

## **International Reserves, Exchange rates, and Monetary Policy –**

### **From the Trilemma to the Quadrilemma**

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USC and the NBER

The open-economy Trilemma, vintage 1960s

Open-economy Trilemma developments post-Bretton Woods system

OECD countries transitioned to greater exchange-rate flexibility and financial integration

The formation of the Eurozone created a new global currency

Emerging Markets convergence to the Trilemma's middle ground

Explaining the changing patterns of hoarding and using international reserves by emerging markets

Testing the modern version of the Trilemma: the open economy Quadrilemma

Quadrilemma, Trilemma or Dilemma?

Financial stability and OECD's crises, swap lines, and future challenges

References

Further Readings

### **Summary**

The links of International Reserves, Exchange rates, and Monetary Policy can be understood through the lens of a modern incarnation of the “impossible trinity” (aka the “Trilemma”), based on Mundell-Flemings’s hypothesis that a country may simultaneously choose any two, but not all, of the following three policy goals: monetary independence, exchange rate stability, and financial integration. The original economic Trilemma was framed in the 1960s, during the Bretton Woods regime, as a binary choice of two out of the possible three policy goals. However, in the 1990s and 2000s, emerging markets and developing countries found that deeper financial integration comes with growing exposure to financial instability and the increased risk of “sudden stop” of capital inflows and capital flight crises. These crises have been characterized by exchange rate instability triggered by countries’ balance sheet exposure to external hard currency debt—exposures that propagated banking instabilities and crises. Such events have frequently morphed into deep internal and external debt crises, ending with bailouts of systemic banks and powerful macro players. This resultant domestic debt overhang led to fiscal dominance and a reduction of the scope of monetary policy. With varying lags, these crises induced economic and political changes, in which a growing share of emerging markets and developing countries converged to “in-between” regimes in the Trilemma middle range— i.e., managed exchange rate flexibility, controlled financial integration, and limited but viable monetary autonomy. Emerging research has

validated a modern version of the Trilemma: that is, countries face a continuous Trilemma trade-off in which a higher Trilemma policy goal is “traded off” with a drop in the weighted average of the other two Trilemma policy goals. The concerns associated with exposure to financial instability have been addressed by varying configurations of managing public butters [international reserves, sovereign wealth funds], as well as growing application of macro-prudential measures aimed at inducing systemic players to internalize the impact of their balance sheet exposure on a country’s financial stability. Consequently, the original Trilemma has morphed into a Quadrilemma, wherein financial stability has been added to the Trilemma’s original policy goals. Size does matter, and there is no way for smaller countries to insulate themselves fully from exposure to global cycles and shocks. Yet successful navigation of the open economy Quadrilemma helps in reducing the transmission of external shock to the domestic economy, as well as the costs of domestic shocks. These observations explain the relative resilience of emerging markets—especially in countries with more mature institutions—as they have been buffered by deeper precautionary management of reserves, and greater fiscal and monetary space.

We close the discussion noting that the global financial crisis, and the subsequent Eurozone crisis, have validated that no country is immune from exposure to financial instability and from the modern Quadrilemma. However, countries with mature institutions, deeper fiscal capabilities, and more fiscal space may substitute the reliance on costly precautionary buffers with bilateral swap lines coordinated among their central banks. While the benefits of such arrangements are clear, they may hinge on the presence and credibility of their fiscal backstop mechanisms, and curbing the resultant moral hazard. Time will test this credibility and the degree to which risk-pooling arrangements can be extended to cover the growing share of emerging markets and developing countries.

**Keywords:** The impossible trinity, international reserves, financial crises, financial stability, swap lines, debt and banking crises, balance sheet exposure.

JEL Classification: F 31, F 32, F33, F34, F36, F38

### **The open-economy Trilemma, vintage 1960s**

A seminal contribution of the Mundell-Fleming 1960s framework is the open macro-economy Trilemma (aka the impossible trinity) that states that a country may simultaneously choose any two, but not all of the three policy goals—monetary independence, exchange rate stability, and financial integration. Accordingly, sustaining monetary policy autonomy and a fixed exchange-rate regime entails capital controls, the preferred choice of most OECD and developing countries during the 1945–1970 Bretton Woods regime.

In contrast, maintaining monetary independence and financial integration entails exchange rate flexibility. Over the last four decades, the U.S., the U.K., Japan, and several other OECD countries followed this regime. Exchange rate stability and financial integration entails giving up monetary independence—the preferred choice of the countries that formed the Euro block (a currency union), or currency board (e.g., Hong-Kong, Argentina during the 1990s).

The Trilemma may be explained in the context of an open economy extension of the IS-LM neo-Keynesian model (Mundell, 1963; “The Prize in Economic Sciences 1999 - Press Release,” 1999). The analysis is considerably simplified by focusing on polarized binary policy choices of a small economy —i.e., a credibly fixed exchange rate or pure float, perfect capital mobility or financial autarky, independent monetary policy or giving up monetary discretion; with risk neutral consumers, in which domestic and foreign bonds are perfect substitutes. Consider first a fixed exchange rate system with perfect capital mobility. If the central bank increases the supply of money, incipient downward pressure on the domestic interest rate triggers the sale of domestic bonds in search of a higher yield of foreign bonds. As a result of these arbitrage forces, the central bank is faced with an excess demand for foreign currency aimed at purchasing foreign bonds (and a matching excess supply of domestic currency). Under the fixed exchange rate, the central bank must intervene in the currency market in order to satisfy the public's demand for foreign currency at the official exchange rate. As a result, the central bank sells foreign currency to the public. In the process, the central bank buys back the excess supply of domestic currency that is triggered by its own attempt to increase the money supply. The net effect is that the central bank loses control of the money supply, which passively adjusts to the money demand at the prevailing foreign interest rate. Thus, the policy configuration of perfect capital mobility and fixed exchange rate implies giving up monetary policy. An open market operation only changes the composition of the central bank's balance sheet between domestic and foreign assets without affecting a monetary base or a domestic interest rate. This pair of policy choices implies that in a small open economy, determination of the domestic interest rate is relegated to the country to which its exchange rate is pegged.

A small open economy wishing to maintain financial integration can regain its monetary autonomy by giving up the fixed exchange rate. Under a flexible exchange-rate regime, expansion of the domestic money supply reduces the interest rate, resulting in capital outflows in search of a higher foreign yield. The incipient excess demand for foreign currency depreciates the exchange rate. Hence, in a flexible exchange-rate regime with financial integration, monetary policy is potent. A higher supply of money reduces the interest rate, thereby increasing domestic investment and weakening domestic currency, which in turn expands the economy through increased net exports. Consequently, achieving monetary independence requires the small open economy to give up exchange rate stability.

An alternative way for the small open economy to regain monetary independence is to give up financial integration and opt for exchange rate stability. Giving up financial integration prevents arbitrage between domestic and foreign bonds, thereby delinking the domestic interest rate from the foreign interest rate. Monetary policy operates in ways similar to the closed economy, where, in the short run, the central bank controls the money supply, and monetary expansion reduces the domestic interest rate.

Framing the Trilemma as a binary choice of “corner options” in the 1960s fitted the global regime well at that time, as framed by the Bretton Woods agreement of 1944. During this time, repressed financial markets and stringent control of private capital flows among the OECD countries were prevalent —most of which had currencies pegged to the U.S. dollar. Indeed, in the first decades post-WW II financial and exchange rate instability was limited. The sharp predictions of the Trilemma and its crisp intuitive interpretation made it the cornerstone of the open-economy, neo-Keynesian paradigm. These predictions are summarized by the textbook Trilemma triangle, as shown in Figure 1. The three triangle sides depict the three policy goals. The triangle vertex determined by the intersection of the triangle’s two sides depict the regime that accomplishes the two policy goals named along the chosen two sides at the cost of giving up the policy goal shown by the third side [e.g., the floating exchange rate regime depicted by the left vertex is compatible with monetary independent and financial integration, the corresponding two sides associated with the left vertex, at a cost of giving up exchange rate stability, etc.].

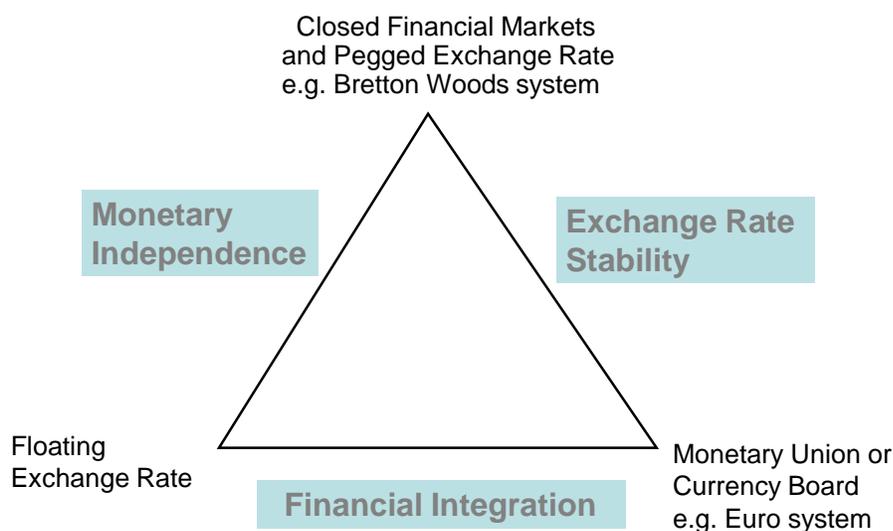


Figure 1: The Trilemma triangle.

In a string of insightful papers, Obstfeld, Shambaugh and Taylor (2004, 2005, 2010), test key predictions of the Trilemma. Specifically, they evaluate the transmission of interest rate shocks in various regimes, contrasting different regimes that were close to the three Trilemma vertices over time. Overall, the results are in line with the Trilemma prediction. During fixed exchange-rate episodes in the classical gold standard period, a pronounced and rapid transmission of interest rate shocks is found (corresponding to the right vertex of the Trilemma). This is in line with the prediction that the fixed exchange rate coupled with capital mobility nullifies monetary independence. In contrast, during the Bretton Woods era, fixed exchange rates did not provide much of a constraint on domestic interest rates, a by-product of widespread capital controls (corresponding to the top vertex of the Trilemma triangle). In the post-Bretton Woods era, the reversion to a more globalized pattern is manifested through an increased interest-rate transmission among fixed rate countries. Non-peg countries, both before 1914 and in the post-Bretton Woods period, have enjoyed considerably higher monetary independence than countries that pegged their exchange rate.

## **Open-economy Trilemma developments after the Bretton Woods era**

The Bretton Woods system served the OECD countries well during the recovery decades that followed the end of WW II. However, it came under growing pressure during the 1960s, reflecting the successful recovery of Western Europe and Japan, as well as the growing assertiveness of Western Europe, as countries went in search of a more balanced global architecture. The expansionary monetary policy of the U.S., the global anchor of the regime during the 1960s, provided the impetus for the ultimate collapse of the Bretton Woods system in the early 1970s (Eichengreen, 1996, 2007). Since then, the global Trilemma configuration has evolved substantially, resulting in with three fundamental changes.

1. **OECD countries transitioned to greater exchange-rate flexibility and rapid financial integration during the 1980s–1990s period.** The outcome was a large increase in private gross financial flows and exchange rate volatility, as well as financial deepening and the proliferation of financial instruments aimed at hedging exposure to greater exchange-rate volatility. In line with the predictions of the Trilemma, greater exchange-rate flexibility and financial integration allowed OECD countries to exercise their monetary independence. With a lag, the dismantling of capital controls induced larger current account deficits and surpluses over time, well above the minor imbalances observed during the Bretton Woods system. These trends led to growing concerns about global imbalances in the 1990s and 2000s. The U.S. current account/GDP deficit reached about 6%, with gross inflows/GDP approaching 20% prior to the Global Financial Crisis of 2007–2008 [GFC henceforth]. Chinese current account/GDP surplus accelerated from close to zero in 1995 to 10% prior to the GFC, while German current account/GDP surplus reached about 7% prior at the same time. In contrast, the current account imbalances of most countries during the Bretton Woods system were close to zero on average, fluctuating in a narrow band of about +/- one percentage point of the GDP. Bernanke (2005) explained these trends in the context of the *Global Saving Glut* hypothesis, asserting that “a combination of diverse forces has created a significant increase in the global supply of saving—a global saving glut—which helps to explain both the increase in the current U.S. account deficit and the relatively low level of long-term real interest rates in the world today.” These trends intensified real estate appreciation, especially in countries running larger current account deficits and liberal leverage regulations. The GFC and the Eurozone crisis put an abrupt end to these dynamics in more than dozen countries, inducing painful balance-sheet adjustments for households and banking systems, and magnifying the recessionary effects of these crises (Adam, Kuang, & Marcet, 2012; Aizenman & Jinjarak, 2008; Bernanke, 2010; Jordà, Schularick, & Taylor, 2015; Lane & Mcquade, 2014).

2. **The formation of the Eurozone created a new global currency, yet the Eurozone crisis raised questions about the viability and stability of the euro.** Growing exchange-rate flexibility is a double-edged sword, as the resultant exchange rate volatility increases the costs of international trade in goods and assets. While deepening forward markets provide useful hedges for short and intermediate contracts, forward contracts rarely eliminate the costs of exchange rate volatility. These considerations, and the willingness of most EU members to move toward deeper integration in the 1990s, induced the birth of the euro project—morphing most of the EU countries towards a currency union. Following the unification of Germany in the early 1990s, countries that were unhappy with the “straightjacket” of the Bretton Woods system, led by France and Germany, joined forces in pushing the Eurozone countries into their own new straightjacket system. Eurozone members gave up their monetary independence in favor of a common currency, aiming for a deeper financial and trade integration. The short history of the Eurozone has been remarkable and unprecedented: the euro project has moved from the planning board to a vibrant currency within less than ten years, forming a “currency without a country.” Most EU countries gave up their national monetary policy, floating jointly against the score of other industrial countries committed to

exchange rate flexibility [the U.S., Japan, the U.K., Canada, Australia, Switzerland, and so forth.]. Observers viewed the rapid acceptance of the euro as a viable currency and the deeper financial integration of the Eurozone during its first decade as stepping stones toward a stable and prosperous “United Europe,” possibly counter-balancing the dominance of the U.S. [see Chinn and Frankel (2008)]. Yet, the 2007–2008 GFC, and the Eurozone crisis that started in 2010, raised fundamental questions about the stability and the viability of the Eurozone, as well as the future viability of the EU (Eichengreen, 2008).

3. **Emerging Markets’ growing financial integration propagated financial crises, and a convergence to Trilemma’s middle ground, buffered by precautionary hoarding and using of reserves.** The take-off and rapid growth of East Asia and other Emerging Markets [EMs henceforth] at the era of growing trade and financial globalization among the OECD countries shrank the relative size of the matured industrialized countries to about half of the global GDP, adjusted properly for purchasing power differentials. Overall, the 1970s and 1980s were turbulent decades for EMs. These markets were exposed first to the consequences of the price of oil quadrupling following the formation of the OPEC cartel in the early 1970s, as well as a subsequent large increase in foreign currency borrowing by most developing and EM countries, which exposed their balance sheets to the downside risk associated with possible dollar interest hikes and dollar appreciation. Indeed, the sharp increase of the U.S. interest rate, associated with Volcker’s fast-but-painful disinflation in the early 1980s proceeded with EMs and developing countries’ debt crisis, leading to their “lost growth decade” of 1980s, with a resumption of growth in the 1990s.

Remarkably, EMs’ economies embraced a gradual process of increasing their financial integration in the early 1990s, while attempting to maintain exchange rate stability. This financial opening led to a sizable increase in financial inflows and an economic boom, with growing balance-sheet exposure to hard currency borrowing [dubbed hot money]. This pattern of borrowing reflected EMs’ inability to borrow in their own currencies, as accounted for by the “Original Sin” hypothesis (Eichengreen, Hausmann, & Panizza, 2003). Over time, a growing share of these countries were exposed to deep financial crises, induced by the onset of a “sudden stop” of financial flows and the capital flight of hot money (Calvo, 1998). The resultant drainage of international reserves led to balance of payment and exchange rate crises, collapsing exchange rates, countries’ banking system destabilization, and the frequent bailing out systemic banks and powerful macro players. These crises also evolved into deep internal and external debt crises, ending with IMF stabilization packages. The resultant domestic debt overhang led frequently to fiscal dominance, reducing the scope of monetary policy [e.g., Mexico in 1994, the East Asian crisis of 1997–1998, the Brazilian and Russian Crises of the late 1990s, and so forth.]. With varying lags, and a “trial and error” learning process, these crises induced economic and political changes, in which a growing share of EMs countries converged to “in-between” regimes—managed exchange-rate flexibility, controlled financial integration, and limited but viable monetary autonomy (Aizenman & Pinto, 2013; De la Torre, Yeyati, & Schmukler, 2002). These observations explain the relative resilience of emerging markets—especially in countries with more mature institutions—as they have been buffered by deeper precautionary management of reserves, and deeper fiscal and monetary space (Frankel, 2011; Vegh & Vuletin, 2012; Franke, Vegh & Vuletin 2013). Thereby, for most EMs, the GFC marked another spell of sudden stop crises, testing their coping abilities with the volatility of hot money, and causing subsequent instability of their commodity terms of trade and demand for exports.

### **Explaining the changing patterns of hoarding and using international reserves by EMs**

Taking stock of the remarkable history of EMs over the past four decades, we note that the key message of the Trilemma is scarcity of macro-policy instruments. This is in line with Tinbergen (1962)’s principle:

namely, the number of policy goals a policymaker can pursue successfully can be no greater than the number of independent instruments the policymaker can control. Arguably, the original Trilemma of the 1960s morphed during the 1990s into a Quadrilemma, in which EMs' crises induced them to add financial stability to their trilemma policy goals. In line with Tinbergen's principle, achieving greater financial stability has been dealt by adding policy instruments -- the management of precautionary buffers [international reserves, possibly combined with sovereign wealth funds], and growing application of macro-prudential measures aimed at inducing systemic players to internalize the impact of their balance sheet exposure on a country's financial stability. Through a costly learning process, EMs morphed from the Trilemma corner of high exchange-rate stability and closed financial markets into the Trilemma middle ground. Precautionary hoarding of international reserves and the growing use of macro-prudential policies dealt with concerns about financial stability (Blanchard, Dell'Ariccia, & Mauro, 2013; Cerutti, Claessens, & Laeven, 2015; Korinek, 2011; Ostry, 2012; Shin, 2011).

Figure 2 vividly illustrates the remarkable hoarding of international reserves that occurred in the early 1990s, and shows the tight association between the timing of developing countries' deeper financial integration, and the take off of their international reserve ratios. Note the relative stability of the international reserves/GDP during the 1980s, a time when the reserve/GDP ratios of developing and industrial economies hovered in the single-digit range, between 6% to 8 % points of the GDP. This was consistent with earlier literature that focused on using international reserves as a buffer stock, part of the management of an adjustable-peg or managed-floating exchange-rate regime. Accordingly, optimal reserves balanced the macro economic adjustment costs incurred in the absence of reserves with the opportunity cost of holding reserves (Frenkel & Jovanovic, 1981). The buffer stock model predicts that average reserves depend negatively on adjustment costs, the opportunity cost of reserves, and exchange rate flexibility; and positively on GDP and on reserve volatility, driven frequently by the underlying volatility of international trade. Overall, the literature of the 1980s supported these predictions. (Edwards, 1983; Frenkel, 1983) .

Aizenman and Marion (2003) and Aizenman and Lee (2007) explain the new hoarding trend of reserves by EMs and developing economies, whereby countries aim to insure against the costs of sudden stop and capital flight crises, triggered by the wave of such crises in the 1990s. This argument may be viewed as an extension of the 1990s Guidotti-Greenspan rule of thumb: countries should hold liquid reserves equal to their foreign liabilities coming due within a year. As the threshold of one-year coverage is arbitrary, a country may opt for deeper reserve coverage in accordance with their risk aversion, concern regarding the duration of such sudden stop crises and their social costs, and the possible need to stabilize the broad supply of money. These developments reflect the shifting focus from reserve adequacy measured in terms of trade flows of goods to flows and stock of assets, which ultimately determine countries' balance sheet exposure. A back-of-the-envelope estimation suggests that the expected benefits of following a Guidotti-Greenspan rule is about 1 % of gross domestic product (GDP). This would be the case if a country holding reserves equal to its short-term debt reduces the annual probability of experiencing a sharp reversal in capital flows by 10 % on average (in line with Rodrik and Velasco (1999)), and if the output cost of a financial crisis is about 10 % of GDP, as found by Hutchison and Noy (2006). Related results have been obtained using more elaborate models (Garcia & Soto, 2004; Ranciere & Jeanne, 2006). These authors have concluded that self-insurance against sudden stops plays an important role in accounting for recent hoarding of international reserves, although other factors may account for the rise in EMs' reserves/GDP ratios in past decades.

Importantly, Rodrik (2006) notes the puzzle of why EMs and relatively poor developing

countries do not rely more on policies curbing balance sheet exposure associated with external hard currency borrowing, instead of the costly hoarding for reserves.

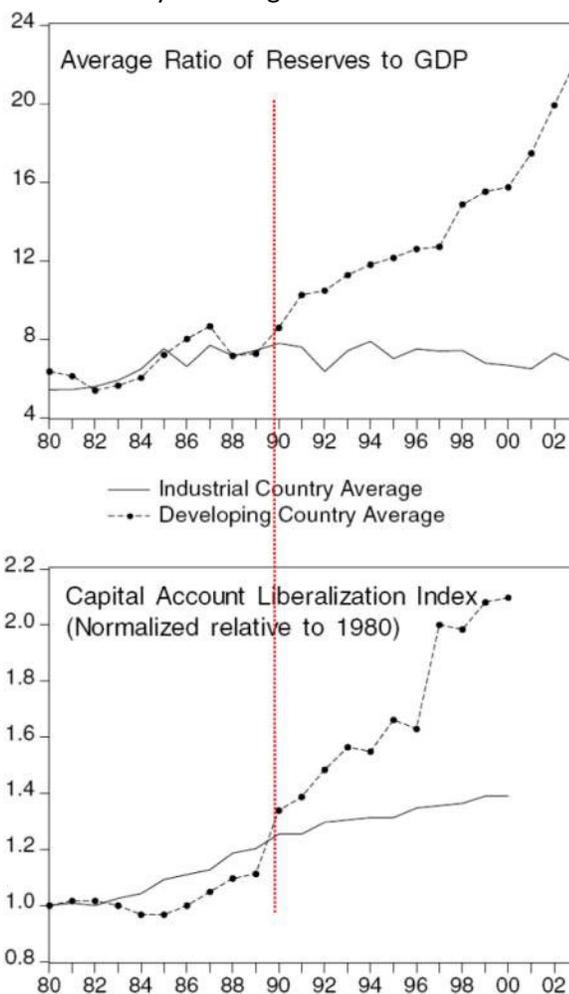
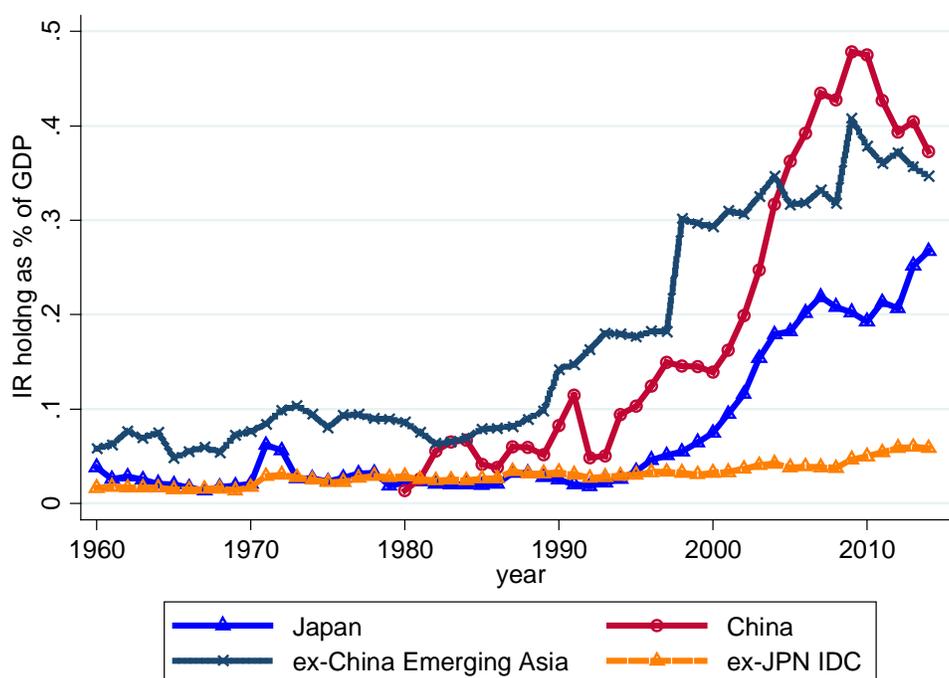


Figure 2. International reserves and financial integration patterns. International reserves/GDP ratios and capital account liberalization indices for industrial and developing countries. Source: Aizenman and Lee (2007)

Figure 3 reports the patterns of international reserves from 1960 to 2016. In the aftermath of the EMS' crises in the late 1990s and the early 2000s, many of the EMS, whether they experienced a crisis or not, started rapidly increasing their international reserve holdings. Most notably, China's reserve accumulation, which lagged behind other Asian EMS during the 1990s, took off in the first part of the 2000s. In the mid-2000s, China became the largest holder, reaching an International reserves/GDP of about 48% before the GFC and surpassing Japan, which had been the largest, long-time international reserve holder. In 2006 China held \$3.8 trillion, about 30% of the world's total international reserve holdings. Among the top ten largest international reserve holders, five are East Asian economies, and accounted for about half of the world's total.

While Aizenman and Lee (2007) report evidence on the dominance of the precautionary motive in explaining international reserve accumulation during the 1990s, the trends of the 2000s were consistent with the growing importance of modern mercantilism, in which countries running growing trade surpluses

may accumulate reserves in order to delay the onset of real appreciation. This may be explained as part of an export-led growth policy, aiming at benefiting from the “learning by doing” positive externality (Aizenman & Lee, 2008; Obstfeld et al., 2010). While this policy may be optimal for a country, it has potentially adverse implications on other countries that may be exposed to the “dis-learning by not doing” negative externality, and raises concerns about possible “hoarding wars.” Such perspectives suggest that China’s massive hoarding of reserves is a hybrid of the mercantilist and self-insurance motives. Yet mercantilist hoarding by one country may induce competitive hoarding by other countries in order to preempt any competitive advantage gained by the first country, a reaction that would dissipate most competitiveness gains. This view is supported by the interdependence of the demand for international reserves among ten East Asian countries (Cheung and Qian (2009)).



**Figure 3: International reserve holdings as a ratio to GDP.**

Note: For the country groups, the group’s aggregate international reserve is divided by the group’s aggregated GDP.

Obstfeld, Shambaugh, and Taylor (2009) link the reserve-hoarding trend to several factors associated with the shifting positions in the Trilemma configuration since 1990. The first is the “fear of floating,” manifested in the desire to tightly manage the exchange rate (or to keep fixing it). This desire reflects a hybrid of factors—to boost trade, to mitigate destabilizing balance sheet shocks in the presence of dollarized liabilities, to provide a transparent nominal anchor used to stabilize inflationary expectations, and so forth (Calvo & Reinhart, 2002; Klein & Shambaugh, 2006). The second factor is the adoption of active policies to develop and increase the depth of domestic financial intermediation through a larger domestic banking and financial system relative to the GDP. The third factor complements the deepening of domestic financial intermediation with an increase in the financial integration of the developing country with

international financial markets.

The views linking the large increase in hoarding reserves to growing exposure to sudden stops associated with financial integration face a well-known contender in a modern incarnation of mercantilism, dubbed “Bretton Woods II” (Dooley, Folkerts-Landau, & Garber, 2003). According to this interpretation, reserve accumulation is a by-product of promoting exports, which is needed to create better jobs, thereby absorbing abundant labor in traditional sectors. Dooley et al argue that in the early 2000s, the international system was composed of the Core [USA] issuing the dominant international currency, the U.S. dollar, and a Periphery. The periphery was committed to export-led growth based on the maintenance of an undervalued exchange rate. The argument is that a system of pegged currencies—in which the periphery exports capital to the core, which serves an intermediary financial role—is both stable and desirable. Although intellectually intriguing, this interpretation remains debatable, as the history of Japan and Korea suggests the near-absence of mercantilist hoarding of international reserves during the phase of fast growth, and the prevalence of export promotion by preferential financing in targeted sectors. Floundering economic growth then led to the onset of large hoarding of reserves both in Japan and Korea, which was probably due to both mercantilist motives and self-insurance to deal with the growing fragility of the banking system.

International reserve management in the form of ‘leaning against the wind’ could also lower real exchange-rate volatility induced by terms of trade shocks. Done properly, this may augment macro economic management in turbulent times, thus mitigating the impact of external adverse shocks, allowing for a smoother current account adjustment, and reducing the adverse growth impacts of external shocks (Aghion, Bacchetta, Ranciere, & Rogoff, 2009; Aizenman & Riera-Crichton, 2008; Céspedes & Velasco, 2012; Ricci, Milesi-Ferreti, & Lee, 2013). Overall, greater exposures of EMs and developing countries to sudden stops and reversals of hot money, growing trade openness, and the desire to improve competitiveness and reduce real exchange-rate volatility go a long way toward accounting for the observed increase in the rapid and massive stockpiling of international reserves by developing markets, even though the relative importance of these factors varies over time (Aizenman, Cheung, & Ito, 2015; Ghosh, Ostry, & Tsangarides, 2017).

### **Testing the modern version of the Trilemma: the open economy Quadrilemma**

The post Bretton Woods era illustrated the lingering challenge of testing the modern manifestation of the Trilemma—in practice, most countries rarely face the binary choices articulated by the original Trilemma. Instead, countries chose the degree of financial integration and exchange rate flexibility. Even in rare cases of adoption of a strong version of a fixed-exchange rate system (like the currency-board regime chosen by Argentina in the early 1990s), the credibility of the fixed-exchange rate changes over time, and the central bank rarely follows the strict version of the currency board. Similarly, countries choosing a flexible exchange-rate regime, occasionally (sometimes frequently) actively intervene in foreign currency markets, resulting in the implementation of a discretionary managed float system. Furthermore, most countries operate in the gray range of partial financial integration, in which regulations restrict flows of funds. These added concerns about financial stability morphed the Trilemma into the Quadrilemma as previously discussed, adding another dimension to empirical tests of the modern Trilemma incarnation. Consequently, testing the predictions of the Trilemma paradigm remains a work in progress, as no unique

way exists to define and measure the degree of exchange rate flexibility, monetary autonomy, and financial integration.

Against this background, Aizenman, Chinn and Ito (2010, 2013) in a string of papers, aim at testing a generalized version of the Trilemma hypothesis. First, they construct continuous measures of the Trilemma, normalized between 0 and 1, the bipolar ends of the original Trilemma (see [http://web.pdx.edu/~ito/Trilemma\\_indexes.htm](http://web.pdx.edu/~ito/Trilemma_indexes.htm) for the data and the definition of these indices). Figure 4 reports the changing patterns of the Trilemma during the post-Bretton Woods period for 181 countries from 1970 through 2014. Curves MI, ERS, and KAOPEN correspond to indexes of Monetary Independence, Exchange Rate Stability, and Capital Account Openness, respectively. The top panel reports the averages of these indices for EMs' economies. The Trilemma curves started in 1970, at the end of the Bretton Woods System, with a high degree of exchange rate stability and low degree of financial integration, which provided a significant degree of monetary independence. Over the next 45 years, the exchange rate stability and financial integration indices of EMs provided coverage to the Trilemma middle ground, a process that intensified during the 1990s. The middle panel reflects the industrial countries' average patterns, in which the formation of the Eurozone accounts for the raise in the average exchange-rate stability in the 1990s. The bottom panel reports the patterns for the average developing, non-EM economies. These countries show no clear convergence patterns.

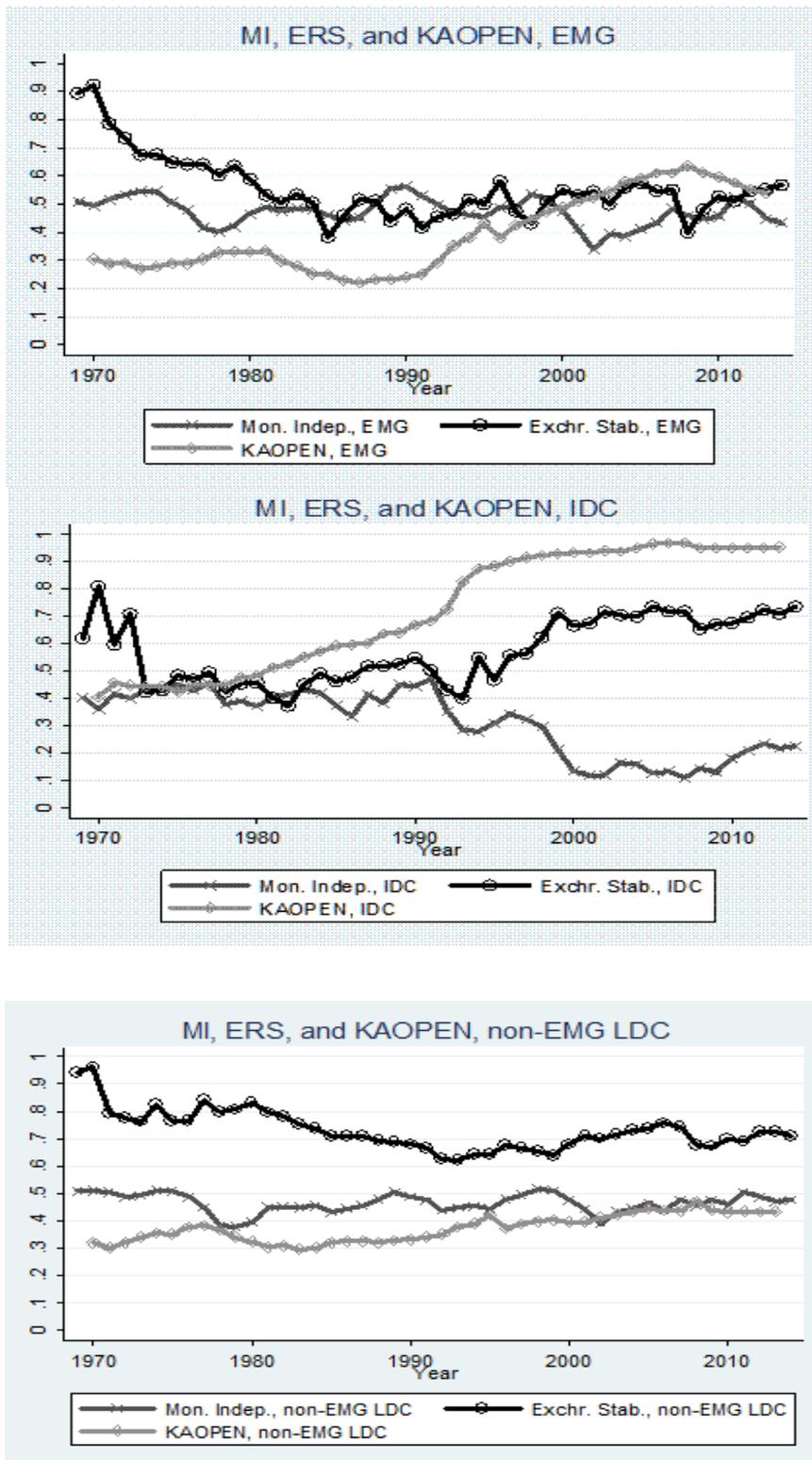
Figure 4: Global Trilemma Patters, 181 countries from 1970 through 2014;

Source: Aizenman, Chinn Ito Trilemma web page [http://web.pdx.edu/~ito/Trilemma\\_indexes.htm](http://web.pdx.edu/~ito/Trilemma_indexes.htm)

The top panel: EMs average patterns

Middle Panel: Industrial Countries average patterns

Bottom Panel: Non-EMs less-developed countries patterns



Aizenman, Chinn, and Ito next test a continuous version of a linear Trilemma, confirming that the sum of the three Trilemma variables adds up, on average, to a constant, in line with the conjecture that a rise in one Trilemma policy variable is traded off by the drop in the sum of the other two policy variables (e.g., greater financial integration is associated with lower weighted average of exchange rate stability and monetary autonomy).

Finally, the authors test a version of the modern Quadrilemma hypothesis, wherein the goal of financial stability is the fourth policy dimension, in which the Trilemma morphed into a Quadrilemma. The results support the growing importance of international reserves and exchange rate management in accounting for the policy trade-offs facing EMs. Specifically, greater monetary independence can dampen output volatility while greater exchange-rate stability implies greater output volatility, which can be mitigated by managing a buffer stock of reserves. Emerging market economies have adopted a policy combination of the three Trilemma policies and international reserves that allow these economies to lessen output volatility through a reduction of their real exchange-rate volatility. This methodology has been applied and extended in several follow-up papers, corroborating the essence of the Trilemma's modern interpretation (Cortuk & Singh, 2011; M. Hutchison, Sengupta, & Singh, 2012; Popper, Mandilaras, & Bird, 2013).

**Quadrilemma, Trilemma, or Dilemma?** Rey (2015) provides an alternative take on the Trilemma, concluding that the economic center's monetary policy influences other countries' national monetary policy. This happens mostly through capital flows, credit growth, and bank leverages, making the types of exchange rate regime of the non-centers irrelevant. In other words, the countries in the periphery are all sensitive to a "global financial cycle" irrespective of their exchange rate regimes. Thereby, the "Trilemma" reduces to an "irreconcilable duo" of monetary independence and capital mobility—that is, "Dilemma not Trilemma." Consequently, restricting capital mobility maybe the only way for non-center countries to retain monetary autonomy. Rey's research concluded that key determinants of the global financial cycle were U.S. policies, which strongly affected the leverage of global banks, capital flows, and credit growth in the international financial system. Whenever capital is freely mobile, the global financial cycle constrains national monetary policies regardless of the exchange rate regime.

The follow-up literature propagated by Rey's intriguing "Dilemma not Trilemma" hypothesis paints a mixed and nuanced view of Rey's conjecture. Taking the "irreconcilable duo" hypothesis literally, it suggests that the European Central Bank and the Bank of England's monetary policy stance are irrelevant for the Eurozone and the U.K., respectively, as the Eurozone and the U.K. have been financially integrated with the global economy. One doubts whether most observers and the data support this interpretation. More generally, Mundell's Trilemma does not argue that countries can insulate themselves from global shocks propagated by large countries. A valid interpretation of Mundell's (1963) is about trade-offs and mitigations. Well before the GFC, it was widely known that size matters and that the flexible exchange rate is not a panacea: among  $n$  currencies, at most only  $n - 1$  are independent (De Grauwe, 1996). The size of the U.S. matters in particular because the country's financial size well exceeds its global GDP share. A possible avenue to test the viability of the Trilemma in the twenty-first century is to verify the degree to which exchange rate regimes significantly impact the transmissions of shocks from financial center economies.

Another methodological concern challenging all the Trilemma empirical literature is that the empirical research is bounded by historical data. To illustrate, had Brazil been under a fixed-exchange rate regime during the turbulent 2010s decade, it would had gone probably a balance of payment crisis, aka collapsing exchange rate (Ghosh, Ostry, & Qureshi, 2015; Reinhart & Rogoff, 2004). Without controlling for

this counterfactual, econometric inference about the relevance of the exchange rate regime is limited and should be taken with a grain of salt. These views are in line with Bernanke Mundell-Fleming 2015 lecture at the International Monetary Fund, which put Rey's conjecture in the context of the evolving debate on the global financial structure (Bernanke, 2017).

Taking this perspective, Aizenman, Chinn, and Ito (2016) examine how the movements in the center economies—the U.S., Japan, the Eurozone, and China—affect the Trilemma choices and financial conditions of developing and EM countries (dubbed peripheral countries). In 2000s-2010s, the strength of the links with the center economies have been the dominant factor. The movements of the policy interest rate also appear sensitive to global financial shocks around the EMS' crises of the late 1990s and since the 2008 GFC. The exchange rate regime and financial openness are found to have a direct influence on the sensitivity to the center economies. The weights of major currencies, external debt, and currency debt compositions are significant factors. More specifically, having a higher weight on the dollar (or the euro) makes the response of a financial variable, more sensitive to a change in key variables in the U.S. (or the euro area, respectively), such as policy interest rates, exchange rate market pressure, and the Real Exchange Rate. Thus, the degree of exchange rate flexibility continues to affect the sensitivity of developing countries to policy changes and shocks in the center economies.

An insightful analysis by Klein and Shambaugh (2015) studies whether partial capital controls and limited exchange-rate flexibility allow for full monetary policy autonomy. They find that partial capital controls do not generally allow for greater monetary control more than open capital accounts, unless capital controls are quite extensive. However, a moderate amount of exchange rate flexibility does allow for some degree of monetary autonomy, especially in emerging and developing economies. Empirically, they observe that while some countries have long-standing, pervasive capital controls, a substantial subset of countries use limited controls on an episodic basis. Their results are in line with Klein (2015), who classified capital control of these regimes into "walls" and "gates," respectively, and shows that walls are more effective than gates in limiting asset price booms and swings in the value of the real exchange rate. In addition, in any given year, there is a wide range of scope with which capital controls are employed, generating an extensive middle ground between open and closed capital markets.

Obstfeld, Ostry, and Qureshi (2017) find that countries with fixed exchange-rate regimes are more likely to experience financial vulnerabilities—faster domestic credit and house price growth, and increases in bank leverage—than those with relatively flexible regimes. The transmission of global financial shocks is likewise magnified under fixed exchange-rate regimes relative to more flexible (though not necessarily fully flexible) regimes. The authors attribute this to both reduced monetary policy autonomy and a greater sensitivity of capital flows to changes in global conditions under fixed rate regimes. Bekaert and Mehl (2017) propose a measure of de-facto financial market integration based on a factor model of monthly equity returns. They find evidence consistent with the Trilemma and inconsistent with the Dilemma hypothesis both throughout history and for recent decades; that is, non-U.S. central banks still exert more control over domestic interest rates when exchange rates are flexible in economies open to global finance. Cerutti, Claessens, Rose (2017) quantify the importance of a Global Financial Cycle for capital flows, using capital flow data dis-aggregated by direction and type between 1990-2015 for 85 countries. They report that most variation in capital flows does not seem to be the result of common shocks nor stem from observables in a central country like the United States.

### **Financial Stability and OECD's Crises, Swap Lines, and Future Challenges**

The GFC, and the subsequent Eurozone crisis validated that no country is immune from exposure to costly financial instability. Yet, countries with more mature institutions, deeper fiscal capabilities, and fiscal

space may gain resilience and stability by activating bilateral swaps lines coordinated among their central banks. Access to such swap lines substitutes the need to manage costly international reserves buffers. The GFC illustrated the willingness of the U.S. FED to activate practically unlimited swap lines between the FED and the key OECD's central banks, providing them with elastic access to dollar liquidity needed to deal with their balance sheet exposure to the dollar ("Central bank liquidity swaps," 2017).

While the benefits of these arrangements are clear, they may hinge on the willingness to activate them, as well as the presence of a fiscal backstop mechanism that deals with the moral hazard aspects of such insurance. The unprecedented extension of these swap lines by the U.S. FED is in line with Gourinchas and Rey (2007) and Gourinchas, Rey, and Govillot (2010)'s insightful *Exorbitant privilege and exorbitant duty* interpretation of the role of the U.S. dollar. Accordingly, the center country of the International Monetary System enjoys an "exorbitant privilege" that significantly weakens its external constraint. This is reflected in the sizeable excess return of U.S. gross assets over gross liabilities in past decades. In exchange for this "exorbitant privilege," they document that the U.S. provides insurance to the rest of the world, especially in times of global stress. This "exorbitant duty" is the other side of the coin. During the 2007–2009 GFC, payments from the U.S. to the rest of the world amounted to 19% of U.S. GDP.

The willingness of the U.S. FED to extend the swap lines to key OECD countries is also in line with the view that the dollar shortage of the Eurozone and other several other OECD countries during the GFC put them in the position of "too big and too costly to fail" from the U.S. perspective. Accordingly, U.S. FED swap lines prevented a massive banking crises in these countries that would have cost the U.S. economy dearly. This is in line with Keynes' view on debt: "If you owe your bank manager a thousand pounds, you are at his mercy. If you owe him a million pounds, he is at your mercy." This logic also explains the high selectivity of the U.S. FED in providing unprecedented access to 30 billion U.S. dollar swap lines to four selected EMs: Brazil, Mexico, South Korea, and Singapore. Aizenman and Pasricha (2010) reported evidence that exposure of U.S. banks to EMs turned out to be the most important selection criterion for explaining these "selected four" swap-lines. Of the selected four countries, only Mexico and South Korea activated their swap lines in a limited way. Observers credit the FED's willingness to extend these swap lines to stopping the financial panic in South Korea from triggering a massive banking crisis during the GFC (Obstfeld et al., 2009; Park, 2011).

Looking ahead, although the benefits of swap line arrangements are clear, they hinge on the presence and credibility of their fiscal backstop mechanisms. Time will test their credibility, and the degree to which risk- pooling arrangements such as institutional swap lines can be extended to cover more EMs and developing countries at times of peril. The selectivity of the swap lines extended during the GFC suggests that only countries with significant trade and financial linkages can expect access to such ad hoc arrangements on a case-by-case basis. Moral hazard concerns suggest that the applicability of these arrangements to EMs will probably remain limited, and there is no end in sight for the hoarding of reserves by such markets.

Common criticism of such sizable hoarding international reserve includes three arguments. First, the sizable opportunity costs of hoarding reserves (Alfaro & Kanczuk, 2009), who argues that the optimal size of reserves is zero. Second, the tendency of countries to refrain from using these reserves aggressively at times of peril, dubbed as "the fear of using reserves," raises questions about the logic of investing in costly insurance that is not fully activated in perilous times. Finally, the possibility exists that tighter restraints on external hard currency borrowing may mitigate the need to hoard costly reserves (Rodrik, 2006).

Bocola, and Lorenzoni (2017) provide insightful interpretation for the first two concerns, explaining

them in the context of EMs characterized by limited credibility of their fiscal backstop mechanisms. They consider an open economy with flexible exchange rates and financial intermediaries that face a potentially binding leverage constraint, confronting the possibility of a self-fulfilling crisis with persistent adverse effects on real activity that produces a current account reversal and a real devaluation. The presence of dollar debt in the financial sector makes a crisis of this sort more likely. The authors show that when domestic savers fear the possibility of a crisis in the future, they self-insure by saving in dollars. However, a reduced supply of domestic currency savings pushes the banks to issue more dollar debt, exposing the economy to the risk of future financial crises. Domestic authorities can eliminate the crisis equilibrium by acting as a lender of last resort, but these interventions only work if they are fiscally credible. Holdings of foreign currency reserves hedge the fiscal position of the government and enhance its credibility, thus improving financial stability.

Rodrik's 2006 perceptive observation about potential gains from curbing hard currency external borrowing has been validated by a greater willingness after the GFC to apply macro-prudential regulations aimed at mitigating external borrowing in hard currency. Bruno and Shin (2014a, 2014b) provide a framework linking capital flows, the exchange rate, and domestic bank leverage, as well as a case study of the impact of macro-prudential regulations in South Korea. First, they formulate a model of the international banking system in which global banks interact with local banks, highlighting the bank leverage cycle as the determinant of the transmission of financial conditions across borders through banking sector capital flows. They show conditions under which local currency appreciation is associated with higher leverage of the banking sector, thereby providing a clear link between exchange rates and financial stability. In a panel study of 46 countries, they find support for key predictions of their model. They then focus on South Korea, a country that serves as a bell-weather for financial exposure. Korea was one of the countries hardest hit in the 1997 Asian financial crisis, and was again at the sharp end of the financial turmoil unleashed in September 2008 by the GFC. In recognition of the sources of Korea's vulnerabilities, since June 2010, South Korea has introduced a series of macro-prudential measures aimed at building resilience against external financial shocks, especially against the country's well-known vulnerability to capital flow reversals in the banking sector and the associated disruptions to domestic financial conditions. Relative to a comparative group of countries, Bruno and Shin find that the sensitivity of capital flows into South Korea to global conditions decreased in the period following the introduction of macro-prudential policies.

Understanding the conditions increasing the efficacy of macro-prudential and capital control policies, their impact on the credit cycle, on patterns of capital flows and the demand for international reserves remains a work in progress, as more experience is needed in managing these policies (Bussiere, Cheng, Chinn, & Lisack, 2013; Fernández, Klein, Rebucci, Schindler, & Uribe, 2015; Financial Stability Board, International Monetary Fund, Bank of International Settlements, 2011; Forbes, Fratzscher, Kostka, & Straub, 2016; Jinjarak, Noy, & Zheng, 2013; Pasricha, 2017).

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