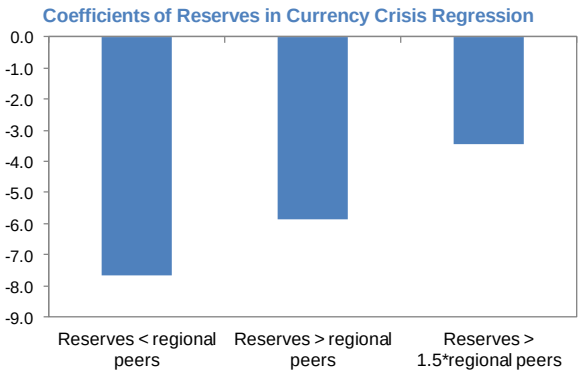
[7] Sovereign assets not directly required for liquidity purposes are more appropriately managed through longer-term Sovereign Wealth Funds (SWFs). Some countries include their SWFs in reserves reporting to the Fund while others do not. The latter is usually the case when SWFs assets do not meet the definition of official reserves, but can be true also even if they would be liquid enough to be reserves.

[8] Dellate and Fouquau (2012) and Bar-Ilan and Marion (2009) report that mercantilist motives have been an important driver of reserve accumulation for some countries. Relatedly, Ghosh and others (2012) argue that while precautionary motives are more important for reserve holding decisions, mercantilist motives became more relevant after the Asian crisis.

Box 1. Can Relative Reserve Holdings Affect Currency Crisis Probabilities in EMs?

The role of international reserves in reducing the probability of a crisis is one of the reasons used to justify their acquisition. A key question relates to whether this reflects the reserves' actual size as a liquidity buffer against potential vulnerabilities or their relative size. It has been argued that *relative* reserve holdings could be an important factor in reducing crisis probabilities. This view would be consistent with a pattern of "reserve accumulation competition" often seen between countries (Bastourre et al. 2009).

Although accumulating reserves helps limit currency crisis in EMs, their marginal benefits become smaller as reserves rise (including relative to its regional peers). Empirically, controlling for the relative reserve size, relative reserve holdings are, in themselves, neither key determinants of currency crises nor of private agents' decisions to remain invested in a country.



Sources: Bloomberg, IFS, WEO and IMF staff calculations.

III. CLASSIFICATION OF ECONOMIES

16. Reserve adequacy assessments should be attuned to the different types of economies. As discussed in ARA (2013), reserves play different roles in advanced, emerging, and low-income countries. In EMs, they are associated with lower risks of a currency crisis, although, as noted above, the marginal benefits decline at high levels. In advanced economies, reserve buffers are associated with a lower risk of banking crises and market dysfunction. In low-income countries, reserves are associated with the ability to smooth domestic absorption to current account shocks.

17. These differences largely reflect these economies' diverse exposure and tolerance to external risks. The ARA (2013) found that countries' tolerance depends on market depth and the robustness of market liquidity, as well as their economic flexibility. The depth and resilience of market liquidity could limit the impact of external pressures, while economic flexibility makes adjustment to external shocks easier.

18. These characteristics do not always align with the standard classification of advanced, emerging, and low income countries. Economies have become more complex, and some face risks that straddle the per-capita income divide. To classify countries into relevant groups, the following methodology was used. First, countries were separated by the extent of market access into counties with market access (MA) and countries with constrained market access (CMAs). In this regard, indicators used related to the durability and depth of market access, such as public sector issuance

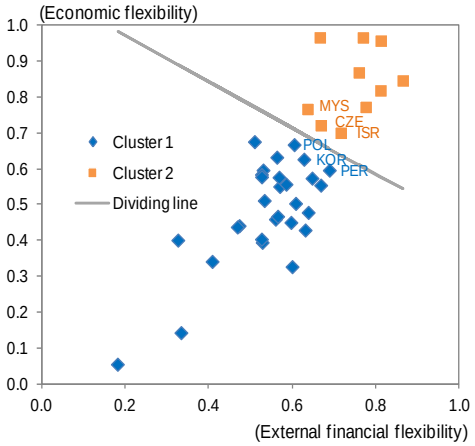
in the last three to five years, sovereign debt rating, borrowing in international markets, including through government guarantees—some of which are also used in PRGT eligibility.[9] Second, market access countries were further divided into mature markets (MMA) and deepening financial markets (DFM) on the basis of the two dimensions proposed in ARA (2013):

- *External financial flexibility*. To capture the flexibility of a country's foreign currency market, variables used included bid-ask spreads in FX markets (median of daily data in each year), external financial account openness (Lane & Milesi-Ferretti index), and financial market efficiency index compiled by the World Economic Forum (WEF).[10]

- *Economic flexibility*. Variables used to proxy a country's ability to adjust to external shocks, include the goods market efficiency index,[11] the labor market flexibility index,[12] and its sovereign rating (the average of S&Ps and Moody's ratings of long-term foreign currency debt).

19. Specific country groupings along these dimensions were derived through cluster analysis. The sample covers countries that do not issue a reserve currency and are outside a currency union. A country showing higher scores in each dimension is interpreted as a more mature market economy. That is, it has more efficient goods and labor markets, and more

Classification of Economies, 2010–12
(Based on simple average)



Sources: Bloomberg, EWND, WEF, PWT and IMF staff calculations.

[9] See Box 1 in *Eligibility to use The Fund's Facilities for Concessional Financing* for further details. Nonetheless, external bonds and commercial loans issued or contracted in markets that are not integrated with broader international markets do not qualify.

[10] This index consists of five components: availability of financial services; affordability of financial services; financing through local equity market; ease of access to loans; and venture capital availability, based on an Executive opinion survey conducted by the World economic Forum. The survey captures opinions from over 13,000 business leaders in 148 economies. The index is calculated as the average of the components. For details of the survey methodology, see Global Competitiveness Report.

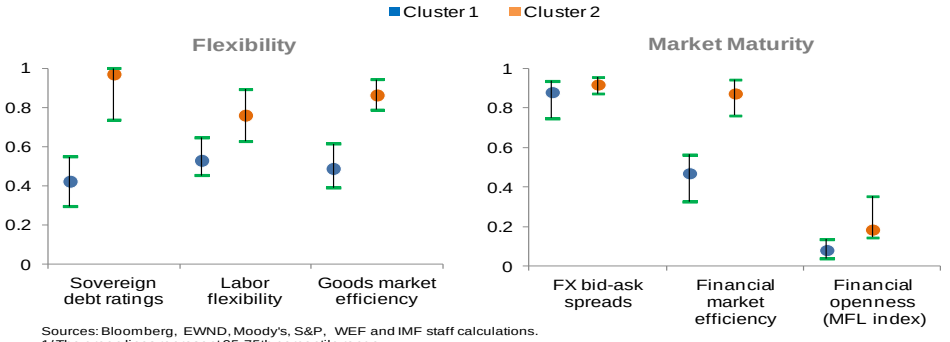
[11] The index has the following components: intensity of local competition (WEF executive opinion survey); extent of market dominance (WEF executive opinion survey); effectiveness of anti-monopoly policy (WEF executive opinion survey); effect of taxation on incentives to invest (WEF executive opinion survey); total tax rate (Doing business); number of procedures required to start a business (Doing business); time required to start a business (Doing business); agricultural policy costs (executive opinion survey); prevalence of trade barriers (executive opinion survey); trade tariffs (international trade centre); prevalence of foreign ownership (WEF executive opinion survey); business impact of rules on FDI (WEF executive opinion survey); burden of customs procedures (WEF executive opinion survey); imports as a percentage of GDP (WTO); degree of customer orientation (WEF executive opinion survey); and buyer sophistication (WEF executive opinion survey).

[12] This consists of the following components: cooperation in labor-employer relations (WEF executive opinion survey); flexibility of wage determination (executive opinion survey), hiring and firing practices (WEF executive opinion survey); redundancy costs (Doing business); and effect of taxation on incentives to work (WEF executive opinion survey).

open and liquid financial markets. The text chart shows the derived clusters based on a simple average during 2010-12.[13] The results are intuitive, with more mature economies showing on the northeast part of the chart and less mature economies on the southwest. Reflecting the sorting of the two groups, Figure 1 shows the difference across the two groups in these indicators. There are seven countries which lie close to the "dividing line" between mature and less-mature economies—Chile, Malaysia, Czech Republic and Israel above the line, and Poland, Peru, and Korea below the line.[14]

Figure 1. Flexibility and Maturity Variables by Cluster

(Median and inter-quartile range, normalized data in 2006–12)

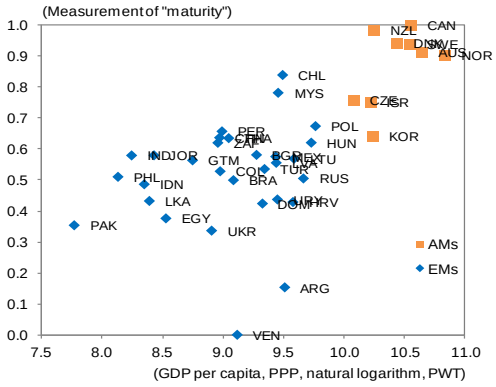


Sources: Bloomberg, EWND, Moody's, S&P, WEF and IMF staff calculations.
1/ The green lines represent 25-75th percentile range.

20. The classification along "maturity" lines has a large overlap with the standard income based classification between AMs and EMs. The distance of each country from the "dividing line" between the two groups could be used to aggregate the information across the financial depth and economic flexibility dimension discussed above.[15] Comparing this aggregated maturity measure with per capita income suggests a strong, but not perfect, relationship. The correlation with (the log of) per capita income is above 0.6.

Classification: Income vs. "Maturity" Measurement

(Based on simple average, 2010–12)



Sources: Bloomberg, EWND, WEF, PWT and IMF staff calculations.

[13] The results in this chart are robust to alternative aggregations of indicators, including using principal component analysis. In particular, these two methods provide the identical list of countries classified as mature and less mature markets.

[14] These results are robust to the use of alternative clustering algorithms and changes in the underlying variables. The algorithms of K-means, K-median, Ward's linkage produce highly consistent cluster outputs (correlations are 0.99). Discriminant analysis suggests remarkably low (less than 2 percent) misclassification error in the separation of mature and less-mature economies.

[15] The "dividing line" is estimated using the canonical function separating the two clusters using discriminant analysis. The estimated slope of the dividing line is negative, suggesting some trade-off between liquidity/depth of financial markets and flexibility in real economy. A country could be classified as "mature" if it has liquid/deep financial markets which sufficiently compensate some inflexibility in real economy (and vice versa).

Proposal: Given the large overlap between the standard and the one based on "maturity" considerations, we present the Board with two options for consideration. On the basis of the Board's endorsement, future guidance to staff would be developed along the lines of either:

- Continue to assess reserve needs and adequacy along the lines of the standard classification.

OR

- Classify countries on the basis of financial and economic flexibility and degree of market access for reserve adequacy purposes. In line with this, countries would be divided into three groups (mature markets, deepening financial markets, and constrained market access economies). For countries that are close to the dividing line, it is proposed that country teams have flexibility to decide how to classify and assess reserve adequacy, justifying their decision in Article IV reports based on these countries' relevant characteristics and external risks.

IV. ADEQUACY CONSIDERATIONS BY TYPE OF ECONOMY

A. Mature Markets

21. Prior to the global financial crisis, relatively little attention was paid to precautionary reserve needs in mature market economies. For instance, the literature has typically abstracted from considering the loss of market access and the risk of external crisis for mature market countries.[16] This reflected the limited experience of sudden stop events in these countries and the general belief that they had strong institutions and policy frameworks, deep financial markets, flexible exchange rates and ample policy space to respond effectively to adverse external shocks. Moreover, as many of them were either reserve currency issuers or could borrow in their own currencies, concerns about reserve adequacy were relatively small.

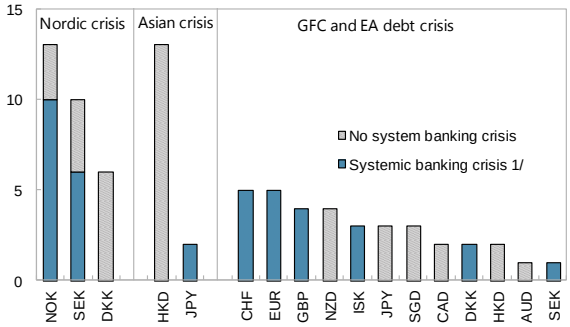
22. The experience of the global financial crisis, however, suggests that even mature markets are not immune to foreign exchange and funding market stress. In fact, during the 2008 crisis, financial institutions in some mature markets were shut out from funding markets, including the foreign exchange (FX) swap market The implied US dollar FX swap rate shot up to record high levels in a wide range of advanced economies, and the U.S. dollar–libor spread, which normally fluctuates around near zero, widened sharply to record levels as market transactions froze.[17]

[16] One exception is Ghosh and Ostry (1997), who calculated optimal precautionary savings for several advanced economies, including the United States and Japan.

[17] For details, see Box 5 in the ARA (2011) and Box 2 in the ARA (2013).

23. Episodes of market dysfunction have frequently occurred around periods of banking stress. ARA (2013) found that periods of stress in the FX swap market and the banking sector tend to coincide. These two processes—banking system stress and market dysfunction—are likely to be self-reinforcing, suggesting two-way causality. In addition, possible foreign exchange funding needs during periods of market dysfunction may extend beyond banks to non-bank financial and non-financial corporates.

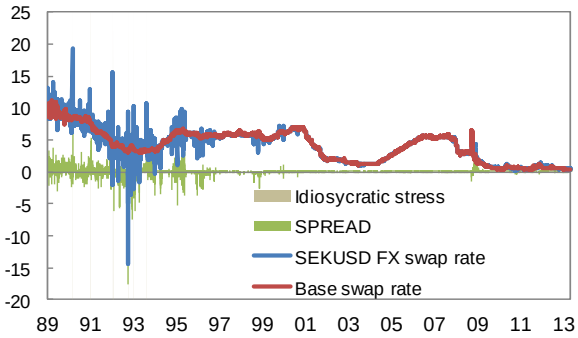
Decomposition of FX Market Dysfunction Episodes
(Number of dysfunction episodes across crisis periods)



Sources: Bloomberg, Laeven and Valencia (2012) and IMF staff calculations.
1/ Systemic banking crises as defined by Laeven and Valencia (2012).

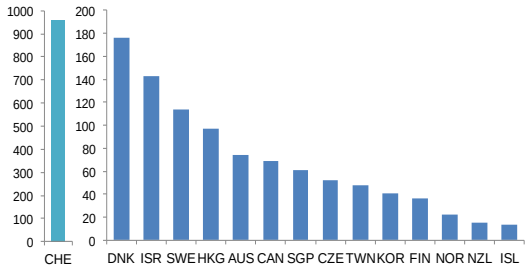
24. Although banks' and non-banks' own liquid assets provide the first line of defense against liquidity needs, in extreme periods of market dysfunction, mature economies have used reserves to protect financial stability.[18] Foreign exchange market dysfunction has occurred in advanced economies both during and outside systemic crises (as can be seen in the widening of spreads for Sweden shown in the text chart). Reserves can play a key role to ensure adequate market funding when markets dysfunction. Consistent with this, a number of mature economies increased their reserves after 2008.[19] However, while the need for reserves is relatively well established, there is no consensus in the literature on how to assess the appropriate reserve level for precautionary purposes in their economies.

Sweden: Stress in the Krona Market



Sources: Bloomberg and IMF staff calculations.

Increase in Stock of Reserves of AMs
(In percent, from 2008 Aug to 2013 Dec)



Sources: IFS and IMF staff calculations.

25. The need for reserve buffers likely differs between reserve currency issuers (and those with predictable access to reserve currencies) and other mature market countries. As ARA 2013 argued, reserve currency issuers as well as countries with standing central bank swap lines are unlikely to need sizable

[18] See Box 1 in the ARA (2013). Responses to the 2013 survey suggest that many central banks rely on price-based indicators, like swap rates, to signal conditions in the foreign exchange market that indicate market dysfunction.

[19] Not all this increase reflected precautionary accumulation, and there is some concern that central bank reserves as a backstop to market dysfunction could increase moral hazard and lead financial institutions and other market participants to misprice risk. For prudent level of reserves, the benefits seem to outweigh the costs. Moreover, appropriate prudential policies and fees can be applied to mitigate moral hazard concern, inherent in any insurance buffers. For example, central banks could impose fees reflecting the cost of holding precautionary reserves based on the marginal risk created by individual institutions.

reserves for precautionary purposes, as they can create assets which can be swapped into any other currency at any time.[20] For non-reserve issuers without predictable access to reserve currencies, external buffers, including in the form of reserves, can provide insurance against the risk of market dysfunction.

26. To assess potential buffer needs, many non-reserve advanced countries rely on scenario analysis, rather than on specific metrics. In a survey of countries for ARA (2013) and discussions with several mature market authorities for this paper, respondents stated that they use scenario analysis as the main tool for assessing reserve adequacy. Although there is no one-size-fit-all approach, scenarios usually center on the risks of market dysfunction and risks to (bank and nonbank) balance sheets from FX funding shortfalls.[21] Relevant indicators cited in the survey responses include foreign exchange market turnover, foreign liabilities, and short-term external debt. The duration of market dysfunction, and extent of market liquidity that could dry-up are two important parameters to calibrate.

27. Model and data gaps complicate a standardized approach for assessing reserve adequacy for mature economies. Country counterparts stressed the difficulty in modeling market dysfunction and liquidity needs, noting the limited historical experience, and that markets normally considered as deep and liquid proved to be less so during times of stress. In addition, detailed bank and market data needed to develop a general metric for these economies is not usually in the public domain.[22] In view of these constraints, scenario analysis offers the most fruitful analytical tool to assess the needs of mature economies for precautionary purposes.

Proposed Application

28. In general, scenario analysis can help approximate FX funding needs of countries with mature markets relative to existing bank and nonbank buffers. It can be calibrated using available historical information (on trading liquidity and turnover, market participant behavior, and short-term funding needs) and assumptions on adverse shocks.

[20] See Chapter 4 in Supplementary information for IMF (2013b) on liquidity swap lines between several central banks and reserve issuers (especially USD swap lines) to meet short-term dollar funding needs of banks and stem market dysfunctions during the global financial crisis.

[21] Some mature economies also reported the need to hold reserves against the possible need to meet obligations to international financial institutions.

[22] Similar concerns have been raised by the Basel Committee in its search for indicators to identify the liquidity of various markets. Recent background work for the implementation of new liquidity requirements under Basel III noted that "while the academic literature has proposed a wide variety of liquidity proxies to measure asset and market liquidity, no single universally accepted measure exists ... [with] [l]imitations in the readily available data across jurisdictions and markets … the main restriction on calculating these liquidity metrics.... For most metrics, transaction volume, outstanding issue, and/or bid-ask quotes are also required" (BCBS, 2014, p. 7).

29. Where a deeper reserve adequacy assessment is warranted, Article IV consultations should seek to discuss reserve needs based on scenario analysis. Country authorities assess their reserve needs on a relatively frequent basis. In fact, some authorities noted that while the predicted needs may not change from year to year, they find this type of exercise useful to test the assumptions underpinning their models. While staff should not aim to replicate the authorities' scenario analysis, they should engage in a discussion on the authorities' reserve adequacy framework, including the authorities' view of dominant risks, the possible reserve needs to stabilize markets, and the costs related to holding reserves.

Proposal. Mature market economies without a reserve currency or automatic access to reserve currencies through standing swap lines have a need for reserve buffers.[23] For these economies, scenario analysis offers a tool to assess their potential needs as well as test their sensitivity. Where reserve adequacy issues are relevant in the external sector assessment of a mature market country, Article IV staff reports would be expected to discuss the authorities' reserve adequacy framework, including risks, possible reserve needs, and the costs associated to holding reserves.

B. Deepening Financial Markets

Metrics of Reserve Adequacy in Literature

30. With reserves providing a critical source of liquidity support, there has been considerable effort to identify guidance on the appropriate level of reserves for less mature market economies (see SM/00/65 and Box 2 or ARA 2011 for a summary). The traditional metrics developed in this literature continue to be widely cited and have the attraction of being relatively intuitive, simple, and transparent, but at the same time they are partial and narrow in scope. They include:

- For countries with less open capital accounts, **import cover** is often seen as a relevant measure, highlighting how long imports can be sustained in the event of a shock. Traditionally, the measure has been based on months of prospective imports, with three months' coverage typically used as a benchmark. However, the applicability of this metric has become less useful for countries that have opened up financially, and the financial links have become large.

- **The ratio of reserves to short-term debt** (ST Debt) has been extensively used as an indicator of crisis risk for market-access countries, and plays a key role in any assessment of reserve adequacy. This measure is particularly relevant for a country with large short-term cross-border financial transactions. The "Greenspan-Guidotti" rule of 100 percent cover of Short-term Debt—is the most widely-used standard of adequacy for EMs.

[23] The central banks which currently have access to standing liquidity swap arrangements with the Federal Reserve are the Bank of Canada, Bank of England, Bank of Japan, the ECB, and the Swiss National Bank.

- For countries with large banking sector and very open capital accounts, **the ratio of reserves to broad money** (typically M2) has been used to capture capital flight risks, given that many recent capital account crises have been accompanied by outflows of residents' deposits. The upper end of a prudent range for reserve holdings is typically set at 20 percent.

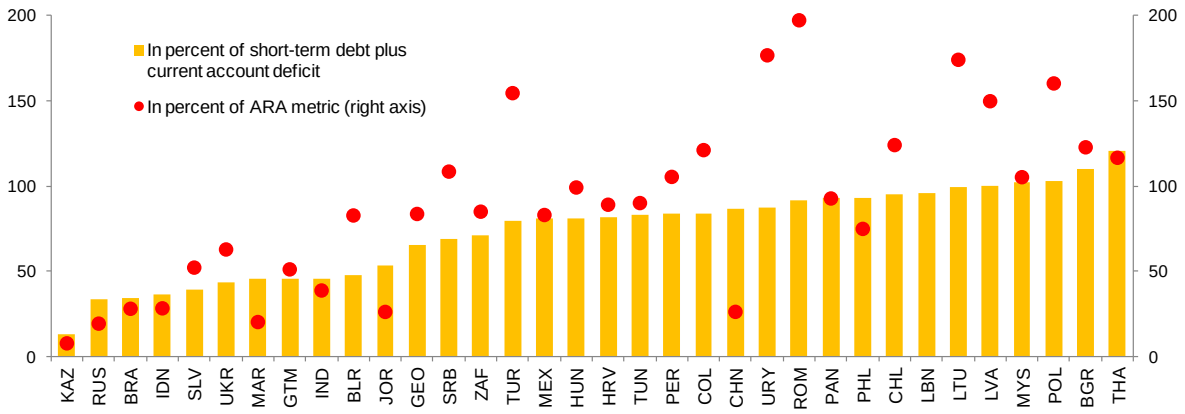
- **Combination metrics** have been used to capture a range of risks. The most common such metric is the expanded Greenspan-Guidotti rule, consisting of ST Debt plus the current account deficit (if it is in deficit), which is intended to reflect the full potential 12-month financing need.[24] Another combination metric is Wijnholds and Kapteyn (2001), which uses ST Debt and M2 to model debt repayments and capital outflows as motivations for holding reserves, taking into account exchange rate regimes and country risk.

31. More recently, optimal reserve models were developed to integrate cost and benefit considerations. A widely used model is that of Jeanne and Rancière (2006), where the optimal level of reserves is determined by balancing the economic cost (the potential loss in output and consumption, given the size and probability of the sudden stop) with the opportunity cost of holding reserves, and reflecting the degree of risk aversion. An issue with this approach is that it can result in a wide range of estimated optimal reserve holdings, depending upon its calibration. A "baseline" calibration of the Jeanne and Rancière (2006) model suggests that many EMs would optimally hold reserves at around 80-100 percent of short-term debt plus the current account deficit and between 75 to 150 percent of the ARA EM metric (Figure 2). However, for alternative assumptions, such as on output loss, the probability of a sudden stop and risk aversion, the level of "optimal" reserves can change considerably (Figure 3).[25]

[24] The asymmetric treatment of the current account implies a larger shock for surplus countries than for deficit countries, whereas if anything the reverse might be more justifiable. From this perspective, a formulation of "ST Debt minus the current account balance" (positive or negative) might be worth considering instead.

[25] With zero liquidity premium, the model postulates an optimal level of reserves that smoothes domestic consumption in the event of a sudden stop. When there is no output loss, this optimal relationship is reduced to the Greenspan-Guidotti rule.

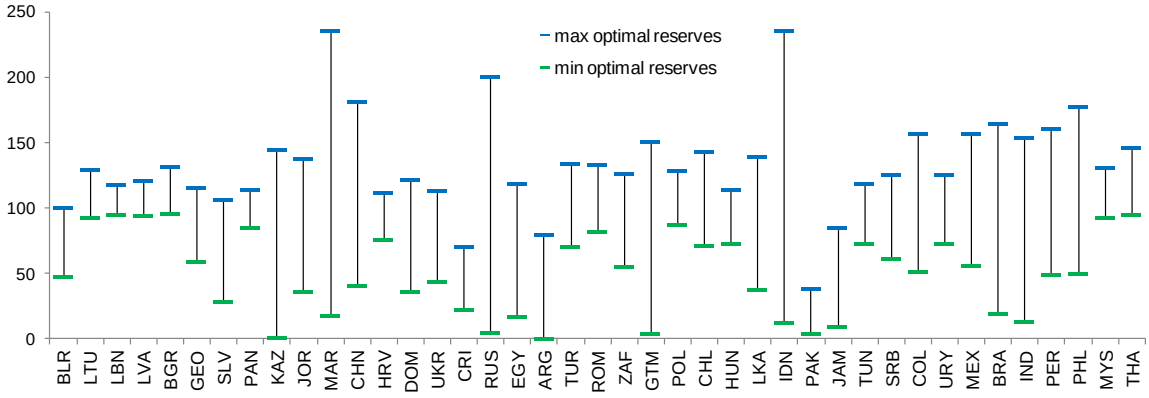
Figure 2. Optimal Reserves: Baseline Calibration[1/]



Sources: Bloomberg, IFS, WEO and IMF staff calculations.
1/ Based on the benchmark calibration in Jeanne and Ranciere (2006) and country-specific cost to hold reserves (defined as the average EMBI spread in the last 12 months).

Figure 3. Optimal Reserves: Sensitivity Analysis[1/]

(In percent of short-term debt at remaining maturity and current account deficit)



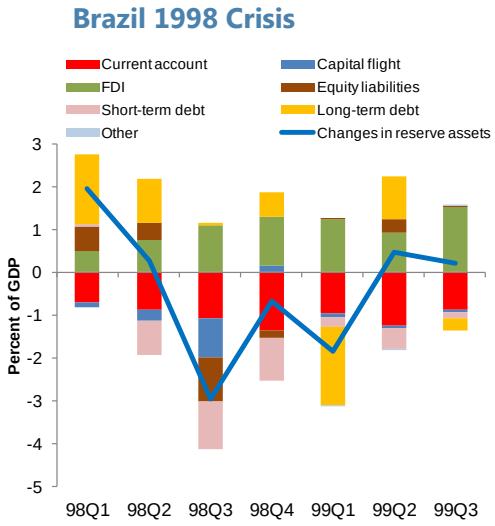
Sources: Bloomberg, IFS, WEO and IMF staff calculations.
1/ Based on country-specific cost to hold reserves (defined as the average EMBI spread in the last 12 months) and the following rage of parameter values: risk aversion from 2 to 4, probability of a sudden stop from 10% to 15%, and output loss from 6.5% to 10% (a country-specific output loss, defined as the largest growth decline in the last 15 years is used if it is outside the 6.5%-10% band).

ARA EM Metric

32. Against the backdrop of the traditional metrics noted above, the Fund proposed an additional metric in early 2011 (and refined it in 2013). A key motivating factor for this work was the experience of past balance of payments crises which were characterized by multiple market pressure channels, suggesting the need for a metric encompassing a broad set of risks (see, for example, the experience in past Brazilian and Russian crises). This view was supported by a survey of country authorities (ARA, 2013) and analytical work from reserve demand regressions,[26] suggesting

[26] See the ARA (2011) and ARA (2013).

multiple risks against which countries hold reserves. The metric aimed to balance simplicity and completeness, while permitting comparability across countries.



Sources: IFS and IMF staff calculations.

Sources: IFS and IMF staff calculations.

33. In particular, the EM metric:

- Comprises four components reflecting potential drains on the balance of payments: (i) *export income* to reflect the potential loss from a drop in external demand or a terms of trade shock; (ii) *broad money* to capture potential residents' capital flight through the liquidation of their highly liquid domestic assets; (iii) *short-term debt* to reflect debt rollover risks; and, (iv) *other liabilities* to reflect other portfolio outflows.[27] The relative risk weights for each component are based on the 10th percentile of observed outflows from EMs during exchange market pressure episodes.
- Reserves in the range of 100-150 percent of the composite metric are considered broadly adequate for precautionary purposes. The selection of a range—rather than of a point estimate for the adequacy level—reflects the intention to be cautious in view of the uncertainty inherent in the estimation of various balance of payments risks. This was also preferable to considering a range of risk weights for the individual components of the metric.
- The weights proposed for the individual components (amended in ARA (2013)) are as follows:[28]

[27] In ARA (2013) consideration was given to separating "other liabilities" into debt and equity liabilities. However, on balance, the composite term was maintained. This reflected the fact that equity remains an intrinsically less risky element of the balance of payments since price falls associated with liquidation limit the value of assets seeking to exit and hence the pressure on the balance of payments, but empirical estimates do not seem to adequately capture this lower vulnerability through lower prices. Consequently, the aggregated term captures the right balance of risks. Moreover, only a limited set of emerging market countries (around 65 percent) have separate data on external debt and equity liabilities.

[28] Given the post-2008 experience, the weights on "other liabilities" (or MLT debt and equity liabilities to non-residents) were raised by 5 percentage points in the ARA (2013).

	(In percent)	Short-term Debt	Other Liabilities	Broad Money	Exports
Revised Weights	Fixed	30	20	10	10
	Float	30	15	5	5

34. ARA (2013) showed empirically that the EM metric outperformed traditional metrics at predicting market pressure events as well as in explaining consumption smoothing behavior during stress events.[29] This partly reflects its broader coverage of balance of payments risks. In addition, the EM metric can capture better the risks resulting from rising external liabilities driven by surges in capital inflows than traditional metrics, and hence indirectly the impact of systemic/global external factors—like monetary policy in advanced countries.

Proposed Application

35. Reserve adequacy metrics provide a starting point for a discussion of reserve adequacy. The available metrics provide a good basis for adequacy assessments of countries with deepening financial markets, and staff should use the metrics that are best suited to the characteristics of the country involved. Staff should consider the IMF's ARA metric which, given its broad coverage of the balance of payments, is suitable for most economies with market access.

36. Additional country specific analysis could complement the discussion on reserve adequacy. Econometric or scenario analysis of country specific factors could supplement the assessment as these may not be captured by metrics. This could include an analysis of possible additional risks or drains on reserves (e.g., swap or forward transactions, or "encumbered" reserves); and availability of additional external buffers (e.g., contingent financing lines and borrowing arrangements).

Proposal. For countries with deepening financial markets, and where reserve issues are relevant, the assessment of reserve adequacy for precautionary purposes would include a discussion of relevant metrics, including the Fund's ARA. Country specific analysis, where necessary, could complement the assessment.

Specific Operational Issues

37. A number of operational questions have been raised about the use of the EM metric in the assessment of reserve adequacy. This section covers how the metric could be used in: (i) countries with capital controls; (ii) commodity intensive economies; and (iii) dollarized countries. In addition, the issues of how to account for capital flows volatility and the use of gross vs. net reserves are also discussed.

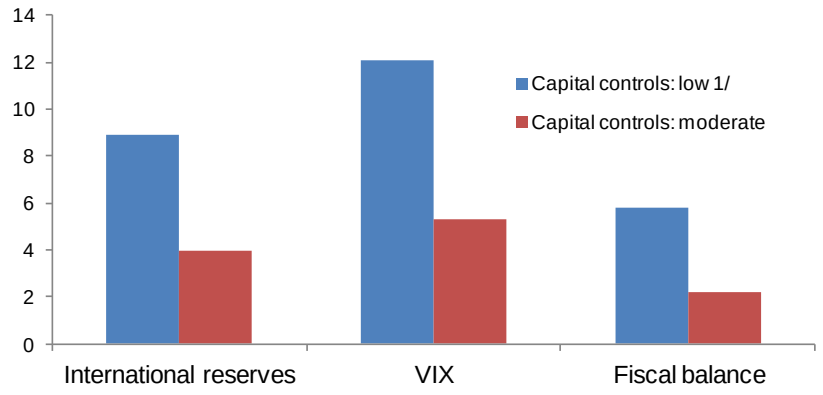
[29] See Chapters 6 and 7 in the supplementary information to the ARA (2013).

Do Countries with Capital Flow Management Measures in place have Different Reserve Needs?

38. Empirical studies suggest that capital controls, or capital flow management measures, could reduce outflows as well as the probability of market pressure events. For instance, Binici, Hutchinson, and Schindler (2010) find that capital controls can substantially reduce the volume of debt and equity outflows (see also Box 2).[30] Capital controls can also reduce the probability of exchange market pressure (EMP) events (Figure 4 and Annex II).[31]

Figure 4. Impact of Capital Controls on EMP Event Probabilities

(Against one standard deviation shock, percentage points)



Sources: IFS, WEO and IMF staff calculations
1/ Defined as the median of the three *de jure* indicators on capital account openness. "Moderate" refers to the mid-point of the controls index, while "low" refers the mid-point between complete liberalization and "moderate" controls. The endogeneity of controls is controlled for through two-stage estimation.

39. In view of these findings metrics should take into consideration the presence of capital controls. For the ARA metric, it would mean lowering the weight on broad money (to reflect the lower risk of resident flight) since outflow controls directly affect the ability of residents to transfer assets abroad.[32] In fact, based on the sample of market pressure events, countries with relatively strict capital controls faced significantly lower pressure on resident assets (as proxied by broad

[30] Their estimates imply that an increase in the severity of controls equivalent to a change from "low" to "moderate" (as in Figure 4) would reduce debt securities outflows and FDI plus equity outflows per capita (US$ base) by about 25 percent and 30 percent, respectively.

[31] These findings aim to highlight the impact of controls and not to imply that capital controls (or capital flow management measures, CFMs) always constitute an appropriate response to external pressures or they are a substitute for reserves. CFMs have been discussed extensively in IMF (2013c). While they can be an appropriate response in some circumstances, they are not a substitute for warranted macroeconomic adjustment. Where used, CFMs should typically seek to be transparent, temporary, and non-discriminatory.

[32] As discussed earlier, broad money is used as a proxy for resident flight, as it includes possibly the most liquid domestic assets (namely currency in circulation and deposits). The latter includes deposits across all sectors, including residents and corporate and which may be converted to foreign assets

money), see Table 1.[33] Recognizing the fact, noted by some Directors in past Board discussions, that in some countries existing capital control measures may not be adequate to capture the ability of non-residents to repatriate past permitted inflows, we do not propose any adjustment to the "other liabilities" term. Nonetheless, where countries maintain clear controls on the exit of non-resident assets—such as minimum holding periods for securities, approval requirements for repatriation of investments, or a tax discouraging early redemptions—the weight on "other liabilities" could be halved as discussed in ARA (2013).

Table 1. Comparison of 10th Percentile Points[1/]

(In percentage point)

	Broad Money (fixed)	Broad Money (float)
With capital controls	-5.4	3.4
ARA (2011)	-12.4	-2.3
ARA (2013)	-8.4	-4.5
Weight in ARA	10	5

Sources: IMF staff calculations.
1/ Countries that at least two of the three normalized capital controls indicators are less or equal to 0.25.

Proposal. Where countries have CFM measures on residents in place, the weights of the ARA metric on broad money should be adjusted as indicated below.

	(In percent)	Broad Money
Without capital controls	Fixed	10
	Float	5
With capital controls	Fixed	5
	Float	2.5

Where there are additional controls on non-resident outflows, the weight on other liabilities could also be halved.

In cases of CFM measures, *both the unadjusted and adjusted* metrics should be presented.

As reserve adequacy should be a forward looking discussion, if liberalization is a likely near-term prospect the speed of liberalization and the supportive macroeconomic policies during the transition period would be important topics for discussions in Article IV consultations.

[33] The exercise in Table 1 reflects actual capital movements for countries during periods of exchange market pressure. It is thus analogous to the analytics underpinning the ARA EM metric, except that the sample it limited to countries with relatively strong de jure controls.

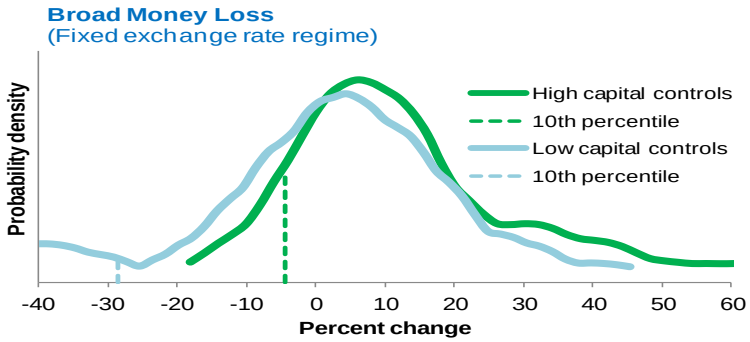
Box 2. Measuring Capital Controls and their Impact

This paper provides new estimates of the impact of capital controls on external pressures. It investigates the implications of controls on the incidence of stress (exchange market pressure), as well as on the distribution of outflows during such events (see Annex II for full details).

The empirical work focuses on three commonly used *de jure* measures to estimate the sensitivity of potential outflows to the imposition of capital controls. In particular, we look for a sub-sample of countries which have relatively stringent capital controls, based on three commonly used *de jure* measures of controls on outflows: (i) Quinn (which is used in EBA assessments); (ii) IMF share (which was developed by MCM and has been used in IMF (2012)); and (iii) Chinn-Ito.[1] Each measure is based on the Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions*. While the use of de facto measures of capital controls would have been preferable, such measures are not directly available, and. are at best often approximated by measures based on external assets and liabilities. These are inadequate for this exercise, as they measure external and financial openness, which is a function of many factors, and may bear little relation to legislated controls (see Annex II).

While recognizing that de jure indices are imperfect measures of capital controls, we combine the information in the three measures by focusing on the median, or 2 out of 3, of these measures. This provides some comfort that if one of the indices shows an extreme value for a country, it would be moderated by the information in the other two. For the purposes of this paper we normalized these indices, so that all three measures range from 0 to 1, where lower numbers indicate stronger controls. We then identify countries with the most binding measures, i.e., with indices in the top quartile.[2] [3]

In countries with capital controls, there are fewer outflows during exchange market pressure events. The distributions the various risk factors (e.g, broad money, short-term debt, or other external liabilities) during periods of exchange market pressure for countries with strict capital controls, as well as the 10th percentile points, lie to the right of the distribution of the whole sample (the text chart shows this for broad money). This pattern is robust to the choice of threshold of "strict capital controls." For example, testing robustness by raising cutoff for controls to include countries with more liberal regimes, the sample size is considerably larger, but the conclusion is much the same. The 'high' capital controls distribution indicates considerably less extreme events than the 'low' capital controls. A similar pattern holds for those with flexible regimes.



Sources: WEO and IMF staff calculations.

[1/] Unfortunately, through its design, the Chinn-Ito index captures both inflows and outflows and information on outflows cannot be stripped out.

[2/] While arbitrary, this provides a set of observations of countries with relatively tight capital controls (specifically, an index value in the range of the most strict quarter of possible values), which can be compared with balance of payments flows relative to the flows seen in full sample. These thresholds are associated with "approval required, sometimes granted" for the Quinn measure, and "controls on ¾ transactions with specific financial sector provisions" for the IMF share measure.

[3/] A question raised about these measures is whether they adequately capture the possible gradual or partial relaxation of thresholds, when controls on specific transactions remain in place. While the indices are updated on a relatively frequent basis, the extent and pace of liberalization may be underestimated in some countries, as recognized by some Directors in past discussions (see Annex II).

Do Commodity-Intensive Economies Have Different Buffer Needs?

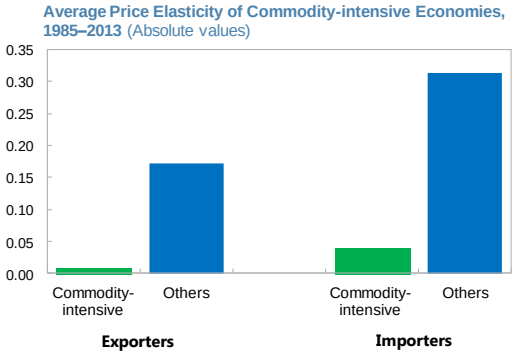
40. Commodity intensive economies differ in their ability to adjust to fluctuations in their terms of trade, suggesting the need for additional buffers. Specifically, commodity intensive economies face more volatile terms of trade, and have greater difficulty in adjusting to these shocks since commodity imports or exports are relatively price inelastic (Box 3). This suggests that they may need higher precautionary buffers than other economies to smooth the adjustment, and the need for such an additional buffer can be added to the discussion on reserve adequacy. The additional buffer could be met in a variety of ways, including through hedging or longer-term contracts, savings under a sovereign wealth fund, or through higher reserves. Many countries have used such alternatives to deal with price risk, including hedging (Mexico), and sovereign wealth funds (Chile).

Box 3. Sensitivities of Fuel Trade Volume to Prices

*Staff's study on the commodity (fuel) import/exports price elasticities shows that **commodity importers/exporters tend to face highly price inelastic demand/supply**, in line with the literature. We illustrate this here with the price elasticity of fuel imports and exports.*

Exports. Export elasticities for fuel exports (in volume terms) to changes in fuel prices (simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh) are estimated controlling for developments in trading partners' demand and REER with panel data with 36 emerging markets spanning 1989-2013. The results indicate that the price elasticity of fuel exports is relatively small in this sample of emerging markets (around -0.17), and statistically indistinguishable from zero for the subset of countries with more than 50 percent of their export proceeds coming from oil exports (text table).

Imports. Likewise the sensitivity of fuel imports (volumes) to changes in fuel prices is estimated after controlling for the growth of real domestic demand and REER changes in a panel data of 36 emerging market economies during the period from 1980 to 2013. The econometric results (text table) suggest that the price elasticity of fuel imports is also small (-0.31) in the overall sample, and not statistically different from zero for countries in the upper quartile of the fuel imports distribution (i.e., those countries with the largest imports of fuel as a share of GDP).



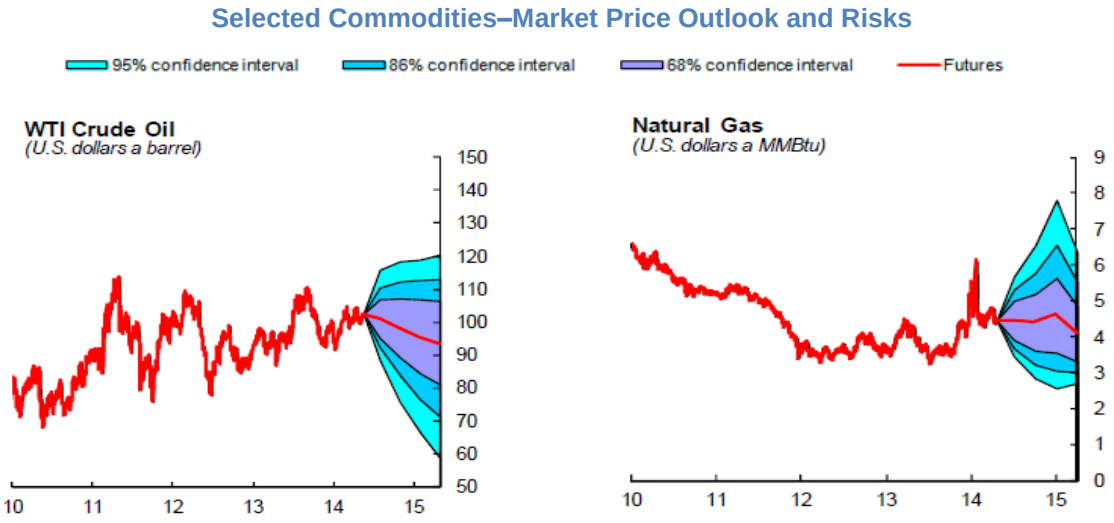
Sources: WEO and IMF staff calculations.

41. How could this buffer be calculated? We propose to calculate it on the basis of the price gap between current prices and a cautious forecast of future prices. Specifically,

- For the price gap, we propose to take a future price at the 68 percent confidence interval (equivalent to one standard deviation if the future distribution is normal). The text chart below illustrates such future price distributions for oil and natural gas prices. A buffer calculated in this

way has the advantage that it will vary with the underlying price risk and depend on the state of the commodity cycle.

- For the medium-term commodity prices, futures prices (as in the text chart below) and model based projections present possible options. Prior to the global financial crisis futures prices—particularly for energy—provided an unbiased projection of commodity prices (Chinn and Coibion, 2013). However, their performance has declined since and they have been outperformed by model based forecasts (IMF, 2014), suggesting the latter may be preferable in more recent times. Some countries (e.g., Chile) have institutions specifically tasked to project long-term commodity prices. For the purpose of Fund surveillance, assumptions could be discussed with the authorities during Article IV consultations.



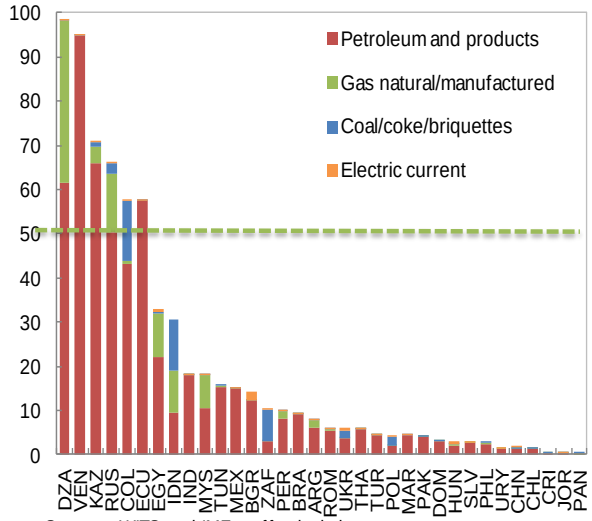
Source: IMF Research Department, data as of May 2014.

42. Who should the buffer apply to? For exports, there is a significant discontinuity in the share of commodity exports at around 50 percent of total exports (Figure 5), suggesting reasonable to consider commodity export dependent economies as being those above 50 percent. This is broadly consistent with the WEO classification of commodity exporters (with only Colombia added as a fuel exporter and Argentina, Brazil and Peru as non-fuel exporters). For imports, there is less of a discontinuity, making it less clear where the dividing line should be; we suggest 20 percent of net commodity imports as a reasonable cut-off (Figure 6). [34]

[34] We look at net commodity imports given that some heavy commodity importers re-export a large share of these imports, mitigating the price risk.

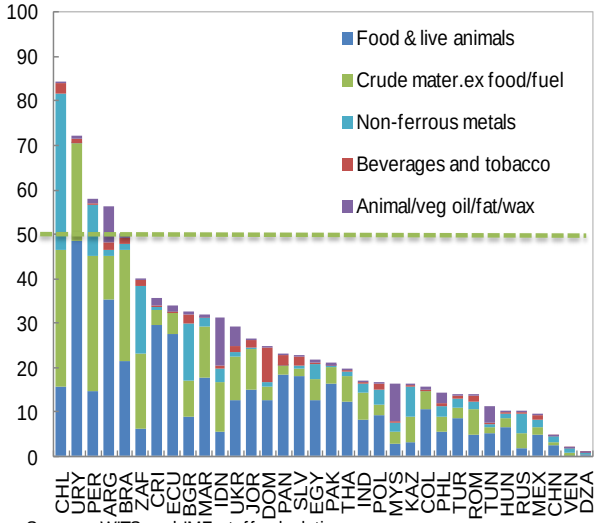
Figure 5. Thresholds for Commodity-Intensive Exporters, 2007–13

EMs: Fuel Exports, 2007–13
(In percent of total exports of goods)



Sources: WITS and IMF staff calculations.

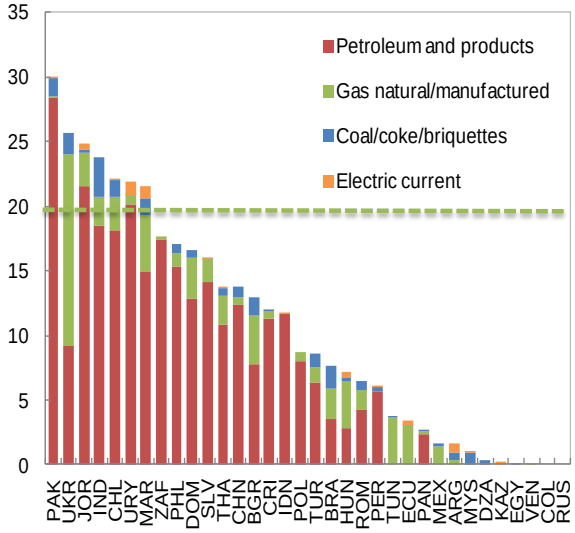
EMs: Non-Fuel Primary Exports, 2007–13
(In percent of total exports of goods)



Sources: WITS and IMF staff calculations.

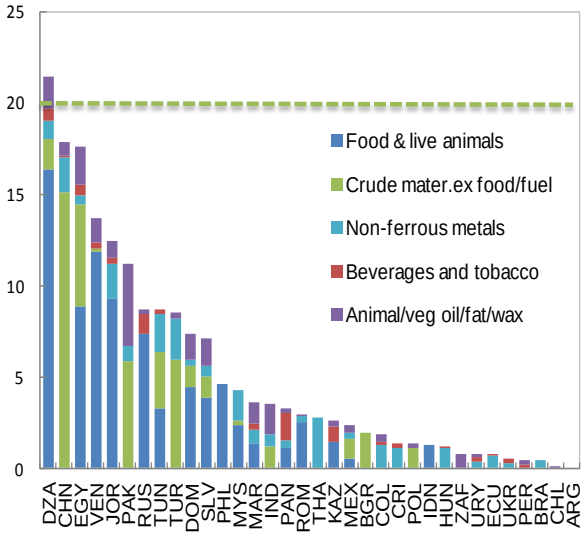
Figure 6. Thresholds for Commodity-Intensive Importers, 2007–13

EMs: Net Fuel Imports, 2007–13
(In percent of total imports of goods)



Sources: WITS and IMF staff calculations.

EMs: Net Non-Fuel Primary Commodities Imports, 2007–13 (In percent of total imports of goods)

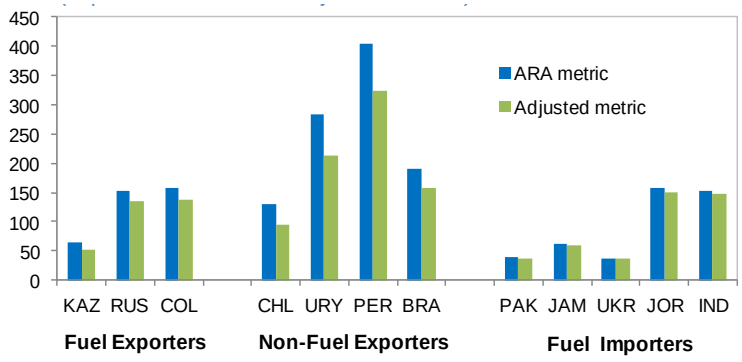


Sources: WITS and IMF staff calculations.

43. An illustrative example is shown in Figure 7. An additional buffer to absorb adverse terms of trade risks was estimated for key commodity-intensive exporters and importers. If held as reserves, the additional buffer would reduce the measured reserve adequacy of commodity intensive economies, especially non-fuel commodity exporters, relative to the ARA metric.[35] While most countries would continue to have ample reserves (within the 100-150 percent range of the EM metric), a few may need additional buffers. As mentioned above, these need not be held as reserves.

Figure 7. Reserve Adequacy and Buffering

(In Percent of ARA and Adjusted Metric[1/])



Sources: WEO, IFS and IMF staff calculations.
1/ Adjusted for adverse price change over the year at 68 percent confidence interval using May 2014 derivatives data.

Proposal. Risks related to intensive commodity economies should be discussed in Article IV consultations, including the need for additional buffers to mitigate these risks. The buffer is proposed to be calculated on the basis of forward looking adverse price movements at some confidence level (e.g., 68 percentile). These buffers could be met in different ways, including through reserves, hedging, or sovereign wealth funds, depending on country specific circumstances. This flexibility argues for separating the need of a buffer from the need for additional reserves, and, therefore, we propose not to include it directly in the metric.

Do Dollarized Economies Have Different Reserve Needs?

44. Reserve adequacy discussions could be relevant in dollarized economies, as they can be subject to balance of payments pressures as other economies. This link is clearer for partially dollarized economies, since they have their own currency and the central banks can meet the local currency needs of the financial system. For these economies, reserve adequacy considerations do not differ conceptually from non-dollarized ones. For fully dollarized economies, the need for the

[35] The "adjusted metric" in the chart shows reserves in percent of ARA metric plus the additional buffer.

authorities to hold an FX liquidity buffer differs from other countries since they do not face the risk of exchange rate fluctuations and currency mismatches.

Fully Dollarized Economies

45. Fully dollarized economies may need liquidity buffers in the adopted foreign currency to support domestic financial institutions, but also as a buffer for government financing. Liquidity pressures in banks could result from outflows from the financial system, which can originate from various sources including a decline in exports, a sudden stop in external financing, non-resident flight, or a resident run. In addition, governments may wish to maintain *additional fiscal savings* as buffer against unexpected fluctuations in revenue or spending since funding in the adopted currency may be difficult in times of stress.[36]

46. Calibrating precisely the possible needs due to external pressures is difficult. Most risks identified above are captured by the components of the EM metric. ARA (2013) argued that, while inferences are hampered by the small sample size, fully dollarized economies do not appear to have faced events of BOP pressures that are more severe than non-dollarized countries. The paper compared the experience of the three fully dollarized Latin American economies (Panama, Ecuador and El Salvador), and, in particular, the changes in each metric component over identified periods of external stress with the distributions based on a general EM sample. The experience of fully dollarized EMs was not particularly extreme when compared with that seen in the broader sample.[37] As such, the ARA metric provides a useful starting point for measuring possible pressures for such economies. For the fiscal reserve buffer, Wiegand (2013) proposes one month of government spending as a standard yardstick.

47. Several fully dollarized economies complement high liquidity ratios in banks with centralized reserve buffers. It has been argued that decentralized liquidity buffers allow dollarized economies to avoid the moral hazard problem of centralized liquidity buffers (Levy Yeyati 2008). However, decentralized buffers do not eliminate the need for centralized reserves and several fully dollarized economies have already established, or are in the process of establishing, liquidity funds as LOLR-type facilities.[38]

[36] Dollarized economies cannot accumulate reserves by issuing base money in exchange for FX assets. Instead, reserves accumulation is achieved through central deposits by another entity, such as the government (Kosovo, Panama) or a bank-financed liquidity fund (Ecuador), controlled by the Central Bank. See Wiegand (2013) for more details.

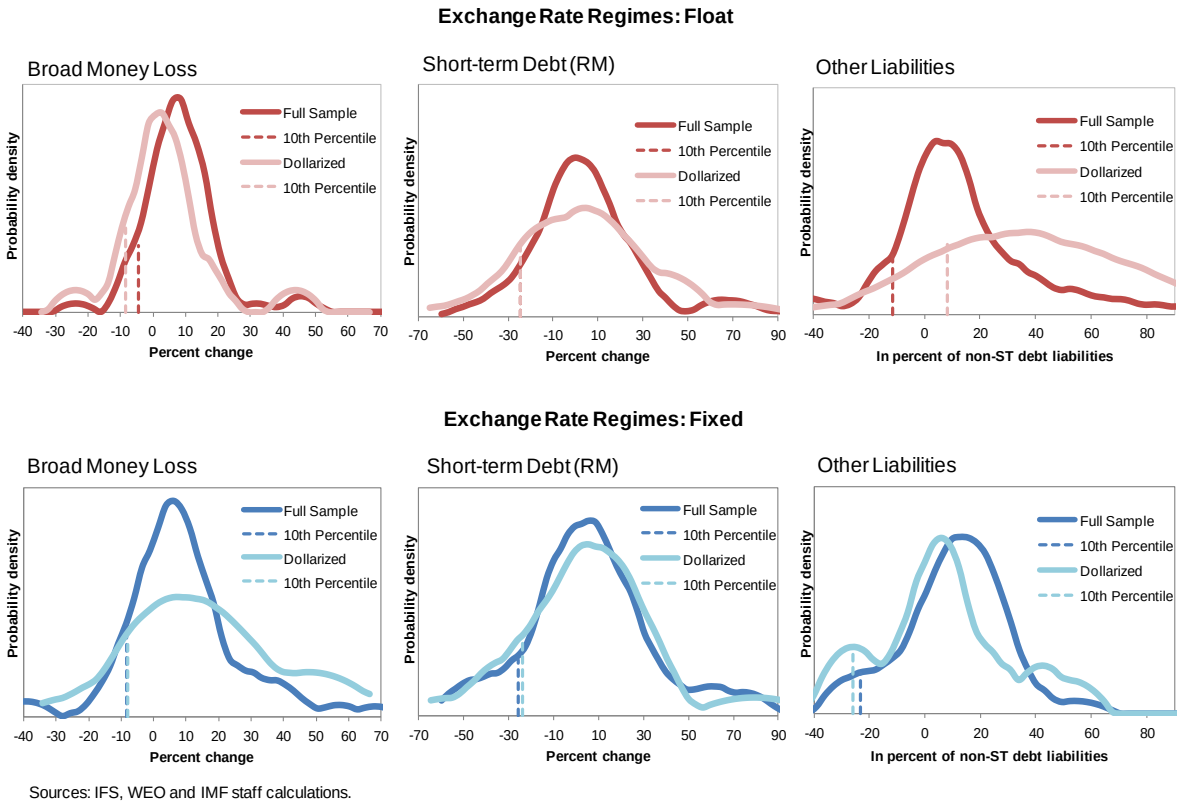
[37] Since we cannot use the EMP index to identify crisis years for these economies, we used instead the most extreme fall in reserves based on the reserve assets reported in the national balance of payments.

[38] In Kosovo, discussions on establishing a liquidity fund financed from bank contributions are underway, while at the same time, funds earmarked for emergency liquidity assistance are operational, drawn from the pool of government deposits at the central bank. A LOLR facility has been established but not yet activated/financed in El Salvador. In Ecuador, the Liquidity Fund, established in 2009, is financed by private banks through a percent contribution of deposits subject to reserve requirements.

Partially Dollarized Economies

48. There is not a strong empirical basis to argue that partially dollarized economies need larger reserve buffers. The existing literature on the impact of dollarization on the likelihood and severity of crises is mixed. In general, there is no clear positive association between the degree of dollarization and crisis likelihood or cost. Moreover, partially dollarized EMs have not seen larger outflows during market pressure events than other EMs (Figure 8). These results are supported by new work presented in Box 3. Nonetheless, non-resident deposits seem more likely to leave during market pressure periods in highly dollarized economies (Figure 9 and Gonçalves, 2007).[39]

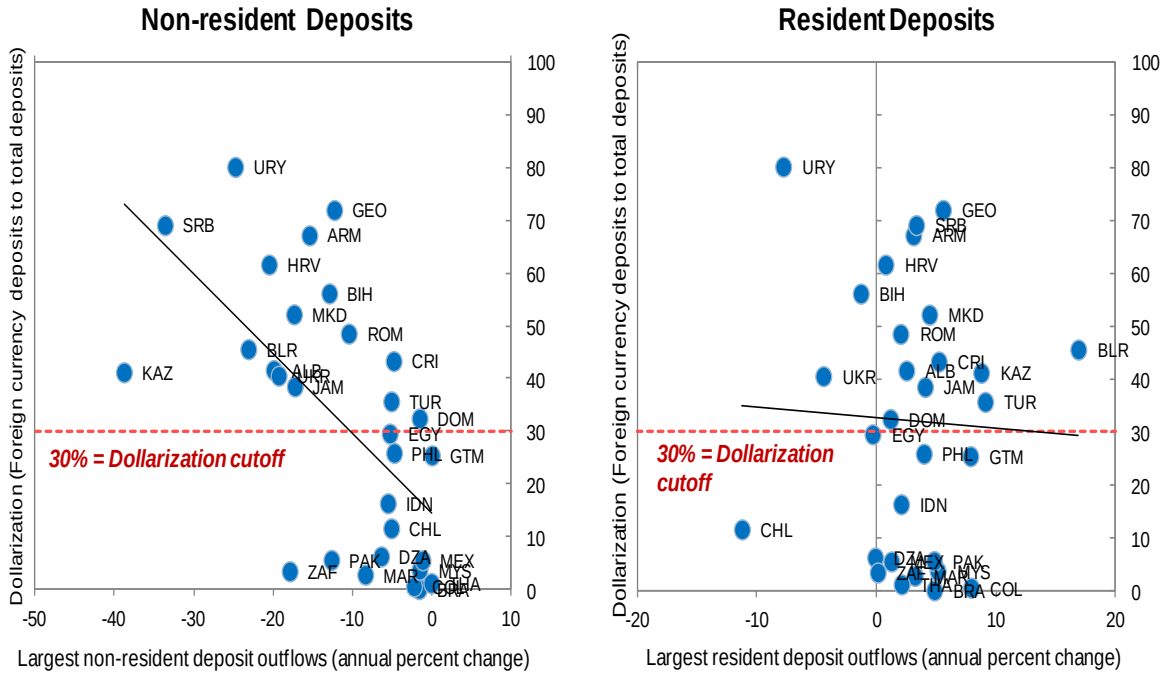
Figure 8. Distributions of Metric Components for Partially and All EMs



Sources: IFS, WEO and IMF staff calculations.

[39] Gonçalves (2007) extends the framework of optimal international reserves developed by Jeanne and Rancière (2006) by incorporating the dollarization of bank deposits, particularly held by non-residents, to examine the optimal level of international reserves in Uruguay. The extension adds the risks of (dollar) deposit flight to the risk of sudden stop in the original Jeanne-Rancière model. In this way it comes closer to modeling the risks captured in the ARA metric. Gonçalves argues that the optimal international reserve level for Uruguay dropped substantially since 2002mainly due to a sharp reduction of short-term foreign currency debt and nonresidents' deposits since the 2002 crisis.

Figure 9. Resident and Non-Resident Deposit Outflows, 2000–13



Source: IFS and IMF staff calculations

Proposal. The discussion on reserve adequacy should take into account the specific circumstances of fully and partially dollarized economies. For *fully dollarized economies*, where reserve issues require a deeper discussion, staff reports should report on whether the available (public and private) buffers provide sufficient scope to meet potential financial stability needs and whether fiscal buffers in the adopted currency may be warranted. For *partially dollarized economies* domestic liquidity pressures could result from balance of payments drains, and the ARA EM metric may provide a useful starting point to consider the foreign exchange liquidity buffers, with the ensuing discussion explaining if the extent of privately held buffers or dollarization means a higher or lower level is warranted. However, to the extent that the non-resident foreign exchange holdings present a higher risks than captured in the ARA EM metric, these should be discussed and accommodated within any adequacy assessment.

Box 4. Impact of Dollarization on Crisis Probability and Cost

There is mixed evidence in the literature on the effect of dollarization on crises probabilities. Emphasizing the balance sheet channel operating through exchange rate changes, Levy Yeyati (2006) finds that devaluation raises the risk of a banking crisis in the presence of dollarization. Calvo, Izquierdo, and Loo-Kung (2012) find that following a large depreciation, crisis risk can result from the rise in the value of FX-denominated liabilities. However, Arteta (2003) fails to find strong support for dollarization raising banking or currency crisis risk. Similarly, Honig (2006) finds weak evidence of positive association between banking crises and unofficial dollarization.

The literature on the severity of crisis in dollarized economies is also limited with mixed results. Arteta (2003) fails to find evidence that dollarization increases the contractionary costs of crises. The author cites the buffer role dollarization can play, such as deposit dollarization insulating deposits from the effect of currency crash, or credit dollarization transferring credit risk from banks to firms, thus creating incentive for latter to improve risk management and increase hedging activities. Focusing on the global financial crisis, Chitu (2012) finds that unofficial loan dollarization was an important determinant of the severity of the crisis, measured by output collapse between 2007 and 2009 in a large number of EMs. Such amplifying effect was found to be transmitted through the traditional channels such as limited ability to act lender of last resort and currency mismatches.

New empirical work undertaken by staff indicate at most a weak link between dollarization and the probability or the cost of external crises. [1/]

- Based on probit regressions of the probability of currency crises against factors widely used in the literature (such as net external asset position, international reserves, VIX, fiscal balance etc.), dollarization has at most a modest impact.[2/]
- Similar to Arteta (2003), there is no empirically significant direct link between dollarization and growth in EMs. Based on a pooled OLS growth regressions controlling for currency and banking crises, dollarization, as well reserves, banks' own buffers and other main macro variables, there is no significant impact of dollarization on growth. Nonetheless, the contractionary effect of exchange rate depreciation is marginally higher in more dollarized economies.

The above results may reflect higher buffers in banks as well as with a larger degree of foreign bank ownership. More specifically, Dinger (2009) shows that foreign banks help significantly in reducing the risk of aggregate liquidity shortages in some EMs. Levy Yeyati (2008) finds that deposit dollarization is robustly related to commercial banks' holding of foreign assets. In Deléchat, and others (2012), deposit dollarization is found to be robustly and significantly associated with higher liquidity buffers in a number of fully and partially dollarized economies.

Probit Model: Currency Crisis Probabilities

	(1)	(2)
Net debt assets	0.793	0.805
Net portfolio assets	-1.272	-1.566
Net FDI position	1.459	1.404
International reserves	-7.453**	-8.562**
Relative per capita GDP (PPP)	-2.107	-1.925
Current account balance	-0.756	0.392
REER gap	0.820	1.350
VIX	10.982***	11.708***
Fiscal balance gap		-13.013*
Dollarization	1.347**	1.092
Constant	-3.394***	-3.486***
Number of observations	427	424
Log likelihood	-39.165	-37.225
Psedo R-squared	0.258	0.281

Sources: WEO, IFS, IIP, Milesi-Ferretti and Lane database, INS and IMF staff calculations.
Note: *** p<0.01, ** p<0.05, * p<0.1

Cost of Crisis in EMs: Effect of Dollarization

Dependent variable: Real GDP Growth	(1)	(2)
Currency crisis	-1.30	
Banking crisis		-4.30
Dollarization (FX deposits to total)	-0.04	-0.02
Reserves to metric	0.01*	0.01
Banks liquid assets to TA	0.04***	0.04***
Banks foreign assets to TA	0.13*	0.11
External debt to GDP	-0.03**	-0.03*
Change in ER	0.03	0.04*
Change in ER * Dollarization	-0.001***	-0.001***
Year and country FE	YES	YES
Observations	230	230
Countries	26	26
R-squared	0.60	0.61

Sources: WEO, IFS, IIP, Milesi-Ferretti and Lane database, INS and IMF staff calculations.
Note: current account balance and exchange rate regime included but not reported*** p<0.01, ** p<0.05, * p<0.1; right side variables are lagged.

[1/] The analysis here is based on deposit dollarization, but the results are the same if loan dollarization is used instead.

[2/] Two percentage points for a one standard deviation increase in dollarization for the median country.

Currency Unions

49. Individual economies in a currency union can be subject to balance of payments shocks. However, when a common central bank holding an adequate level of reserves can allocate adequate liquidity within the union, there would generally be less need for individual members to cover their reserve needs through their own reserve holdings.

50. The nature of the currency union is critical for the level of external buffers needed. Assuming reserve pooling can operate within a union, the considerations for reserve adequacy would generally reflect the underlying structure of its members. For currency unions able to issue a reserve currency, the reserve adequacy considerations at the *consolidated union level* would align with those for a reserve currency issuer (discussed in section IV.A). For unions comprising emerging market and low income countries, reserve adequacy considerations should be in line with those types of economies. For example, the Eastern Caribbean dollar is pegged to the US dollar, and supported by a quasi-currency board. In the ECCU's case, the monetary base is backed by international reserves (Dehesa and Druck, 2008). On the other hand, the West African and the Central African CFA francs are pegged to the euro and backed by the French Treasury. The overall reserves should reflect the nature of these pegs (Delèchat and Martijn, 2007).

51. The financial architecture of the currency union and the synchronization of shocks may limit the scope for reserve pooling.

- *Financial architecture*. The financial architecture of the union, such as the absence of a banking union, and the possibility that liquidity may not be allocated efficiently within the union to stem financial pressures would be a limitation for reserve pooling.

- *Synchronization*. If members of a currency union lack sufficient economic diversification, the synchronicity of their business cycles may expose them to correlated shocks, limiting the value of pooling. Such shocks could include surges in food and fuel prices, plunges in FDI and terms of trade, and drops in the external demand of common trading partners. In these cases, the level of pooled reserves will need to be higher, and may even reach the aggregate level of the reserve needs for each individual member.

Proposal. In the case of currency unions, a starting point for reserve adequacy discussions is to consider the reserve needs of the consolidated, union level, economy. This could be supplemented by a discussion of factors that have a bearing on the size of reserves, such as the union's financial architecture and supportive institutions (like a common central bank which can efficiently allocated needed FX liquidity within the union), and the correlation of shocks faced by union members.

Volatility of Capital Flows

52. Concerns have been raised about the impact of volatile financial flows on a country's reserve needs and, thereby, the application of the ARA EM metric. On the one hand, it has been

argued that large and volatile portfolio and bank-related flows increase a country's reserve needs, which should be reflected in the metric. On the other hand, the view has been expressed that the metric should be relatively stable against volatility in financial flows as reserve holdings should not be adjusted on a high frequency. By design, the metric tries to address both concerns. Unlike most traditional metrics, the ARA EM metric includes components on short-term debt and portfolio flows. When these increase, the metric increases as well to provide reserve buffers against possible outflows. At the same time, the other liabilities and short-term debt components in the EM metric reflect stocks (i.e., accumulated flows in the past), making the metric less sensitive to high frequency changes in flows. That said, where excessive volatility in financial flows creates sizable movements in the ARA EM, consideration could be given to introducing some persistence in the desired reserve levels for these economies.

Proposal. Maintaining reserves relative to a moving average of the other liability and short-term debt components of the ARA EM metric could be a possible adjustment, which could be considered by country teams if measures of reserve adequacy seem excessively volatile.

The coverage of reserves

53. In some cases, central banks may have short-term FX liabilities or other short-term drains on their reserves that may not be captured under a relevant metric. For example, provisions that allow commercial banks to meet their reserve requirements in foreign exchange boosts gross international reserves. However, the part of the international reserves linked to required reserves may not be available for balance of payments support as reserves would fall if deposits were to decline. Similarly, a central bank may have drains on its reserves reflecting its forward position. The ARA EM metric tries to estimate the appropriate size of reserve buffers against the possible size of external pressures a country may face in extreme cases of heightened pressures. In this respect, it is a measure of external buffers available for effective intervention if needed. In line with this, any central bank liabilities or drains on its reserves should be discussed in Article IV reports (this would be symmetric to the treatment of non-reserve buffers discussed in paragraph 11).

Proposal. Short-term FX liabilities to residents which could lead to a sudden drain in reserves need to be discussed in assessment of reserve adequacy in the Article IV staff report, given they may limit the usability of reserves. The amount of the possible drain would depend on the character of the liabilities, and should be reflected in the discussion between the authorities and Fund staff.

C. Credit-Constrained Economies

Background and Objectives

54. The IMF recently developed a new approach to calculate an appropriate level of foreign reserves for credit constrained economies with limited market access. This complements traditional metrics, such as three months of imports coverage. The approach balances

the benefits from holding reserves in terms of both crisis prevention and mitigation against the opportunity cost of holding reserves, focusing on the precautionary motive for accumulating reserves. In 2011, the IMF developed the approach introducing a method for estimating the marginal benefits from holding reserves, and in 2013 it enhanced the approach by providing a framework for quantifying the cost of holding reserves and making some refinements to the estimates of benefits for resource-rich economies.

55. This section summarizes the recent advice on reserve adequacy in LICs provided in ARA (2011 and 2013). It also provides an illustrative assessment of adequate reserve holdings compared to actual reserves and underscores the complementary role of the new approach to existing traditional current account based metrics.

56. The next section provides an overview of recent developments in reserve accumulation in LICs, measured by two traditional metrics, import coverage and reserves as a share of broad money. While crises in EMs are generally characterized by pressures on the capital account, reflecting access to market financing, the share of non-concessional (and non-official external) debt is low in most credit constrained economies so that external drains come primarily from the current account.

57. The following section summarizes the new approach for estimating the adequate level of reserves in LICs. A three step approach is used which involves (i) estimating the benefits of holding reserves in LICs; (ii) providing a framework for quantifying the cost of reserves; and (iii) deriving the optimal level of reserves using the estimated regression coefficients and costs of holding reserves.

58. An illustrative estimate of the adequate level of reserves for these is provided. As with other approaches, however, it cannot fully capture the range of factors that bear on a country's resilience to shocks and cost of holding reserves. Close examination of the balance of payments and the foreign exchange markets could also be useful to inform judgment.

Recent Trends in Reserve Accumulation

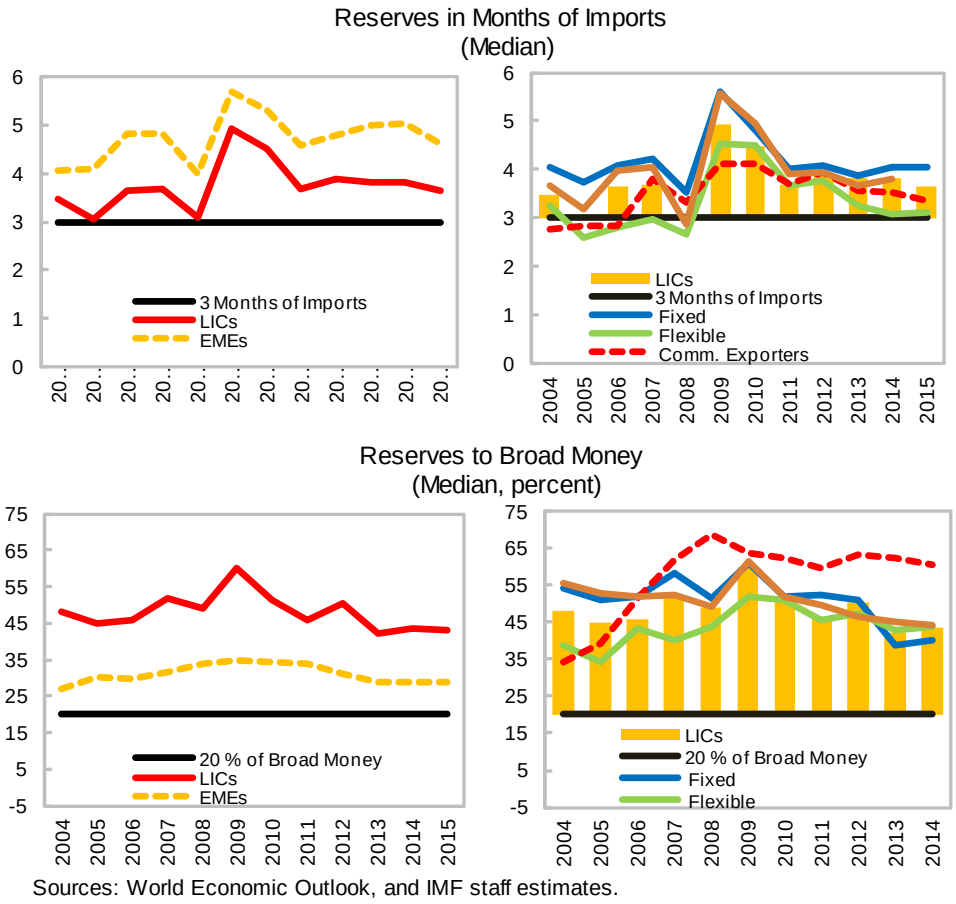
59. Reserve holdings in credit constrained economies are generally higher than suggested by traditional reserve adequacy metrics (Figure 10). The median coverage ratio among LICs was around 3.8 months of imports in 2013, exceeding the traditional three-month rule.[40] Similarly, reserves were equivalent to 42 percent of broad money liabilities in 2013, suggesting that they provide sufficient coverage against resident-based capital flight; 20 percent is a typical upper-bound benchmark.

[40] Coverage ratios differ significantly across countries, however, for example, 5 LICs (about 11 percent of the total LICs for which data is available) have reserves less than two months of imports.

60. While on average credit constrained economies reserve coverage satisfies traditional metrics, pre-crisis reserve buffers have not been fully re-built. In contrast to the sharp build-up in reserves before the crisis, coverage has not kept pace with the surge in imports and broad money liabilities (Figure 10). For example, the median coverage ratio among economies with flexible exchange regimes and frontier markets declined from 4.5 and 5.6 months of imports, respectively, in 2009 to 3.1 and 3.7 months of imports, respectively, in 2013. Broad money coverage among both economies with flexible exchange regimes and frontier markets stood at 44 percent in 2013 down from 52 and 62 percent, respectively, in 2009.

61. While traditional metrics have some value, they are often poorly tailored to country circumstances and can give conflicting guidance. For example, export revenues in resource-rich (RRs) economies can be very volatile, suggesting that they may need reserve levels above the three-month rule due to their higher vulnerability to shocks than the arbitrary three-month rule. Traditional metrics can also provide mixed messages; for example, the import coverage suggests that the Democratic Republic of Congo does not have adequate reserves (1.6 months in 2013 compared to the suggested three month import rule) while the typical broad money benchmark suggests otherwise (at 48 percent of broad money liabilities).

Figure 10. Recent Trends in Reserve Accumulation in LIC



Sources: World Economic Outlook, and IMF staff estimates.

A New Approach for LICs

62. The new approach provides a methodology for assessing reserves that balances the absorption smoothing benefits of reserves in the event of adverse shocks against the opportunity cost of holding reserves.[41] Specifically, it:

- Defines the particular shocks that can lead to balance of payments pressures in credit constrained economies, capturing the motivation for holding reserves for precautionary purposes;
- Emprically examines past country experiences to estimate what may constitute the type of tail-risk shocks against which countries may wish to insure; and
- Estimates the level of reserves that would be sufficient to guard against such shocks by weighing the benefits from being able to smooth domestic absorption in the event of large external shocks against the costs of holding reserves.

The Benefits of Holding Reserves

63. The absorption smoothing benefits of holding reserves in the event of shocks are estimated empirically by examining the impact of reserves on the likelihood and the severity of a crisis. A three-step procedure is employed that involves: (i) identifying large shocks and crisis episodes, (ii) estimating the impact of reserves on the probability of a crisis; and (iii) estimating the role that reserves play in reducing the magnitude of an aggregate demand drop in the event of external shocks.

64. As a first step, large adverse external shocks and associated crisis events are identified from the data. Large external shocks that LICs typically experience are considered, in particular, shocks to: external demand, terms of trade, FDI, foreign aid, remittances and large natural disasters. A shock event is identified if the annual percentage change of the relevant variable falls below the 10^{th} percentile in the left tail of the country-specific distribution. Within the sample of identified shock events, a crisis is defined as a large drop in real aggregate demand (or consumption) per capita. The analysis uses country-specific distributions to better capture heterogeneity across LICs (e.g., with regard to their vulnerability to shocks).

65. The second step involves estimating the impact of reserves on the *likelihood* of a crisis. This is undertaken empirically using a (probit) model that estimates the probability that a large adverse shock leads to a sharp drop in aggregate demand. Reserves and other pertinent country-specific fundamentals are included as explanatory variables.[42]

[41] See ARA (2013) for a detailed discussion of the approach.

[42] A dummy variable to capture for resource-rich countries was also considered. The results suggest that the probability that resource exporters face a demand drop is not different from that of the rest of the sample.

66. The findings suggest that higher reserves are associated with lower probability of a crisis but other factors also help buffer against shocks. The probability of a crisis decreases the stronger the country's fundamentals (e.g., fiscal position). This could reflect greater fiscal space to mount a countercyclical fiscal response which would help on growth, thereby supporting aggregate demand, but could exacerbate balance of payments problems. The exchange rate regime and the presence of a Fund-supported program are also important determinants of the likelihood of crisis, given an external shock.

Probability of a Drop in Aggregate Demand 1/
(Panel Probit Regression, 1990–2007)

Reserves, months of imports	-0.0896*** (0.0339)
Flexible exchange rate regime	-0.3801*** (0.1366)
Government balance, % of GDP	-0.0323*** (0.0125)
CPIA	-0.3090*** (0.1056)
IMF dummy	-0.3021** (0.1409)
Constant	0.8648** (0.3614)
No. of observation	445
R^2 2/	0.11
Country fixed effects	No

Sources: IFS, WEO and IMF staff calculations.
Note: Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10, 5, and 1 percent, respectively.
1/ All variables lagged (t-1), except the IMF dummy.
2/ Pseudo R2 is reported.

67. The third step involves estimating the role that reserves play in moderating the severity of the crisis. This step reflects the fact that reserves not only help in crisis prevention but also play a role in mitigating the consequences of crisis. The magnitude of the drop in aggregate demand is regressed against reserves controlling for country characteristics (RR and exchange rate regime dummies) and the size of the shock. The marginal benefits for holding reserves in RRs is adjusted to take into account the higher absorption losses that these countries tend to face in the event of adverse shocks.

Magnitude of Drop in Aggregate Demand
(Panel OLS Regression, 1990–2007)

	ARA-1 2011 Board Paper	ARA-2 2013 Board Paper
Reserves, months of imports (t-1) 1/	-2.240*** (0.668)	-2.257*** (0.665)
Flexible exchange rate regime (t-1)	-8.698*** (2.169)	-8.624*** (2.173)
External demand growth	-0.932** (0.436)	-1.002** (0.428)
Terms of trade growth	-0.084* (0.048)	-0.086* (0.048)
Change in FDI to GDP	-0.016 (0.339)	-0.023 (0.336)
Change in aid to GDP	0.053 (0.084)	
Resource-rich		5.017* (0.969)
No. of observation	418	420
R^2 2/	0.34	0.43
Country fixed effects	Yes	Yes

Sources: IFS, WEO and IMF staff calculations.
Note: Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10, 5, and 1 percent, respectively.
1/ Log of reserves in months of imports is used.
2/ Adjusted R2 is reported for OLS.

68. The findings confirm the effectiveness of reserves in mitigating the domestic effects of external shocks but other factors also affect vulnerability to a crisis. In particular, the domestic impact of external shocks is larger in RRs due to their dependence on commodity revenues. Similarly, the findings suggest that economies with fixed exchange rate regimes need substantially higher reserve levels than those willing to let the exchange rate act as a shock absorber.

The Cost of Holding Reserves

69. Conceptually, the cost of holding reserves can be analyzed from a narrow perspective focusing on the actual financial costs incurred by the monetary authorities in acquiring reserves or a broader economy-wide view. Three approaches are proposed for determining the cost of holding reserves, not all relevant for all LICs:

- *The external funding cost for these economies beginning to access capital markets*, net of the estimated return earned on foreign assets held as foreign reserves.
- *The sterilization cost that the central bank incurs when it purchases foreign exchange from the market, for these economies with more developed financial markets,* netted against the return earned on foreign reserve assets. Comparing an interest cost denominated in domestic currency

with the rate of return on foreign assets held as reserves requires some adjustment to account for exchange rate risk.

- *The opportunity cost to the economy as a whole of devoting investible resources into holdings of liquid foreign financial assets*. In this case, the marginal productivity of capital (MPK) provides an estimate of the potential returns on foregone physical investment less the returns earned on liquid foreign assets (see Box 5 in ARA, 2013). In some cases where the state has command of significant resources held in foreign currency at the central bank-including several RRs—the opportunity cost of holding reserves can be viewed as the marginal productivity of public investment (since government see the choice as increasing reserves by one unit versus decreasing public investment by the same amount).

70. Measuring the cost of holding reserves is challenging in part due to the difficulty in choosing and quantifying an appropriate proxy for these approaches. Thin, distorted, segmented markets diminish the informational importance of interest rates as measures of economic costs.

71. Three proxies for the cost of holding reserves are suggested, specifically:

- *The yield on sovereign borrowing* is a useful proxy for the external cost, for countries with limited market access. It is a market-based indicator which also captures the sovereign risk.[43]

- *The return on the most liquid longer-term government bonds adjusted for exchange rate risk* provides a good proxy for the sterilization cost for countries with liquid government securities markets.

- *The marginal product of capital* is a useful proxy for capturing the opportunity cost of foregone fixed investment (MPK), in cases where financial markets are thin or underdeveloped. It depends essentially on investment as a percent of GDP, output, the depreciation rate, and the share of capital stock. The MPK (public capital) could be a useful indicator for RRs, but measurement and data issues could preclude country-specific estimates.

72. The marginal cost of holding reserves is obtained by netting off the return on reserve assets. Central banks have traditional invested in short-term bank deposits and government securities and typically earn a return on their foreign exchange claims. However, in recent years, these asset returns have turned negative in real terms.[44] The return on foreign exchange claims is estimated as the highest interest that could be earned from holding either government debt

[43] See IMF (2013b) for a discussion of some of the potential biases.

[44] See ARA (2013) for a more detailed discussion.

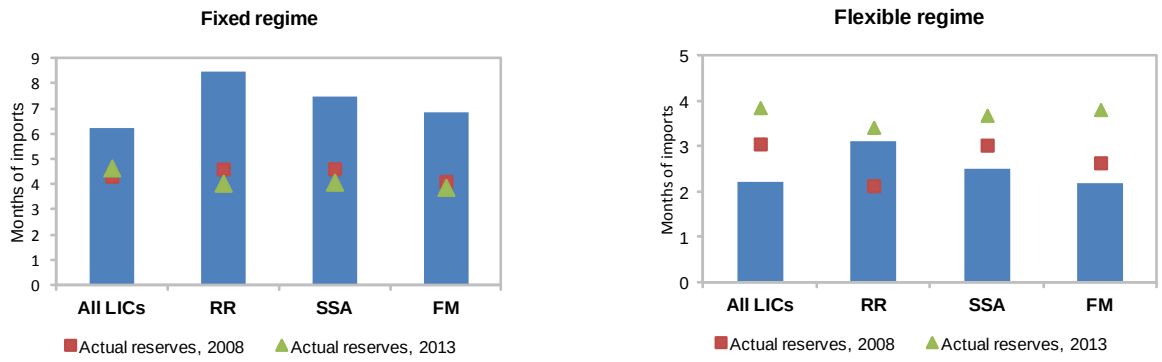
security of foreign bank deposits for the constituent currency. The marginal cost of holding reserves ranges from around 4 to 6 percent using alternative cost proxies.[45]

Determining the Adequate Level of Reserves

73. The estimated results for individual countries suggest that there is scope to raise reserve levels in a sizeable number of LICs that have fixed exchange rate regimes (Figure 11). These results are intended to be illustrative rather than to provide firm policy prescriptions.

74. Since LICs tend to be quite heterogeneous, to capture the differences in reserve need, the adequate levels are calibrated for RRs, frontier markets, and SSA sub-groups (Figure 11)**.** The adequate level of reserves is higher for fixed exchange rate regimes due to their greater vulnerability to shocks. The adequate level of reserves for frontier markets is relatively lower than for other sub-groups; on the one hand their cost of holding reserves is lower due to their access to capital markets but their institutions are generally stronger and exposure to shocks is smaller. In general, the adequate level of reserves for RRs is higher than for other sub-groups as they face a more adverse domestic impact of external shocks.

Figure 11. LICs: Illustrative Calibration of Adequate Level of Reserves



Sources: IMF staff calculations.
1/ Country groupings are as follows: RR = Resource-rich exporters, SSA = Sub-Saharan Africa, and FM=Frontier Markets. The FM grouping excludes RRs.
2/ The calculation assumes access to Fund support following a shock.

Application to LICs

75. Judgment is required in applying this metric to LICs. The findings from a LIC country team survey called for customizing the approach to country circumstances, given the diversity of economic and financial structures across countries.[46] Findings point to the need for a structured approach to considering adjustment of various parameters and also further operational guidance for using the metric. LICs with market access could supplement the reserve adequacy results with the

[45] See ARA (2013) for a more detailed discussion.

[46] See ARA (2013) Supplement for a discussion.

EM-type metric as it captures capital flight risks. As the methodology focuses exclusively on the precautionary motive for holding reserves and assumes risk neutrality, countries may need to hold higher reserves than indicated.[47]

Proposal: Low-Income and Credit Constrained Economies have a low share of non-concessional debt, as a result the sources of liquidity drains (mainly sudden stops for portfolio investment) are likely to differ from those in many EMs. The proposed approach for assessing the adequate level of reserves involves balancing the benefits from holding reserves in terms of both crisis prevention and mitigation against the opportunity cost of holding reserves, focusing on the precautionary motive for accumulating reserves. The approach is a complement to existing approaches, including traditional approaches like the three-month import rule and could be used in Article IV Consultations. LICs with market access could supplement the reserve adequacy results with the EM-type metric as it captures capital flight risks.

V. COST OF RESERVES FOR COUNTRIES WITH MARKET ACCESS

76. As noted earlier, reserves can be a costly form of self-insurance, making understanding their cost a relevant input into the decision on the size of reserves to hold. Estimates of the cost of reserves generally comprise two main components: (i) the foregone return on an alternative use/asset of the local authorities or the cost of issuing paper for sterilization; *less* (ii) the foreign currency return on reserves (Hauner, 2005).[48] For the first component, indicators identified in the literature include external debt servicing cost (pointing to the opportunity cost of retiring debt), [49] the social opportunity cost of public capital,[50] and sterilization cost.[51] Each of these approaches can be relevant in different circumstances.

77. Where reserves are inadequate or barely adequate, the marginal cost of financing their accumulation would seem relevant. These costs could be either the cost of borrowing reserves, or the cost of sterilizing the intervention to acquire them. When reserve levels are relatively low,

[47] For example, countries that include savings held for future use as part of foreign reserves (e.g., some RRs) could consider targeting higher levels.

[48] Hauner (2005) also suggests that the opportunity cost of future sterilization for additional reserves could be included, although he notes the data to calculate this is generally not available.

[49] Rodrik (2006) proposes a different measure of external debt servicing cost, which incorporates private sector having a net open position in foreign currency.

[50] Due to the methodological difficulties with estimation precision, most papers make "heroic assumptions," such as using the return on domestic government bonds as a proxy (Hauner 2005).

[51] As sterilization involves the central bank exchanging high-yield domestic paper for low-yielding reserves, an appropriate measure of the quasi-fiscal costs of sterilization is estimated by the difference between the return on longer term US Treasury bonds and domestic yields. Typically the relevant domestic yield is a short tenor one, since many central banks issue short-term paper for this purpose.

alternatives to accumulation are less relevant, but the quasi-fiscal cost of sterilizing the accumulation can be high (Calvo 1991).[52] These costs would include the anticipated exchange rate valuation losses. ARA (2012) argued that sterilization can become increasingly costly, as domestic public debt increases. Higher public debt, including that associated with sterilization, raises the spread between yields on domestic long-term sovereign bonds and yields on US bonds in EMs.[53] This is in line with past Fund studies. In fact, increasing marginal quasi-fiscal costs as sterilization-related debt rises is a partial reason why sterilization efforts are often temporary during episodes of capital inflows (IMF 2007).

78. Where reserves are ample, the "net financing" or opportunity cost would be a suitable measure of the cost of reserves. Specifically, the net financing cost can be defined as the difference between the local yield of reserves and the return on reserve assets, adjusting the country's yield for the fact that higher reserves may reduce these yields as they reduce risk. This measure is designed to reflect opportunity cost of holding reserves, and can be tailored to country circumstances.

- For market access economies with high externally issued foreign currency debt, the use of the external FX denominated yield is a relevant opportunity cost measure, reflecting the opportunity cost of partially retiring this debt. As argued by Levy Yayati (2008), this measure can be proxied by the EMBI spread less the endogenous impact of higher marginal reserves in lowering spreads.[54] ARA (2011) found that while the impact of reserves on lowering the marginal cost of reserves had been significant in the past, for the median EM, the rise in reserve holdings in recent years had essentially eliminated this effect. That is, there had been a general convergence of the net financial cost measure with the EMBI spread.[55]

- For market access economies with adequate reserves and local currency debt which could be retired, a local currency bond yield is a commonly used proxy. This reflects the opportunity cost of the government retiring local currency debt or using the savings for a project they would have otherwise borrowed for.

- The cost of reserves is lower for mature market countries than countries with still deepening financial markets (Figure 12). This reflects that mature market sovereigns generally have

[52] Central banks also sterilize foreign exchange purchases by issuing central bank bills, or by reverting to non-market based intervention such as increasing the reserve requirement ratio.

[53] See discussion in the cost of reserves in the ARA (2013) and Chapter 8 in Supplementary Information of the ARA (2013). Other costs of large stocks of sterilized reserves discussed in the literature, which we do not address here, include their distortionary effect on the domestic banking system and subsequently on the real economy. This occurs through crowding out of banks' lending activity either due to their holding of large stocks of government debt, or to their facing of higher reserve requirements when non-market based intervention is used (Lavigne 2008; Cook and Yetman 2012).

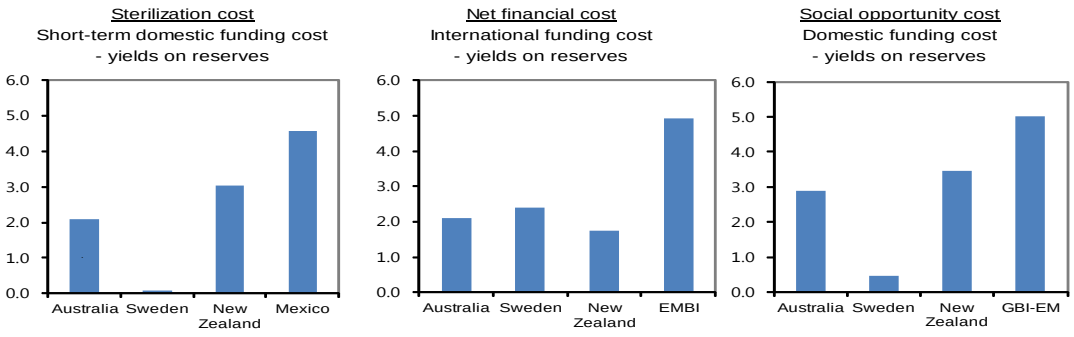
[54] This effect is not statistically significant for advanced economies.

[55] The yield would be adjusted to count any anticipated FX depreciation, and could be in line with the expected exchange rate path in the Article IV.

relatively lower funding costs in both foreign and domestic currencies than less mature markets while the return earned by reserve assets is equal.

- For credit constrained economies going market access (frontier economies), its external financing cost—the cost of holding reserves—could be approximated by the yield on a sovereign bond, capturing sovereign risk. Although this indicator could be biased in such economies,[56] the markets over time would reflect these factors in the sovereign risk premium if sovereign bonds are tradable. In cases where frictions prevent such corrections in the sovereign bond market, then a cross-country currency interest rate swap could be used.[57]

Figure 12. Measuring the Cost of Reserves



Sources: Bloomberg, IFS and IMF staff calculations.
1/ Yields on reserves are the average interest on 3-month US T-bill and 2-year US treasury bond.
2/ Domestic funding cost is the interest on 3-month domestic bill.
3/ International funding cost is the interest on USD denominated international government bonds maturing between 2015 and 2017 for AMs and JP Morgan EMBI Global for EMs.
4/ Social cost is the spread between yields on reserves and 2-year domestic government bonds for AMs and JP Morgan GBI-EM for EMs.

Proposal: Sterilization and yield-based opportunity costs provide useful measures of the marginal cost of reserves. The chosen measure should reflect country circumstances, including the adequacy of reserves, the alternative use of reserves, and the level of exchange rate compared to its fundamentals.

- The cost of acquiring reserves (e.g., sterilization or borrowing costs) would seem most appropriate for countries with low reserve holdings.
- The net financial (opportunity) cost would be relevant for counties with market access and adequate reserves. Depending on the composition of public debt, the cost may be appropriately measured through either local or foreign currency yields, counting the anticipated depreciation (consistent with the external sector assessment). If the gains have not been exhausted the marginal impact of reserves on spreads could be reflected.

[56] For example, it could be biased downward if sovereign borrowing is collaterized or securitized by future commodity-revenues or guaranteed by a strong donor. Also, it could be biased upward if the government debt and probability of default are high. The impact of high default probabilities on the sovereign risk premium would be captured in the benefits of holding reserves. See Levy Yeyati (2008) and Jeanne and Ranciere (2006) for details.

[57] This provides an estimate of the interest rate that banks are willing to take to enter into a cross-currency swap with another bank or client to exchange the local currency for a foreign currency during the tenor of contract.

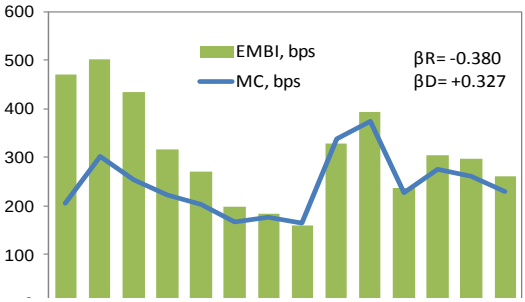
Box 5. Costs of Reserves Accumulation: Feedback Effects from Higher Reserves to Lower Yields

For countries with market access accumulating reserves through the issuance of external foreign currency debt, the "cost of carry" or net financial cost of reserve accumulation could be overstated if the effect of reserves on lowering sovereign spreads is not taken into account. Levy-Yeyati (2008) derives the external financing cost of reserve accumulation as a function of sovereign spreads, the reserves to debt ratio *(w)*, and the elasticities of debt and of spreads with respect to changes in reserve levels:

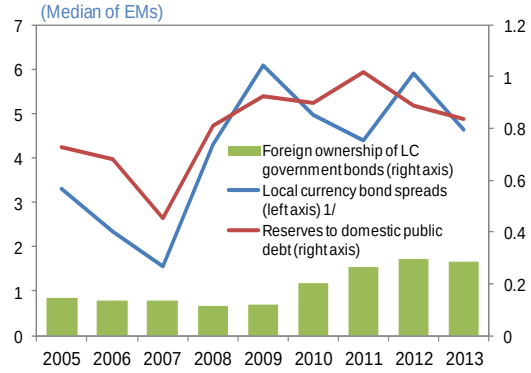
$$MC = EMBI * (1 + \frac{\beta R}{w} + \beta_D)$$

Extending the cost analysis of Levy-Yeyati (2008) from ARA (2011), we estimate these elasticities for EMs with a regression of EMBI spreads on its determinants, including debt and reserves levels. [1/] With homogeneous estimated elasticities across EMs, the level of reserves relative to debt determines reserve costs relative to EMBI spreads. For the median EM in the first half of decade, when reserves were low relative to debt, the returns on reserve accumulation were high and thus the marginal cost of accumulation was lower than what EMBI spreads would suggest. While this trend reversed over time as reserves more than covered debt, the costs of reserve accumulation declined after the Global Financial Crisis (GFC) as the reserve-to-debt ratios worsened.

EMBI Spreads and Marginal Cost of Holding Reserves, 2000–13 (median values)



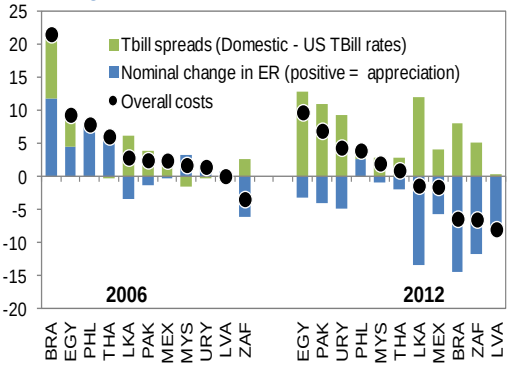
Measures of Return on Domestic Investment
(Median of EMs)



Sources: Bloomberg, IFS and IMF staff calculations.
1/ Local currency bond spreads are the difference between 5-year local currency bond yield and 5-year US treasury bill rates

With no good measure of return on domestic investment, local currency bond yields are often used as proxy for the social opportunity cost of reserves accumulation. Since the GFC and as foreign ownership of local currency bonds increased, increases in the ratio of reserves to domestic public debt were associated with decreases in LC spreads.

Changes of Reserves Valuation



Sources: Bloomberg, IFS and IMF staff calculations.

Accommodative policies in advanced economies have increased quasi-fiscal costs in EMs, but reserves valuation gains have offset rising spreads. Prior to the GFC, spreads between short-term domestic T-Bill and US T-Bill rates were positive but low, and have significantly increased after the crisis. However, currency depreciation against the dollar for instance in 2012 in some EMs more than offset rising spreads, significantly lowering costs. With frequent exchange rate swings, revaluation losses/gains would be a significant part of cost of reserves, and the expected rise in yields as monetary policy normalizes in the US will likely lower costs.

[1/] This impact is not significant for advanced economies.

VI. ISSUES FOR DISCUSSION

79. This paper seeks to advance Fund's work on the assessment of reserve adequacy in bilateral surveillance. In this regard, the paper proposes a methodology for classifying countries for reserve adequacy purposes, and puts forward specific proposals for the coverage of reserve adequacy issues in Fund surveillance reports.

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

- Do Directors agree that there should be flexibility in the assessment of reserve adequacy in Article IV reports, tailoring the depth and emphasis of the discussion to a country's characteristics and circumstances?

- Do Directors agree that where reserve adequacy issues are important for a country's external stability and/or global stability, Article IV reports should include a discussion of the considerations underpinning reserve holdings, including precautionary and non-precautionary motives, and the cost of reserves?

- Do Directors prefer reserve adequacy to be assessed along the lines of the standard per-capita income classification or see merit in adopting the maturity-based classification developed in this paper?

- Do Directors agree that mature economies (advanced economies) need precautionary foreign currency buffers to prevent the risk of disorderly markets? Do Directors view that scenario analysis offers an appropriate tool to assess these countries potential reserve needs?

- Do Directors agree that reserve adequacy discussions in economies with deepening financial markets (emerging market countries) should be based on a range of relevant indicators, including the ARA EM metric, supplemented where needed by country specific analysis? Do the proposed adjustments of the ARA and other metrics for commodity intensive economies and for countries with CFMs capture the general characteristics of these economies?

- Do Directors agree with the framework for assessing reserve adequacy in countries with limited market access (low income countries)?

- Do Directors continue to see the preparation of a guidance note to staff on reserve adequacy issues, in line with the Management implementation plan (IMF, 2013d), as useful?

Annex I. Can Relative Reserve Holdings Affect Currency Crisis Probabilities in EMs?

1. The role of international reserves in reducing crisis probabilities is one of the pillars justifying their acquisition. However, this seems to reflect their role as a liquidity buffer against potential vulnerabilities rather than reserve holdings per se. It is often said that *relative* reserve holdings could be an important driver of crisis probabilities. This view would be consistent with the apparent pattern of "reserve accumulation competition" often seen between countries (Bastourre et al. 2009), which is not derived from the precautionary motives to hold reserves.

2. The crisis probability regression model used in the ARA (2013) is used here to investigate the effect of relative reserve holding on crisis likelihood, controlling for other fundamentals. The sample extends from the 1980s. In order to capture the effect of reserve holdings relative to peers on crisis probabilities, a cross term of international reserves and a dummy which has the value one when a country's international reserve is higher than its regional peers (or in specification 3, 1.5 times). If the coefficient is positive, it indicates the higher relative reserves, the smaller marginal impact of international reserves on crisis probability.

3. Relative reserve holdings do not seem a key determinant of private agents' decisions to remain invested in a country. In estimated regressions, the cross term of international reserves and a dummy which has value one when reserves are higher than its regional peers has a positive sign although it is not statistically significant (see Table). The cross term becomes statistically significant when the threshold for the dummy is switched to 1.5, although the sign of the coefficient suggests the beneficial marginal impact of reserves is reduced by such high reserve holdings. The result suggests that the marginal benefits of accumulating reserves become smaller as the level of reserves relative to regional peers increases.

Crisis Probability Regression

	(1)		(2)		(3)	
	coef	t-stat	coef	t-stat	coef	t-stat
Net debt assets	-0.016	-0.029	0.052	0.091	0.138	0.235
Net portfolio equity assets	-3.048*	-1.778	-2.882*	-1.675	-3.461*	-1.958
Net direct investment	2.222**	2.384	1.987**	2.147	2.019**	2.099
International reserves over GDP	-6.192***	-2.717	-7.664***	-3.355	-8.316***	-3.202
Ratio of reserves over GDP to regional peers					0.703**	2.384
Relative per capita GDP (PPP)	0.036	0.032	-0.084	-0.072	0.179	0.156
Current account balance	-4.253*	-1.701	-3.741	-1.536	-4.553*	-1.686
REER gap	1.339*	1.700	1.336*	1.703	1.341*	1.693
VIX	5.600***	3.000	6.081***	3.180	6.805***	3.341
Fiscal balance gap	-9.086**	-2.199	-9.057**	-2.191	-9.478**	-2.275
International reserves (over GDP)*dummy (=1 if reserve is higher than regional peers)	1.815	0.974				
International reserves (over GDP)*dummy (=1 if reserve is higher than 1.5*regional peers)			4.226**	2.143	-1.648	-0.629
Constant	-2.280***	-4.566	-2.251***	-4.401	-2.767***	-4.887
Number of samples	860		860		860	
Log-Likelihood	-109.23		-107.39		-106.65	
Psedu-R square	0.119		0.125		0.124	

Sources: Bloomberg, IFS, WEO and IMF staff
Note: *** indicates p-value <0.01, ** indicates p-value <0.05, and * indicates p-value <0.1.

Annex II. Capital Control Measures—What Do They Show?

1. There are several alternative measures for capital controls, but none is perfect. The two principal types of measures are (i) *de jure* measures which reflect the laws and regulations governing controls; and (ii) *de facto* measures attempting to capture the stringency of controls (Box 2). The latter is a difficult task: while there are several *de facto* control measures (IMF 2012), they bear little relation to measures of legislated controls and thus seem more directly a measure of financial openness rather than controls on capital accounts.

2. Despite some drawbacks, *de jure* indicators are still useful to provide information on *relative* openness and restrictiveness of capital accounts across countries. The Chinn-Ito, Quinn, Schindler[1] and IMF share (compiled by the IMF's Monetary and Capital Markets Department[2]) indices are widely used *de jure* measures of capital controls. For all indicators, the primary source of information is the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER), based on inputs from country authorities. While the Chinn-Ito index uses information in the AREAER's summary table, other three indicators draw on more detailed information provided in the AREAER's text but in different ways, suggesting that they can measure controls on inflows and outflows separately. Despite the various differences in approach and construction of the indices, they show very strong correlation (around 0.8). This indicates much agreement on the relative openness and restrictiveness across countries for any given year. Since disaggregated item-by-item information in the AREAER is binary (i.e., "yes" or "no" on existence of restrictions), gradual liberalization efforts (such as gradually adjusting thresholds) may not cross thresholds compared to other countries if the reforms are regarded as not broad and deep as those found in other country settings. This tendency may make some of the indicators less time variant—in particular, the Quinn index, because its score is highly discrete.[3]

3. While there are several *de facto* indicators, they seem to bear little relation to legislated controls. External assets and liabilities (Lane and Milesi-Ferretti index) and portfolio investment assets and liabilities are some of possible *de facto* indicators (IMF, 2012).[4] In theory, *de facto* measures should measure capital controls better than *de jure* because they could measure the

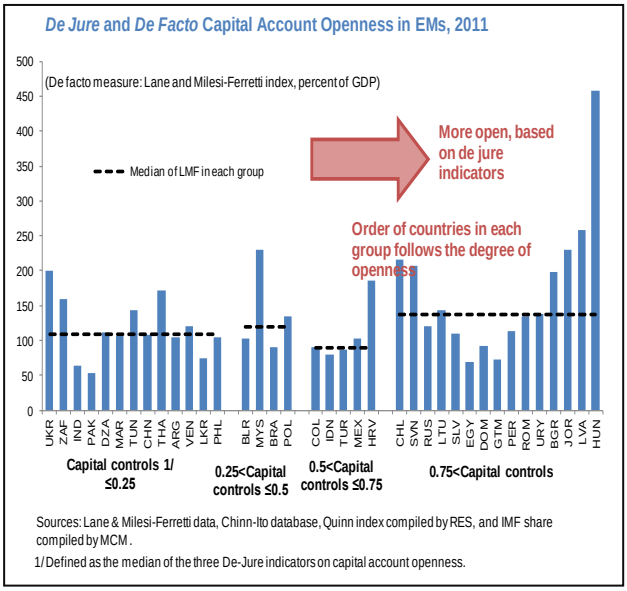
[1] Unfortunately, the Schindler index is available only up to 2005, while an update is expected to be available in 2014. Therefore, it is not used in this paper.

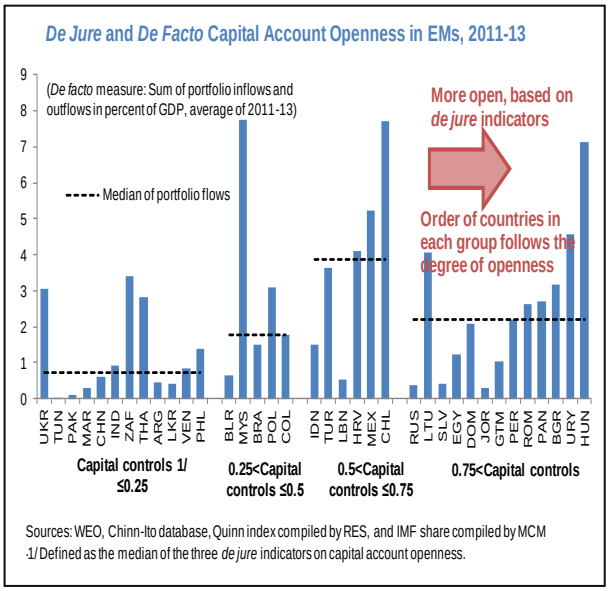
[2] See IMF (2012).

[3] The Quinn index can take only 5 values: 0, 0.5, 1, 1,5 and 2, where large number indicates less controls.

[4] The measure based on financial flows (depicted in the right hand chart) was constructed for this paper in respose to suggestions from Directors in past Board discussions.

strength of capital controls in ways that *de jure* indicators cannot. However, these *de facto* indicators appear to bear little relation to measures of legislated controls (text figures below), which should form the basis of any measures. Instead, they seem more directly a measure of financial openness rather than controls on capital accounts. This may reflect that these *de facto* measures tend to be affected by factors other than capital controls such as the degree of financial development, financial depth, the country's risk premium, access to international markets (concessional as well as non-concessional), and global financing conditions.





Annex III. Probit Model to Examine Impact of Capital Controls on Outflows

1. A (probit) model is used to identify the impact of capital controls on a probability of heightened exchange market pressure event, controlling for global factors and country-specific fundamentals (reserves, fiscal policy, net foreign assets, current account balance, per capita income, exchange rate misalignment) and *de jure* capital controls. A two-step estimation procedure is applied to control for the potential endogeneity of controls.

2. While the sample with capital controls is limited, empirical evidence supports the general conclusion that stricter controls, measured by *de jure* measures, mitigate the impact of exchange market pressure (EMP). In particular, we estimate a probit model[1] explaining periods of exchange market pressure and find that capital controls, along with vulnerability measures, explain its likelihood.[2] Imposing capital controls could reduce EMP probabilities against some exogenous shocks. Probit model regression on the probability of EMP events against factors widely used in the context of currency crisis probabilities (net external asset position, international reserves, VIX, fiscal balance etc.) suggests that strengthening capital controls (from 0.75 to 0.50 index points)[3] could reduce the marginal impact of lower international reserves, higher uncertainty and more deteriorated fiscal balance on the EMP probabilities by more a half, as shown in the presentation.

Impact of Changes in Variables on Exchange Market Pressure Events
(Increase in EMP event probability, percentage points)

	Capital controls level	
	0.50	0.75
One standard deviation change in		
International reserves	4.0	8.9
VIX	5.3	12.1
Fiscal balance	2.2	5.8

Sources: IFS, Bloomberg, WEO and IMF staff calculations.

Probit Model on Exchange Market Pressure Events

	(1)		(2)	
	coef	t-stat	coef	t-stat
Capital controls	5.956***	5.343	5.763***	4.934
Net debt assets	0.398	1.242	0.218	0.639
Net portfolio assets	-0.085	-0.092	-0.488	-0.501
Net FDI position	1.759***	3.861	1.826***	3.708
International reserves	-1.811***	-2.597	-1.688**	-2.312
Relative per capita GDP (PPP)	-0.266	-0.353	-0.233	-0.284
Current account balance	0.589	0.442	0.452	0.324
REER gap	-0.068	-0.165	0.207	0.414
VIX	5.168***	5.828	5.065***	5.442
Fiscal balance gap			-5.434**	-2.361
Constant	-4.588***	-7.351	-4.561***	-6.994
Number of observations	844		813	
Log likelihood	-429.21		-403.40	
Psedo R-squared	0.071		0.077	

Sources: WEO, IFS, IIP, Milesi-Ferretti and Lane database, INS, and IMF staff estimates.
Note: *** p<0.01, ** p<0.05, * p<0.1

[1] For details on the model, see Chapter 1 in the Supplementary information in the ARA (2013).

[2] Since the degree of capital controls may be an endogenous variable, it is instrumented by exogenous variables (lagged variables in regressors other than capital controls are used as instrumental variables) since they may be thought to enter into the decision to implement capital controls. Variables other than capital controls are one year lagged. The probit is estimated by panel regression with controlling time factors.

[3] For Quinn index, this corresponds to a change from "approval is not required and receipts are heavily taxed" to "approval is required and frequently granted." As for IMF share, this is equivalent to a change in the share of restricted transactions from 75 percent to 50 percent.

Annex IV. Commodity Intensity and Price Sensitivity

To capture the impact of price shocks on commodities-intensive economies, we run a set of panel data regression models of export and import volumes' growth as a function of commodities prices' changes, controlling for a set of macroeconomic indicators. These indicators include trading partners' demand growth, domestic demand growth, real effective exchange rate changes, an indicator of commodities-intensive economies, and an interactive variable composed of the commodities-intensive indicator times the commodities prices' changes. The sample includes annual observations for 36 emerging markets during the period from 1989 to 2013. Due to the paucity of data on volumes of each commodity transacted, in these panel data regressions we use fuel as the main proxy for commodities-dependence.[1] Due to the lack of information on volumes, we compute fuel volumes for each country/year based on identified gross trade flows (in US$) from the WITS/UN Comtrade database and the average of three spot prices (Dated Brent, West Texas Intermediate, and the Dubai Fateh) from the WEO/GEE database.

For commodities exporters, statistical tests (e.g. Hausman specification tests) broadly favor the use of random effects specification relative to the fixed effects one. Following that approach, our results indicate that the price elasticity of fuel exports is relatively small in this sample of emerging markets (around -0.17), and statistically zero for the subset of countries with the bulk of export proceeds coming from oil exports (text table).

The price elasticity is slightly larger (about -0.31) for the sample of importers than for the sample of exporters above described. However, controlling for the interactive effect (i.e. being a commodity-intensive importer times the price change) offsets most of that impact (+.27), resulting in a price sensitivity that is of a statistically negligible amount (text table).

These econometric results suggest that, once we control for relevant macroeconomic variables, the trade volumes of commodities-intensive economies present much lower sensitivity to price shocks than those of peers.

EMs: Panel Data Regressions on the Sensitivity of Fuel Export Volumes to Fuel Prices, 1989–2013 [1/]

Dependent variable: Fuel export volume growth (annual average, in percent)	(1)	(2)	(3)	Fixed Effects	Random Effects
Fuel price changes (annual average, in percent)	-0.0887**	-0.145***	-0.133***	-0.167***	-0.172***
	(0.0379)	(0.0427)	(0.0435)	(0.0487)	(0.0485)
Trading partners' demand growth (annual average, in percent)		0.464***	0.475***	0.468***	0.474***
		(0.165)	(0.170)	(0.171)	(0.170)
REER changes (annual average, in percent)			0.0310	0.0536	0.0598
			(0.107)	(0.109)	(0.108)
Fuel exporters' dummy times fuel price changes (annual average, in percent)				0.157*	0.164*
				(0.0914)	(0.0912)
Fuel exporters' dummy					2.035
					(4.523)
Constant	1.489	-1.235	-1.354	-0.395	-1.772
	(1.867)	(2.117)	(2.189)	(1.410)	(2.379)
Observations	698	698	676	676	676
R-squared	0.01	0.02	0.02	0.02	0.02

Sources: GEE, VEE, WEO and IMF staff calculations.
1/ Random effects models unless specified. Standard errors in parentheses. The symbols * , **, and *** indicate that parameter estimates are statistically significant at 10, 5, and 1 percent, respectively.

EMs: Panel Data Regressions on the Sensitivity of Fuel Import Volumes to Fuel Prices, 1989–2013 [1/]

Dependent variable: Fuel import volume growth (annual average, in percent)	(1)	(2)	(3)	Fixed effects	Random effects
Fuel price changes (annual average, in percent)	-0.221***	-0.252***	-0.275***	-0.315***	-0.313***
	(0.037)	(0.041)	(0.043)	(0.047)	(0.047)
Real domestic demand growth (annual average, in percent)		0.407**	0.350	0.152	0.351
		(0.205)	(0.222)	(0.232)	(0.222)
REER changes (annual average, in percent)			0.315***	0.365***	0.322***
			(0.120)	(0.123)	(0.120)
Fuel importers' dummy times fuel price changes (annual average, in percent)				0.320***	0.274**
				(0.123)	(0.132)
Fuel importers' dummy					-0.273
					-3.594
Constant	9.683***	8.347***	8.427***	8.784***	8.046***
	(1.102)	(1.484)	(1.617)	(1.652)	(1.719)
Observations	1,119	952	853	853	853
R-squared	0.03	0.04	0.05	0.06	0.06

Sources: GEE, VEE, WEO and IMF staff calculations.
1/ Random effects models unless specified. Standard errors in parentheses. The symbols *, **, and *** indicate that parameter estimates are statistically significant at 10, 5, and 1 percent, respectively.

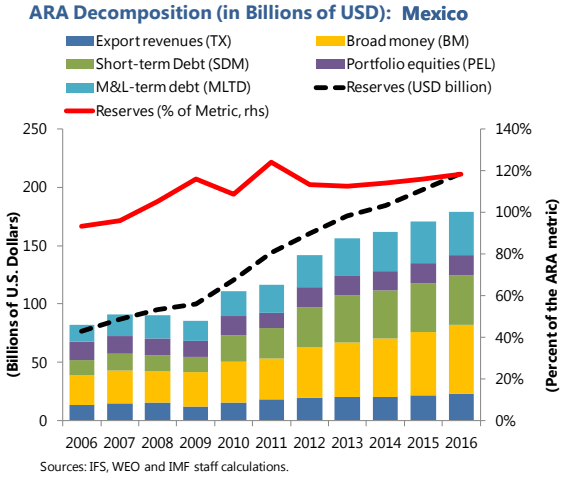
[1] Country and time coverage are based on data availability. Due to the lack of information on quantities of oil traded, we compute fuel volumes for each country/year based on identified gross exports and imports flows (in US$) from the WITS/UN Comtrade database and the average fuel price from the WEO/GEE database. The commodities-intensive indicators are based on the share of traded fuel in total trade flows.

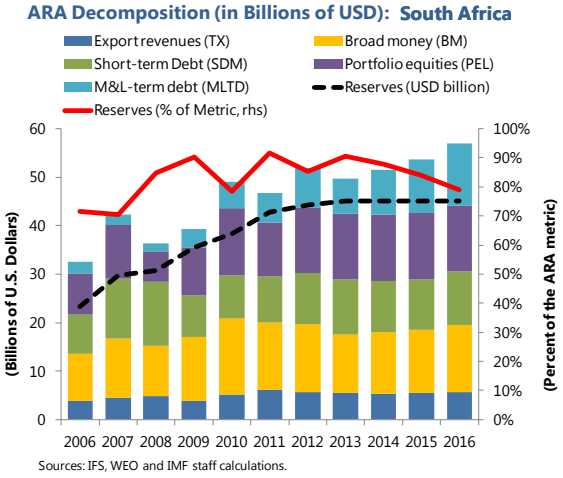
Annex V. Dynamic Reserve Assessment

1. To better capture evolving risks and the build-up of external vulnerabilities, we propose a forward-looking approach to assess reserve adequacy. The approach consists on taking into consideration not only a country's current reserve position metric, but also to evaluate relevant metrics in light of the expected path of the reserves and the key risks. It is illustrated here using the ARA metric. The main advantage of such scheme is its forward-looking.

2. The dynamic ARA metric relies on desks' projections of its main components. For instance, the projections on changes in the foreign exchange reserves, short-term debt, broad money, and exports could be taken directly from the latest WEO, while the projections on portfolio equity and medium- and long-term debt could be constructed based on the latest available international investment position data and the WEO projections on the balance-of-payment flows pertaining to these transactions (assuming no valuation changes).

3. Applications to Mexico and South Africa is shown below. For most emerging markets their relative position vis-à-vis the IMF adequacy metric does not change in the projection period, although there are changes for some because of projected changes in international reserves (e.g. Mexico), or projected movements in the country-specific components of the ARA EM metric (e.g. South Africa). This type of forward-looking diagnostic could serve as an important surveillance tool for policy discussions with country authorities.





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