

International Reserves Before and After the Global Crisis: Is There No End to Hoarding?

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Abstract

We evaluate the global financial crisis (GFC) and the structural changes of recent years that have been associated with new patterns of hoarding international reserves. We confirm that the determining factors of international reserves are evolving with developments in the global economy. From 1999–2006, the pre-GFC period, gross saving is associated with higher international reserves in developing and emerging markets. An outward direct-investment effect is consistent with the view of diverting international assets from the international reserve account, the “Joneses’ effect” lends support to the rivalry hoarding motivation, and commodity price volatility induces hoarding against uncertainty. During the 2007–2009 GFC, those variables became insignificant or displayed the opposite effect, probably reflecting the frantic market conditions that prevent a normal economic relationship to hold. Nevertheless, the propensity to continue to trade displays a strong positive effect. The 2010–2012 post-crisis results are dominated by factors that have been mostly overlooked in earlier decades. While the effects of swap agreements and gross saving are in line with expectations, we find a change in the link between outward direct investment and international reserves in the pre- and post-crisis period. The macro-prudential policy is found to complement international reserve accumulation. Developed countries display very different demand behaviors for international reserves. Higher gross saving has been associated with lower international reserve holding because developed countries are more likely to deploy their savings in the global capital market. The presence of sovereign wealth funds is associated with a lower level of international reserve holding in industrial countries. Our predictive exercise affirms that if an emerging market economy experienced a deficiency in international reserves holdings in 2012, that economy tended to experience exchange-rate depreciation against the U.S. dollar during the recent adjustment to the news of tapering quantitative easing (QE) in 2013.

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1. Introduction and Overview

The global financial crisis (GFC) has ended the “great moderation” era, bringing instability to the fore of challenges facing policymakers in the U.S., the Eurozone, and other OECD countries—i.e., volatility is back. Yet, for emerging markets, volatility never disappeared, and the GFC is another crisis in the long sequence of turbulent events, this time originating from the U.S. A key lesson of emerging markets’ growing financial integration has been a greater exposure to capital flight and sudden-stop crises [see Calvo et al. (2004) on the empirics of sudden stops]. With a lag, the emerging market substantially increased their international reserves/GDP after the financial crises of the 1990s, recognizing the benefits of self-insurance against the volatility associated with financial globalization. Indeed, the growing financial integration of emerging markets during the 1990s and the ensuing crises were identified as key factors in the structural changes of international reserves that increased the weight of financial factors as well as the crises history among the determinants of international reserves/GDP [Aizenman and Marion (2003), Aizenman and Lee (2007); Cheung and Ito (2009)]. The takeoff of hoarding reserves by China and other countries in the 2000s and the crises affecting emerging markets in the late 1990s and early 2000s added new factors to the list of controls that have contributed to hoarding reserves, including mercantilist motives [Aizenman and Lee (2008)], “keeping up with the Joneses,” [Cheung and Qian (2009)], and self-insurance against local residents’ flight from domestic assets in the context of the trilemma [Obstfeld, Shambaugh, and Taylor (2010); Aizenman, Chinn, and Ito (2010)].

The purpose of this paper is to evaluate whether the GFC and the structural changes of recent years have been associated with new patterns of hoarding international reserves (IR). This possibility is exemplified in the recent experience of China and South Korea, which have undergone large structural changes that have impacted their international reserves/GDP in the past decades. For China, the GFC and its aftermath have been associated with a sizable IR/GDP decline [see Fig. 1] that has resulted in a rebalancing of the country’s export-led growth strategy in the face of declining global demand, a liberalization of its outward foreign direct investment, and the placing of greater emphasis on Chinese sovereign wealth funds (SWFs) [Aizenman, Jinjarak, and Marion (2014)]. The GFC found South Korea struggling with confidence amid a banking crisis. The initial sizable stock of IR failed to isolate Korea from massive deleveraging, and the ensuing financial panic was ultimately abated with the help of the Fed’s special swap.

Arguably, the experience of Korea illustrated the need to supplement hoarding reserves with prudential regulations dealing with balance-sheet exposure of systemic banking. Indeed, unlike the 1997–1998 Korean crisis, the crisis this time did not lead to a further increase in Korea’s reserves/GDP but to prudential regulatory changes [(Park (2010), Bruno and Shin (2014)]. The experience of China and Korea raises the possibility that the GFC may induce structural changes, thereby supplementing hoarding reserves with new policies [dynamic prudential regulations] and institutions [financial stability boards and SWFs, among others]. These developments exemplify a growing trend among emerging markets. The GFC and the resultant quantitative-easing policy [QE] by the Fed and other central banks also led to large, hot money inflows to emerging markets in search of yields. Emerging markets reacted to these developments by experimenting with dynamic capital controls aimed at mitigating the resultant appreciation pressure and reducing the exposure of future destabilizing outflows. These steps also included relaxing the controls on outward flows at times of larger inflows and greater appreciation pressures, as has been the case in China and other emerging markets [Aizenman and Pasricha (2013)].

The greater reliance on sovereign wealth funds in managing the public sector’s saving pre-dates the GFC. The impetus for sovereign wealth-fund formation has been the recognition that the mandate of the central bank is the conduct of monetary policy and financial stability. Hence, the opportunity cost of reserves in practice may be of limited relevance for the central bank’s operations.⁴ Therefore, once international reserves/GDP reach a high-enough level to cover self-insurance needs, countries chartered by high savings rates may opt to manage their own SWFs. The mandate of SWFs is to secure stable income for future generations; therefore a SWF has a higher risk tolerance than the central bank, which is aimed at higher-than-expected income and longer-term investments. These considerations suggest that a higher savings rate would increase the level of international reserves/GDP,⁵ while the presence of SWFs may lower international reserves/GDP for a given savings rate.

Against this background, we evaluate the stability of factors accounting for international reserves, and the role of conditioning variables that were not studied sufficiently before the

⁴ This also explains the failure to find a stable and economically significant impact of the opportunity cost of reserves on the observed international reserves/GDP ratios.

⁵ Political economy considerations suggest another channel linking a lower gross savings rate with lower international reserves/GDP; such a scarcity of saving would make it harder for the central bank to maintain sizable hoarding of international reserves, as the reserve stock may be an administration’s target of opportunity at times of a fiscal crunch, as has been the experience of Argentina and Venezuela [Aizenman and Marion (2004)].

GFC—the presence of sovereign wealth funds, macro-prudential policies, access to bilateral swap lines, saving rates, commodity terms of trade volatility, outward foreign investment, export composition (shares of fuel, commodity, services, or manufacturing exports in total exports), financial exposure, and various versions of the “keeping-up-with-the-Joneses” motives. The presumption is that over time, the introduction of an SWF will reduce the exclusivity of IR as the main financial buffer. Effective prudential regulations may reduce external borrowing and the inflows of hot money thereby reducing the need for IR hoarding for self-insurance. Access to bilateral swap lines may also mitigate the need for IR at times of peril, although this applies only if the use of swap lines does not entail the stigma effect and the swap-line arrangements are maintained. Export composition and terms of trade volatility matters in determining the volatility of trade and the terms of trade, explaining patterns of pro-active leaning against the wind type of exchange rate and hoarding reserves policies.

Previewing results, we group the explanatory variables into three broad factors. The traditional macroeconomic factors include a propensity to import, trade openness, the volatility of IR holdings, the opportunity cost of holding an IR, exchange-rate regime arrangement, and the level of economic development. These variables capture the elements of an international reserve-demand equation from vintage 1970s. The financial factors include domestic financial depth (measured by M2/GDP), external financing, and capital flow. The third group includes several factors that have come to the fore in recent discussions: the tenures of national-level SWFs; bilateral currency-swap agreements; the implementation of macro-prudential policies, gross saving; outward direct investment, the implicit-rivalry incentive (a.k.a catching-up-with-the-Joneses’ effect); the composition of trade; and the discounted experience of past crises. We confirm that the appropriate level of IR is not necessarily constant and determining factors continue to evolve with developments in the global economy. In 1999–2006, the pre-GFC period, gross saving was associated with higher international reserves in the developing and emerging markets, the outward direct-investment effect was consistent with diverting international assets from the IR account, the Joneses’ effect lent support to the implicit rivalry-hoarding motivation, and commodity-price volatility induced hoarding against uncertainty. During the 2007–2009 GFC period, the additional variables that were significant in the previous period become insignificant or displayed the opposite effect, probably reflecting the frantic market conditions that prevented a normal economic relationship to hold. Nevertheless, the propensity to continue

to trade displays a strong positive effect. The post GFC 2010–2012 results are dominated by the “recently added factors.” While the effects of swap agreements and gross saving are in line with expectations, the positive outward direct-investment effect implies a change in the link between outward direct investment and international reserves in the pre- and post-crisis period. Such a change deserves further analysis in future studies. Some of the findings are unexpected and not totally intuitive such as a negative Joneses’ effect among developing countries in Europe, the banking-crisis effect, and the commodity-export effect. Interestingly, most of these non-intuitive results disappeared (they became either insignificant or significant with the expected sign) when we pooled the data from the three sample periods. In addition, the macro-prudential policy is found to complement the international reserve-accumulation policy.

We repeated the exercise using data from developed countries. In line with previous findings in the literature, the developed and developing countries display very different demand behaviors for international reserves. Despite the differences, our results confirm that the recently discussed factors including SWFs, the gross saving, the Joneses’ effect, and the trade composition affect the international reserve-hoarding behavior of the developed economies in the pre-GFC period. Our results indicate that the presence of SWFs tends to be accompanied by a lower level of IR holding. Gross saving has a negative implication for IR holding possibly because developed countries are more likely to deploy their savings in the global capital market.⁶ The Joneses’ effect is quite robust among the Asian countries, in both developed and developing countries alike. Even variables that show up as significant could exhibit opposing effects on the level of international reserves. For instance, in reference to the 1999–2006 sample, the money stock, swap agreement, manufacture export, and banking crisis-experience variables have opposing effects on the IR holdings of developing and developed countries. At the minimum, the statistical-demand specification for international reserves evolves over time and is different between developed and developing countries. It is possible that the two kinds of countries have different motivations for holding international reserves due to their economic realities.

We close with an examination of the adequacy or excessiveness of IR holding in the 2010–2012 period. We confirm that the “fragile five” countries (Brazil, India, Indonesia, South

⁶ Akin to the Bretton Woods II argument by Dooley, et al. (2005, 2009), it could be argued that by holding international reserves, the monetary authorities of developing countries are playing the role of financial intermediary that cannot be provided effectively by their own domestic, shallow financial markets. In this sense, high savings in advanced economies can be directly invested overseas whereas those in developing economies often get funneled through monetary authorities in the form of holding international reserves.

Africa, and Turkey) do appear to be experiencing under-hoarding of IR in this period. Such a situation reflects the vulnerability of these countries to the environment of the global economy in the last few years. We test the degree to which economies with IR-holding levels below model predictions are more susceptible to external shocks, focusing on the induced exchange rate depreciation against the U.S. dollar between 2012 and 2013, a period dominated by QE tapering news coming from the Fed. We confirm a negative and significant correlation between the exchange rate depreciation against the U.S. dollar, the global vehicle currency, and the prediction errors of IR holding. Therefore, a country that experiences a deficiency in IR holding tends to also experience depreciation in its currency value against the U.S. dollar during the recent adjustment to the tapering news.

Sections 2 and 3 outline the empirical specifications and report the estimation results. Section 4 addresses the issue of over- or under-hoarding of international reserves and the link between a deficiency in international reserves and exchange rate depreciation. Section 5 provides concluding remarks.

2. Empirical Specifications

Our analysis examines annual data of more than 100 countries from 1999 to 2012. Given existing evidence on different international reserve demand behaviors across different historical time periods defined by global events, and across advanced and developing economies,⁷ our empirical exercise considers a) advanced and developing economies separately, and b) three disjointed sample periods; namely 1999-2006, 2007-2009, 2010-2012.

2.1 Models

We use the following regression equations to study the international reserve demand behavior:

$$r_{i,t} = c + X'_{i,t} \alpha + Y'_{i,t} \beta + D'_i \delta + \varepsilon_{i,t}, \text{ and} \quad (1)$$

$$r_{i,t} = c + X'_{i,t} \alpha + Y'_{i,t} \beta + Z'_{i,t} \gamma + D'_i \delta + \varepsilon_{i,t}. \quad (2)$$

The variable of interest is $r_{i,t} = R_{i,t} / GDP_{i,t}$, where $R_{i,t}$ and $GDP_{i,t}$ are, respectively, generic notations of economy i 's holding of international reserves and gross domestic product at time t ,

⁷ The differential behaviors are noted in, for example, Bahmani-Oskooee (1988), Cheung and Ito (2008, 2009), Frenkel (1974a), Frenkel (1980), and Lizondo & Mathieson (1987).

and both variables are measured in US dollars. Scaling international reserves as a ratio to GDP facilitates comparison across countries of different sizes. For brevity, we call the ratio $r_{i,t}$ international reserves (IR), henceforth.

The four types of determinants are: a) $X_{i,t}$ ($=\{x_{i,k,t}; k=1,\dots,N_x\}$) includes the traditional macro variables, b) $Y_{i,t}$ ($=\{y_{i,k,t}; k=1,\dots,N_y\}$) includes the financial variables, c) $D_{i,t}$ ($=\{d_{i,k,t}; k=1,\dots,N_d\}$) includes other characteristics of the economies, and d) $Z_{i,t}$ ($=\{z_{i,k,t}; k=1,\dots,N_z\}$) includes the possible determinants discussed during the GFC and afterwards. Appendix 1 provides a complete list of variables, their definitions, and their sources.⁸ The coefficient vectors α , β , γ , and δ are conformable to the associated explanatory variables. The intercept and disturbance term are given by c and $\varepsilon_{i,t}$, respectively.

With (1) as a benchmark, the relevance of the determining factors that come to the fore during and after the recent GFC could be gauged by comparing results from (2) and those from (1).

2.2 Explanatory Variables

The traditional macroeconomic variables considered under X_{it} are motivated by extant studies on international reserves including Frenkel (1974a, b), Frenkel and Jovanovic (1981), Heller (1966), and Kelly (1970). These variables include the propensity to import, trade openness, the volatility of IR holding, the opportunity cost of holding IR, and the level of economic development. Thus, the X_{it} component of (1) captures the elements of an international reserve demand equation of the 1970s vintage.

The main economy characteristic (D_{it}) discussed in the subsequent discussions is the exchange rate regime arrangement. Frenkel (1980) and Flood and Marion (2002), for example, report that exchange rate arrangements have effects on the holding of international reserves, while Lane and Burke (2001) finds no significant effect. The other country-specific characteristics including the past crisis experiences and geographical locations are considered under Z_{it} .

⁸ Cheung and Ito (2009), for example, adopted a comparable framework, and compared the relatively explanatory powers of $X_{i,t}$, $Y_{i,t}$, and $D_{i,t}$ in historical periods between 1975 to 2005 using cross-sectional analysis.

Financial factors are playing an increasing role in the global economy in general and in influencing the holding of international reserves in particular (Aizenman and Lee 2007). The financial variables in Y_{it} include domestic financial depth (measured by M2/GDP) and external financing capacity measured by net portfolio flow. The money stock in a developing economy is considered as a proxy for potential magnitude of capital flight and, therefore, affects the demand for international reserves, which act as a buffer against the ‘internal drain’ and alleviate the adverse impact of sudden capital flight.⁹

There are different views on the implications of external financing for international reserve holdings. One view is that economies with a large external financing exposure in the forms of debts or portfolio flows (Aizenman *et al.*, 2007; Feldstein, 1999) hold a high level of international reserves to guard against the possibility of reverse capital flow.¹⁰ However, if external financing is a substitute for international reserves, then the correlation between the two variables will be negative. The external financing and capital flow data are drawn from Lane and Milesi-Ferretti (2007 and updates)

The variations in international reserve holdings observed during and after the GFC have led to further discussions on the determination of the appropriate amount of international reserves. The variable Z_{it} includes some of determining factors in the recent discussions.

Countries employ sovereign wealth funds (SWFs) to hold and manage their external assets. Typically, the monetary authorities use their international reserves to fund SWF. This suggests that the existence of a SWF can be negatively correlated with the level of international reserve holding. However, the possibility of shifting external assets to a SWF offers a way to divert political pressures on excessive holding of international reserves. If it is the case, then holding of international reserves could even increase in the presence of a SWF. To assess its role, we include the dummy variable that represents the presence of national-level SWFs in our analysis. In passing, we note that the use of the SWF tenure does not change the results reported below.¹¹

⁹ See, for example, de Beaufort Wijnholds and Kapteyn (2001), Calvo (1998, 2006), Aizenman and Lee (2007), and Obstfeld, *et al.* (2009)

¹⁰ Dooley *et al.* (2005, 2009), based on the Bretton Woods II system argument, also note that external financing flows and international reserves are positively related.

¹¹ The information is from the SWF Institute (<http://www.swfinstitute.org/fund-rankings/>). Canadian or American SWFs are not included in the analysis because they are all managed by provincial or state level authorities, and are thereby not supposed to affect the holding of international reserves at the country level.

Bilateral currency swap agreements are another factor. If a country has access to hard currencies via a swap arrangement, then it has less incentive to hold international reserves. The information on swap agreements (regardless of the currency of the agreement) is from official websites since the breakout of the 2008 global financial crisis.

The desire or the need to hold international reserves could be affected by the implementation of macro prudential policies, which have attracted considerable discussions in the global community after the GFC (Ostry et al., 2010; Ostry et al., 2011; The Strategy, Policy, and Review Department, IMF, 2011). We included a qualitative variable that assumes a value of one if a country has in place any of the macro prudential policies based on the information in Lim, et al. (2012, 2013).

Countries with a high level of gross saving tend to run a current account surplus, and accumulate international reserves, unless they are conscientiously investing abroad. Thus, a country's saving could be indicative of its holding of international reserves. By the same token, a policy of promoting outward direct investment which is one means to deploy international assets overseas and, thus, could be negatively correlated with the holding of international reserve. In the subsequent empirical analyses, both gross saving and outward direct investment are expressed as a ratio to GDP using the data from WDI, WEO, and UNCTAD.

Besides the usual economic considerations, the implicit rivalry incentive could drive countries to accumulate international reserves in a “competitive” manner. The so-called catching up with the Joneses effect was noted in Machlup (1966) and revived in, for example, Cheung and Qian (2009) and Cheung and Sengupta (2011). Given the regional character of the Joneses effect, we allow for countries in different regions to display different Joneses effects by interacting regional-specific Joneses variables with the corresponding regional dummy variables.¹²

The composition of trade, in addition to trade intensity, is seen as a factor that can affect the international reserve hoarding behavior. To this account, we explore the possible effects of, say, shares of fuel, commodity, or manufacturing exports in total exports, commodity terms of trade volatility, and the relative share of goods to services exports.

The potential effects of the experience of currency and/or banking crises are controlled for in the empirical international reserve demand estimation. For each type of crisis, we

¹² The regions are: “North and South America,” “Europe,” which includes Western, Central, and Eastern Europe, “East and South Asia,” “Middle-east and North Africa,” and “Sub-Saharan Africa.”

constructed a dummy variable based on the crisis experience in the preceding five-years; that is from $t-1$ to $t-5$, using the formulation: $D_{c(t-1)} + .95 * D_{c(t-2)} + .90 * D_{c(t-3)} + .85 * D_{c(t-4)} + .80 * D_{c(t-5)}$, where $D_{c(.)} = 1$, if there is a crisis, and $= 0$, otherwise.¹³

The number of explanatory variables under all these categories considered in the entire set of empirical exercises is larger than discussed in the previous paragraphs. For brevity, we only discussed those that are significant in the subsequent analyses. Most of these data are extracted from the *World Development Indicator*, *International Financial Statistics*, and the IMF's *World Economy Outlook*. The Data Appendix presents all these variables in detail.

3. Estimation Results

Most of the discussions of the hoarding of international reserves are driven by the observed behaviors of developing countries. We thus focus our attention on developing countries. Results derived from data of developed countries will be included for comparison purposes.

3.1 Basic Results – Developing Countries

The results of estimating equation (1) based on data from developing countries are summarized in Table 1. The results are based on panel regressions allowing for country-fixed effects. Indeed, we found that a model with fixed effects is statistically appropriate and, according to the Hausman test, better than a random effects specification. To avoid the endogeneity issue, all the right-hand-side variables are lagged by one year. The specification is chosen using the following strategy. First, in the pre-test stage, we considered the 1999-2006 period, and examined the all the possible traditional macro, financial, and an economy's (institutional) characteristics variables; that is, X_{it} , Y_{it} , and D_{it} . We sequentially dropped the insignificant variables, and come up with the specification reported in column 2 of the Table. Then, we fitted the model to the sample periods of 2007-09, 2010-12, and 1999-2006.

A few observations are in order. First, let us consider the results of the 1999-2006 sample. The positive propensity to import effect is in accordance with the trade openness interpretation, which suggests that a higher level international reserves should be held to cover a higher level of imports (Frenkel, 1974b). The negative reserve volatility effect, however, is different from the

¹³ We assume that the weight diminishes by 5% every year; that is, the memory of a crisis among policy makers “depreciates” at the annual rate of 5%.

prediction of the buffer stock model of international reserves (Frenkel and Jovanovic, 1981). In the current panel setting, the negative effect could be associated with the anecdotal observation that large variations in a developing country's international reserves are usually caused by large drawn downs.

In addition to the internal drain and capital flight interpretation, the positive money supply stock effect is also in line with the early monetarist model of balance of payments that asserts, for example, an increase in international reserves is driven by an excess demand for money (Courchene and Youssef, 1967; Johnson, 1958). The other financial variable, the net value of portfolio liabilities, on the other hand, has a significantly negative effect on international reserve holdings. One possible interpretation is that, on the average, these developing countries treat international reserves and portfolio flows as substitutes.

The second observation is that the performance of these explanatory variables in the relative tranquil 1999-2006 period is quite different from their performance during the GFC crisis and post-crisis samples. The coefficient estimates of these variables could change in magnitude, sign, and the level of significance. For instance, during the 2007-2009 crisis period, the propensity to import is the only significant variable. During the post-crisis period, the import propensity effect becomes negative – a finding that is counter-intuitive.¹⁴ When we pooled the three sample periods, the estimation results resemble those of the pre-GFC 1999-2006 period, with the exception that the net portfolio liabilities show no significant effect.

These results reinforce the previous findings that the empirical demand for international reserves is time-varying, and its determining factors evolve over time (Cheung and Ito, 2008, 2009). Apparently, authorities respond to actual market conditions and adjust their reserve holding behavior. An implication is that the optimal or appropriate level of international reserves is not necessarily constant, and demand for international reserves is responding to developments in the global economy.

3.2 *The “New” Factors – Developing Countries*

In this sub-section, we discuss the results pertaining to the variable Z_{it} , that includes determining factors proposed during the GFC and post-crisis periods.

¹⁴ It is noted that the import variable used in our analysis is the import to GDP ratio, which is an average, and not a marginal, measure of import propensity. Thus, the negative propensity result could be attributed to Heller's (1966) argument which is based on marginal rather than average propensity.

Using the specification in Table 1 as the starting point, we included elements of Z_{it} , individually and then jointly, in the panel regression. All these results are presented in the Appendix. In Table 2 we reported the parsimonious representations, which are obtained from sequentially dropping the insignificant variables from the specifications reported under column (26) of the tables in Appendix; that is, the specification that includes all the Z_{it} variables.

One obvious observation is that these added variables have differential effects in the different sample periods under consideration. Although they are “labelled” as recently discussed factors, their effects on international reserve hoarding behavior are detected in the pre-GFC period. Specifically, the grossing saving has the expected positive sign; a result that lends support to the view that, for developing countries, grossing saving and holding of international reserves could be linked via current account surplus; a high level of national saving leads to a better current account and a high level of international reserve holding.

The outward direct investment effect is consistent with the view that investing overseas helps divert international assets from the international reserve account. As anticipated, the Joneses effect varies across country groups and historical time periods. The Joneses effects displayed by Asian countries in the pre-GFC and full sample periods echo the results reported in Cheung and Qian (2009). However, the rivalry in IR hoarding motivation is reversed during the crisis period. Countries in other regions do not display a stable Joneses effect across the sample periods. Nevertheless, the Joneses effect, if significant in the full sample, is always positive.

The two commodity price variables, the manufactures to export ratio, and the two crisis variables do not perform consistently across sample periods. Some of the findings are not totally intuitive. For instance, the negative banking crisis effect, manufactures effect, and commodity export effect are not what we expected.

During the 2007-9 crisis period, those additional variables that were significant in the previous period become insignificant or display the opposite effect. The change in the performance of these variables may not be surprising as the crisis represents hectic market conditions that prevent the normal economic relationship to hold. Nevertheless, the propensity to trade still displays a strong positive effect.

The post crisis 2010-12 result may be the most surprising one. The list of significant variables is dominated by the factors included Z_{it} . While the effects of swap agreements and gross saving are in line with expectations, the positive outward direct investment effect implies a

change in the link between outward direct investment and international reserves in the pre- and post-crisis period. Such a change deserves further analysis in future study.

Interestingly, most of these non-intuitive results disappeared (either become insignificant or significant with the expected sign) when we pooled the data from the three sample periods. In addition, the macro prudential policy is found to complement the international reserve accumulation policy.

3.3 *The Developed Countries*

We repeated the exercise using data from developed countries. The results are summarized in Table 3, which has a layout similar to Table 2 for developing countries. In accordance with previous findings, developed and developing countries display very different demand behaviors for international reserves in each of the sample periods under examination.

Despite the differences, our results confirm that the recently discussed factors including the sovereign wealth fund, the gross saving, the Joneses effect and the composition of trade affect the behavior of international reserve hoarding even in the pre-GFC period. The presence of the sovereign wealth funds decreases the level of holding of international reserves. The gross saving has a negative implication for international reserve holding; possibly due to developed countries are likely to deploy their savings in the global capital market. Taking results from different specifications into consideration, the Joneses effect is quite robust among the Asian countries; developed and developing countries alike.

The lists of significant variables in Tables 2 and 3 are quite different. Even the variables that turn out to be significant could exhibit opposing effects on the level of international reserves. For instance, with references to the 1999-2006 sample, the money stock, swap agreement, manufacture export, and banking crisis experience variables have opposing effects on the amounts of international reserves between developing and developed countries. Similar opposing impacts on international reserve holdings are displayed by the money stock variable, the swap agreement, and manufactures export in the full sample of 1999 to 2012.

As was the case with developing countries, the statistical specification of the demand for international reserves for developed countries display time variation. In addition, as attested by the results in Tables 2 and 3, these two groups of countries have different motivations of holding international reserves.

4. Prediction Exercises

4.1 *Are Developing Countries Over- or Under-Hoarding International Reserves?*

In the last two decades or so, economists and policymakers alike have been debating on the issue of the adequacy of international reserve holding. While deficiency in international reserve holding can trigger economic and financial instabilities, excessive hoarding of international reserves can create domestic economic over-heating and contribute to instability in the global economy. An overarching issue of the debate is how to determine, either theoretically or empirically, the appropriate or the optimal level of international reserves. A benchmark level is required to assess whether the actual level of holdings is too much or too few.

The estimation results in the previous section clearly show that, even in the last one and a half decades, the empirical demand function for international reserves changes over time and includes different sets of factors over different time periods. Thus, if we use the estimated level of international reserves as a reference point, the estimated degree of over- or under-hoarding depends upon which empirical model is used to compute the benchmark.

To illustrate the point, we used the estimated models reported in Table 2 to generate predictions of IR holding for developing countries. For each specification, we generate the in-sample and out-of-sample forward predictions, but not backward predictions. For example, using the model estimated for the 2007-2009 sample, we generate the in-sample predictions for 2007 to 2009, and the out-of-sample predictions for 2010 to 2012. These predictions and the actual levels of international reserve holding are graphed in Figure 2.

One caveat in reading these graphs is that the predictions are generated without country-fixed effects. We conceived that predictions made without country-fixed effects would resemble the way international investors compare cross-country investment destinations for arbitrage opportunities.¹⁵

Figure 2 includes actual and predicted holdings of international reserves of selected individual countries and countries groups. The individual countries include Argentina, China, Korea, Malaysia, Mexico, Thailand, and the “Fragile Five” of Brazil, India, Indonesia, South

¹⁵ Alternatively speaking, one could say that predictions with country-fixed effects are relevant for assessing whether the path of actual holdings of international reserves are higher or lower relative its historical tendency.

Africa, and Turkey. The country groups are the developing Asia excluding China, the Latin America, and emerging market economies.

Let us consider the differences during the period of 2010 to 2012. The models of the demand for international reserves estimated for the four sample periods could generate predictions that are quite different from each other. Compared with those from the other two specifications, the predictions from the 1999-2006 and 1999-2012 specifications are quite similar. The observation is in accordance with the results in Table 2 – the data from the 1999-2006 and 1999-2012 sample periods yield relatively similar estimation results. Depending on individual countries or country groups, predictions from the 2007-2009 or 2010-2012 specifications are quite different from those of the specifications estimated from a longer time span.

These plots confirm the assertion that whether a country is under- or over-hoarding international reserves depends on which estimation model is used as benchmark. China during the 2010-2012 period, for example, is deemed to hold international reserves that are far more than those predicted by the model estimated for the 2007-2009 period, are slightly less than those by the 1999-2006 specification, and are about right by the other two model specifications. The over-hoarding result delivered by the 2007-2009 specification is not unique to China. Indeed, similar over-hoarding results are observed for other Asian economies and the group of Asian economy excluding China included in Figure 2.

The “Fragile Five” – a recent acronym surfaced in the media that comprises Brazil, India, Indonesia, South Africa and Turkey – are viewed by the market as vulnerable to the reverse of the US quantitative easing (QE) policy. The graphs in Figure 2 indicate that these five countries are likely to be deficient in international reserves during the period of 2010-2012; they are considered under-hoarding by two or three of the four specifications under consideration. If it is the case, the market’s concern is quite justified in view of their deteriorating current account conditions.

Despite the wide variation of over- and under-hoarding estimates for individual countries, the three selected country groups tend to hold international reserves less than predicted.

4.2 International Reserve Holdings and Currency Depreciation

How are the countries that are susceptible to external financial shocks doing lately? In recent years, emerging market economies have ambivalent feelings about the spillovers from

advanced economies. On the one hand, emerging market economies benefit from the recovery of advanced economies, which are their important trading partners. On the other hand, with recovery underway, the advanced world will trigger the tapering policy to end the extremely low interest rate policy, which in turn could cause massive outflow of capital from emerging market economies. Indeed, the world witnessed on May 22, 2013 the adverse market effect of the Federal Reserve chairman Ben S. Bernanke's comment on tapering the QE policy on emerging financial markets.

As amplified in the media, economies that are financially vulnerable, including the Fragile Five discussed above, have been experiencing economic and financial stress. One sign of economic and financial stress is exemplified by the value of the domestic currency. With (anticipated) capital outflow and deteriorating economy performance, some emerging market economies have experienced a noticeable depreciation of their currencies in recent years.

While our estimation of the demand for international reserves does not answer definitely the question of whether a country is holding too much or too little international reserves, the results may shed light on the relative sufficiency/deficiency of international reserves. To investigate the issue, we study the possible links between our estimates of international reserves holding and the observed exchange rate movements. Specifically, we investigate if the currency stress is associated with the level of international reserve holding, which is interpreted as a barometer of a country's vulnerability to external financial shocks.

Figure 3 displays scatter diagrams of the magnitude of exchange rate depreciation and the degree of over-hoarding of international reserves. The exchange rate depreciation is measured against the US dollar, which is the prominent international currency. The difference between the actual and predicted levels of international reserves is our proxy of the degree of over-hoarding; that is, a positive difference implies over-hoarding while a negative one under-hoarding. If the under-hoarding proxy is a reasonable measure of vulnerability to external financial shocks, we expect it has a negative associate with exchange rate depreciation.

The scatter plots of the annual averages of exchange rate depreciation observed during the year of 2013 and the over-hoarding proxies for the period of 2010-2012 display different patterns. For instance, the proxies derived from the 2007-2009 model (Panel B) exhibit a wide dispersion relative to those from other model specifications. Nonetheless, a (weak) negative association of the two variables could be visualized in these four scatter plots.

To shed additional insight, we regress the rate of depreciation of the exchange rate against the U.S. dollar on the proxy for international reserve over-hoarding, and report the results in Table 4. Two over-hoarding proxies are considered: one is the average of the 2010 to 2012 values, and the other is the proxy value as of 2012.

The estimation results lend support to the visual inspection that the two variables are negatively related. All coefficient estimates are negative and, with the exception of the 1999-2006 case, statistically significant. The explanatory power, as given by the adjusted R-square estimates, ranges from 2% to 7% for the significant cases. Apparently, the information conveyed by the 2012 proxy for over-hoarding has a stronger impact for exchange rate depreciation than the one embedded in the annual averages of 2010 to 2012.

Based on the presumption that the market will drive down the exchange rate value of a country that experiences signs of external vulnerability amplified by its holding of international reserves, our findings either lend support to this presumption or are indicative of the relevance of the estimated demand models for international reserves (with the 1999-2006 model as a likely exception). A strong inference is that, if a country holds a deficient amount of international reserves, it tends to experience currency depreciation. The result will be reinforced by intervention in the foreign exchange market that further depletes the holding of international reserves.

5. Conclusions

Our analysis confirms structural changes associated with new patterns of hoarding international reserves. While there is no end in sight for hoarding reserves, some of the new factors may mitigate eventual reserve accumulation. The proliferation of sovereign wealth funds and possible rebalancing of emerging markets that followed aggressive export-led growth before the GFC may reduce reserve/GDP ratios of developing countries, as confirmed in the predictive exercises using the latest data. However, these predictions should be taken with a grain of salt, as there is no reason to expect future stability in the use of hoarding patterns in international reserves.

Appendix 1 Data Definitions

Macro/Traditional Variables (X):

Propensity to import – Imports as a ratio to GDP.

Reserve volatility – Standard deviations of the growth of IR holding in five year windows ($t - 5$ through $t - 1$) are used. The data are extracted from WDI and IFS.

Gross saving – Gross saving is used as % of GDP. WDI and WEO.

Opportunity cost of holding reserves – It is the difference between the long-term government bond yields and the U.S. 10-year government bond yields (Previously, I used the Treasury bill rates, not any more). For the countries for which the long-term bond yields data are not available, “lending rates” from the IFS are used. The data are from WDI and IFS.

Dummies for the fixed/pegged and crawling peg regimes – The Reinhart-Rogoff (2004) index is used to construct the exchange rate regime dummy variables. Their index ranges from 1 “no separate legal tender,” to 14 “Freely falling” (with increasing flexibility of exchange rate movement) and is a “de facto” index (in contrast to IMF’s “de jure” exchange rate regime classification). Here, as in Cheung and Ito, we aggregate these categories into three groups; namely “floating,” “Crawling Peg,” and “Fixed/Pegged.” The Reinhart and Rogoff index is updated to 2010. For 2011, we assume countries have the same exchange rate regime as in 2010.

Financial and Institutional Variables (Y):

M2 as % of GDP – M2 as a share of GDP (I used liquid liability ratios in the previous round)

Gross Portfolio Exposure – The sum of external assets and liabilities divided by GDP. The data are extracted from Lane-Milesi-Ferretti dataset. Previously, we used “net” exposure or change in the net exposure. Following Joshua’s advice, we now use the “gross” variable.

Currency, Banking, and Debt crisis – The number of crises in the window of time from $t - 5$ through $t - 1$ is counted for each type of crisis. The crisis dummies are the ones constructed in Aizenman and Ito (2013).

Net liabilities for FDI, debt, and portfolio investment – For each of the cross-border investment types, the net liabilities are calculated as <external liability minus external asset>, using the updated dataset of Lane and Milesi-Ferretti (2007 and updates).

De jure measure of financial openness – The index is based on Chinn and Ito (2006, 2008) and downloaded from http://web.pdx.edu/~ito/Chinn-Ito_website.htm .

Country Characteristic Variables (D):

Dummy variables are not tested because the estimations are conducted with fixed effects.

‘New’ Variables (Z)

Dummy for the sovereign wealth funds (SWF) – Using the data from the SWF Institute (<http://www.swfinstitute.org/fund-rankings/>), we assign the value of one for the country and

years in which the country of concern possesses a national-level SWF.

Dummy for bilateral swap agreements (SWAP) – This dummy takes the value of one if a country is in an agreement of a bilateral swap agreement (regardless of the currency of the agreement). The data are compiled using website information.

Dummy for macro prudential policies (MPP) – This dummy takes a value of one if a country has in place any of the macro prudential policies Lim, et al. (2013) compiled.

Gross saving – Gross saving is used as % of GDP. WDI and WEO.

Commodity TOT Volatility – Using the commodity terms of trade data compiled by Spatafora and Tytell (2009), we use the moving five-year standard deviations (in $t-5$ through $t-1$) of the change in the commodity TOT index as a proxy for commodity TOT volatility.¹⁶

Jones Effects – This variable is supposed to capture regional externality of IR holding and its computation is based on Cheung and Qian (2009). It is essentially the average of IR holding in the region country i belongs to, but it excludes the level of IR holding of country i itself. The regions are: “North and South America,” “Europe,” “East and South Asia,” “Middle-east and North Africa,” and “Sub-Saharan Africa.”¹⁷

Outward direct investment (ODI) – Outward direct investment as a share of GDP. The data are extracted from UNCTAD’s database.

Oil exporters – The dummy is assigned for oil exporters defined by the World Bank or Spatafora and Tytell (2009).

% of commodity exports – The “commodity exports” are the sum of fuel, food, agricultural goods, and minerals, all of which are extracted from WDI. It is shown as the share of total exports.

% of manufacturing exports – The data are from WDI. It is shown as the share of total exports.

Ratio of goods exports to service exports – Using the BoP data, we calculate the proportion of service exports in goods and service exports. Then, we come up with the ratio as $(1 \text{ minus service exports as \% of total exports}) / (\text{service exports as \% of total exports})$.

Financial Exposure – We use the ratio of (total external assets + total external liabilities) to GDP. The data are based on Lane and Milesi-Ferretti (2007 and updates).

Currency and Banking Crises – We use the dummy for both currency and banking crisis episodes that are identified in Aizenman and Ito (2013). For the identification of currency crisis, Aizenman and Ito (2013) first calculate the exchange rate market pressure (EMP) against the base country (Aizenman, et al., 2008, Eichengreen, et al. 1995, 1996). For the countries whose data for the EMP are not available, the crisis dummy is supplemented by the currency crisis identification by Reinhart and Rogoff (2009). Their banking crisis data are essentially based on Laeven and Velancia (2008, 2010, 2012). We count the number of past crisis years over $t-1$ through $t-5$ for each type of crises while assigning weights on the crisis dummies depending on the year. That is, the crisis variables are calculated as: $D_{c(t-1)} + .95 * D_{c(t-1)} + .90 * D_{c(t-3)} + .85 * D_{c(t-4)} + .80 * D_{c(t-5)}$. We assume that the weight diminishes by 5% every year, i.e., that the memory of a crisis among policy makers “depreciates” at the annual rate of 5%.

¹⁶ The original data are available up to 2009, but we obtained more updated data (up to 2011) from the authors. We thank authors for the generosity to share the data.

¹⁷ “Europe” includes Western, Central, and Eastern Europe.

Appendix 2: Estimation Results with New Variables Included One by One

Table A1-1: Determinants of IR holding -- 1999-2006: Panel, Developing Countries (LDC)

	LDC 1999-2006 (1)	LDC 1999-2006 (2)	LDC 1999-2006 (3)	LDC 1999-2006 (4)	LDC 1999-2006 (5)	LDC 1999-2006 (6)	LDC 1999-2006 (7)	LDC 1999-2006 (8)	LDC 1999-2006 (9)	LDC 1999-2006 (10)	LDC 1999-2006 (11)	LDC 1999-2006 (12)	LDC 1999-2006 (13)
Propensity to Import (t-1)	0.098 (0.035)***	0.098 (0.035)***	0.098 (0.035)***	0.094 (0.035)***	0.102 (0.034)***	0.112 (0.035)***	0.057 (0.035)	0.093 (0.035)***	0.101 (0.035)***	0.098 (0.035)***	0.098 (0.035)***	0.107 (0.035)***	0.101 (0.035)***
Reserve Volatility	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.012 (0.007)*	-0.012 (0.007)	-0.013 (0.007)*	-0.011 (0.007)	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*
M2 (% of GDP, t-1)	0.142 (0.026)***	0.142 (0.026)***	0.144 (0.026)***	0.133 (0.026)***	0.135 (0.025)***	0.143 (0.026)***	0.113 (0.026)***	0.132 (0.026)***	0.144 (0.026)***	0.143 (0.026)***	0.141 (0.026)***	0.142 (0.026)***	0.145 (0.026)***
Net Port. Liab.(t-1)	-0.101 (0.040)**	-0.101 (0.040)**	-0.104 (0.040)**	-0.093 (0.040)**	-0.112 (0.039)***	-0.107 (0.040)***	-0.110 (0.039)***	-0.098 (0.040)**	-0.108 (0.041)***	-0.101 (0.040)**	-0.101 (0.040)**	-0.116 (0.040)***	-0.110 (0.040)***
SWF, dummy (t-1)		0.003 (0.022)											
Swap agr., dummy (t-1)			-0.021 (0.041)										
Macro Prud.Pol., dummy (t-1)				0.018 (0.008)**									
Gross saving (t-1)					0.157 (0.048)***								
Commodity Volatility						0.067 (0.033)**							
Jones x Asia(t-1)							1.614 (0.360)***						
Jones x Europe(t-1)								0.888 (0.370)**					
Jones x MENA(t-1)									-0.084 (0.138)				
Jones x West Hem.(t-1)										-0.117 (0.507)			
Jones x SubSaharan(t-1)											0.511 (0.545)		
Outward Direct Inv.(t-1)												-0.176 (0.081)**	
% of manuf. export (t-1)													-0.096 (0.041)**
Ratio of Goods to Service exports (t-1)													
Financial openness (Chinn-Ito)													
Crawling Peg													
Fixed/Peg													
Opportunity Cost (t-1)													
Net Debt Liab.(t-1)													
Net FDI Liab.(t-1)													
Fin. exposure(t-1)													
% of fuel export (t-1)													
Commodity exp (%)													
# of Currency crisis (t-5 t-1)													
# of Banking crisis (t-5 t-1)													
Constant	0.064 (0.018)***	0.064 (0.018)***	0.063 (0.018)***	0.070 (0.018)***	0.033 (0.020)*	0.048 (0.020)**	0.044 (0.018)**	0.039 (0.021)*	0.064 (0.018)***	0.068 (0.023)***	0.054 (0.021)***	0.062 (0.018)***	0.111 (0.026)***
N	441	441	441	441	441	441	441	441	441	441	441	441	441
# of countries	70	70	70	70	70	70	70	70	70	70	70	70	70
Overall R2	0.56	0.57	0.56	0.57	0.58	0.56	0.33	0.37	0.55	0.57	0.52	0.55	0.52
W/in R2	0.16	0.16	0.16	0.17	0.18	0.17	0.20	0.17	0.16	0.16	0.16	0.17	0.17

* p<0.1; ** p<0.05; *** p<0.01

Table A1-2: Determinants of IR holding -- 1999-2006: Panel, Developing Countries (LDC)

	LDC 1999-2006 (14)	LDC 1999-2006 (15)	LDC 1999-2006 (16)	LDC 1999-2006 (17)	LDC 1999-2006 (18)	LDC 1999-2006 (19)	LDC 1999-2006 (20)	LDC 1999-2006 (21)	LDC 1999-2006 (22)	LDC 1999-2006 (23)	LDC 1999-2006 (24)	LDC 1999-2006 (25)	LDC 1999-2006 (26)
Propensity to Import (t-1)	0.098 (0.035)***	0.098 (0.035)***	0.095 (0.035)***	0.097 (0.035)***	0.097 (0.035)***	0.100 (0.035)***	0.105 (0.036)***	0.087 (0.039)**	0.098 (0.034)***	0.105 (0.035)***	0.096 (0.035)***	0.100 (0.035)***	0.103 (0.044)**
Reserve Volatility	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.012 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*	-0.012 (0.007)*	-0.012 (0.007)*	-0.012 (0.007)*	-0.013 (0.007)*	-0.013 (0.007)*
M2 (% of GDP, t-1)	0.142 (0.026)***	0.142 (0.026)***	0.142 (0.026)***	0.142 (0.026)***	0.142 (0.026)***	0.143 (0.026)***	0.148 (0.026)***	0.139 (0.026)***	0.138 (0.025)***	0.144 (0.025)***	0.139 (0.026)***	0.134 (0.026)***	0.101 (0.028)***
Net Port. Liab.(t-1)	-0.101 (0.040)**	-0.101 (0.040)**	-0.101 (0.040)**	-0.102 (0.040)**	-0.100 (0.040)**	-0.101 (0.040)**	-0.120 (0.045)***	-0.104 (0.040)***	-0.103 (0.039)***	-0.113 (0.040)***	-0.096 (0.040)**	-0.093 (0.040)**	-0.184 (0.047)***
SWF, dummy (t-1)													0.011 (0.025)
Swap agr., dummy (t-1)													-0.052 (0.047)
Macro Prud.Pol., dummy (t-1)													0.008 (0.008)
Gross saving (t-1)													0.165 (0.050)***
Commodity Volatility													0.052 (0.035)
Jones x Asia(t-1)													1.583 (0.394)***
Jones x Europe(t-1)													1.136 (0.406)***
Jones x MENA(t-1)													-0.102 (0.139)
Jones x West Hem.(t-1)													-0.043 (0.579)
Jones x SubSaharan(t-1)													0.418 (0.533)
Outward Direct Inv.(t-1)													-0.194 (0.079)**
% of manuf. export (t-1)													-0.025 (0.067)
Ratio of Goods to Service exports (t-1)	-0.000 (0.007)												-0.007 (0.007)
Financial openness (Chinn-Ito)		0.001 (0.015)											-0.010 (0.017)
Crawling Peg			0.005 (0.007)										-0.014 (0.010)
Fixed/Peg				-0.005 (0.009)									-0.023 (0.012)*
Opportunity Cost (t-1)					-0.003 (0.007)								0.009 (0.009)
Net Debt Liab.(t-1)						-0.003 (0.013)							-0.011 (0.014)
Net FDI Liab.(t-1)							0.028 (0.031)						0.033 (0.035)
Fin. exposure(t-1)								0.004 (0.006)					0.001 (0.008)
% of fuel export (t-1)									0.155 (0.048)***				0.128 (0.060)**
Commodity exp (%)										0.111 (0.041)***			0.040 (0.070)
# of Currency crisis (t-5 t-1)											-0.006 (0.004)		-0.004 (0.004)
# of Banking crisis (t-5 t-1)												-0.005 (0.003)*	0.002 (0.003)
Constant	0.064 (0.020)***	0.064 (0.019)***	0.063 (0.018)***	0.067 (0.018)***	0.069 (0.020)***	0.062 (0.020)***	0.065 (0.018)***	0.064 (0.018)***	0.043 (0.019)**	0.007 (0.027)	0.069 (0.018)***	0.072 (0.018)***	-0.062 (0.075)
N	441	441	441	441	441	441	441	441	441	441	441	441	441
# of countries	70	70	70	70	70	70	70	70	70	70	70	70	70
Overall R2	0.56	0.56	0.57	0.56	0.56	0.56	0.54	0.60	0.53	0.51	0.57	0.58	0.27
W/in R2	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.18	0.18	0.16	0.17	0.31

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A2-1: Determinants of IR holding -- 2007-09: Panel, Developing Countries (LDC)

	LDC 2007-09 (1)	LDC 2007-09 (2)	LDC 2007-09 (3)	LDC 2007-09 (4)	LDC 2007-09 (5)	LDC 2007-09 (6)	LDC 2007-09 (7)	LDC 2007-09 (8)	LDC 2007-09 (9)	LDC 2007-09 (10)	LDC 2007-09 (11)	LDC 2007-09 (12)	LDC 2007-09 (13)
Propensity to Import (t-1)	0.303 (0.160)*	0.302 (0.161)*	0.287 (0.161)*	0.344 (0.166)**	0.453 (0.163)**	0.296 (0.163)*	0.199 (0.162)	0.306 (0.160)*	0.319 (0.159)**	0.295 (0.163)*	0.314 (0.160)*	0.291 (0.168)*	0.340 (0.160)**
Reserve Volatility	0.261 (0.187)	0.262 (0.188)	0.215 (0.191)	0.243 (0.188)	0.314 (0.182)*	0.260 (0.188)	0.234 (0.183)	0.218 (0.190)	0.256 (0.185)	0.259 (0.188)	0.237 (0.188)	0.254 (0.190)	0.291 (0.186)
M2 (% of GDP, t-1)	0.050 (0.145)	0.045 (0.146)	0.024 (0.147)	0.067 (0.146)	0.050 (0.140)	0.054 (0.147)	0.076 (0.142)	0.036 (0.145)	0.078 (0.145)	0.052 (0.146)	0.050 (0.145)	0.052 (0.146)	0.031 (0.144)
Net Port. Liab.(t-1)	0.065 (0.127)	0.046 (0.138)	0.046 (0.128)	0.073 (0.127)	0.069 (0.122)	0.065 (0.127)	-0.034 (0.130)	0.041 (0.128)	0.055 (0.126)	0.064 (0.127)	0.055 (0.127)	0.066 (0.127)	0.047 (0.126)
SWF, dummy (t-1)		0.020 (0.055)											
Swap agr., dummy (t-1)			0.032 (0.028)										
Macro Prud.Pol., dummy (t-1)				-0.018 (0.018)									
Gross saving (t-1)					0.660 (0.221)**								
Commodity Volatility						0.077 (0.332)							
Jones x Asia(t-1)							-2.475 (1.006)**						
Jones x Europe(t-1)								-0.632 (0.518)					
Jones x MENA(t-1)									-1.444 (0.820)*				
Jones x West Hem.(t-1)										0.656 (2.395)			
Jones x SubSaharan(t-1)											-2.614 (2.283)		
Outward Direct Inv.(t-1)												-0.081 (0.333)	
% of manuf. export (t-1)													-0.207 (0.122)*
Ratio of Goods to Service exports (t-1)													
Financial openness (Chinn-Ito)													
Crawling Peg													
Fixed/Peg													
Opportunity Cost (t-1)													
Net Debt Liab.(t-1)													
Net FDI Liab.(t-1)													
Fin. exposure(t-1)													
% of fuel export (t-1)													
Commodity exp (%)													
# of Currency crisis (t-5 t-1)													
# of Banking crisis (t-5 t-1)													
Constant	0.029 (0.098)	0.028 (0.098)	0.056 (0.100)	0.003 (0.101)	-0.217 (0.125)*	0.024 (0.100)	0.172 (0.112)	0.066 (0.102)	0.071 (0.100)	0.011 (0.117)	0.088 (0.110)	0.036 (0.103)	0.120 (0.110)
N	182	182	182	182	182	182	182	182	182	182	182	182	182
# of countries	67	67	67	67	67	67	67	67	67	67	67	67	67
Overall R2	0.34	0.35	0.30	0.35	0.40	0.34	0.01	0.39	0.02	0.27	0.20	0.34	0.27
W/in R2	0.06	0.06	0.07	0.06	0.13	0.06	0.10	0.07	0.08	0.06	0.07	0.06	0.08

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A2-2: Determinants of IR holding -- 2007-09: Panel, Developing Countries (LDC)

	LDC 2007-09 (14)	LDC 2007-09 (15)	LDC 2007-09 (16)	LDC 2007-09 (17)	LDC 2007-09 (18)	LDC 2007-09 (19)	LDC 2007-09 (20)	LDC 2007-09 (21)	LDC 2007-09 (22)	LDC 2007-09 (23)	LDC 2007-09 (24)	LDC 2007-09 (25)	LDC 2007-09 (26)
Propensity to Import (t-1)	0.302 (0.161)*	0.273 (0.162)*	0.311 (0.161)*	0.315 (0.161)*	0.255 (0.165)	0.343 (0.156)**	0.411 (0.156)***	0.241 (0.162)	0.314 (0.159)*	0.334 (0.159)**	0.331 (0.159)**	0.308 (0.160)*	0.413 (0.184)**
Reserve Volatility	0.263 (0.189)	0.259 (0.187)	0.263 (0.188)	0.258 (0.188)	0.222 (0.190)	0.347 (0.184)*	0.313 (0.179)*	0.271 (0.185)	0.280 (0.186)	0.299 (0.186)	0.263 (0.185)	0.218 (0.195)	0.311 (0.193)
M2 (% of GDP, t-1)	0.049 (0.146)	0.085 (0.148)	0.048 (0.145)	0.051 (0.145)	0.058 (0.145)	0.053 (0.141)	0.052 (0.138)	0.120 (0.148)	0.045 (0.144)	0.034 (0.144)	0.001 (0.146)	0.037 (0.146)	0.096 (0.149)
Net Port. Liab.(t-1)	0.063 (0.128)	0.109 (0.132)	0.051 (0.129)	0.050 (0.128)	0.026 (0.131)	0.046 (0.123)	-0.038 (0.124)	0.055 (0.125)	0.046 (0.126)	0.051 (0.125)	0.056 (0.125)	0.049 (0.128)	-0.148 (0.143)
SWF, dummy (t-1)													-0.001 (0.053)
Swap agr., dummy (t-1)													0.029 (0.029)
Macro Prud.Pol., dummy (t-1)													-0.018 (0.018)
Gross saving (t-1)													0.410 (0.232)*
Commodity Volatility													-0.180 (0.343)
Jones x Asia(t-1)													-2.822 (1.080)**
Jones x Europe(t-1)													0.422 (0.693)
Jones x MENA(t-1)													-1.072 (0.788)
Jones x West Hem.(t-1)													-0.474 (2.991)
Jones x SubSaharan(t-1)													-0.943 (2.149)
Outward Direct Inv.(t-1)													0.338 (0.396)
% of manuf. export (t-1)													0.070 (0.283)
Ratio of Goods to Service exports (t-1)	0.006 (0.048)												-0.018 (0.048)
Financial openness (Chinn-Ito)		-0.110 (0.096)											-0.274 (0.102)***
Crawling Peg			0.023 (0.032)										0.073 (0.051)
Fixed/Peg				-0.033 (0.042)									0.038 (0.064)
Opportunity Cost (t-1)					0.031 (0.026)								0.059 (0.036)*
Net Debt Liab.(t-1)						0.222 (0.078)***							0.176 (0.088)**
Net FDI Liab.(t-1)							0.286 (0.082)***						0.185 (0.108)*
Fin. exposure(t-1)								-0.021 (0.011)*					0.006 (0.015)
% of fuel export (t-1)									0.342 (0.219)				0.171 (0.270)
Commodity exp (%)										0.257 (0.135)*			0.272 (0.311)
# of Currency crisis (t-5(t-1))											0.052 (0.027)*		0.065 (0.030)**
# of Banking crisis (t-5(t-1))												0.018 (0.022)	0.001 (0.025)
Constant	0.022 (0.112)	0.093 (0.112)	0.012 (0.100)	0.032 (0.098)	0.022 (0.097)	0.025 (0.095)	0.052 (0.093)	0.054 (0.097)	-0.044 (0.108)	-0.110 (0.121)	0.039 (0.097)	0.036 (0.098)	-0.024 (0.374)
N	182	182	182	182	182	182	182	182	182	182	182	182	182
# of countries	67	67	67	67	67	67	67	67	67	67	67	67	67
Overall R2	0.34	0.39	0.35	0.35	0.34	0.33	0.28	0.24	0.34	0.24	0.26	0.32	0.00
W/in R2	0.06	0.07	0.06	0.06	0.07	0.12	0.15	0.08	0.08	0.09	0.09	0.06	0.42

 * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A3-1: Determinants of IR holding -- 2010-12: Panel, Developing Countries (LDC)

	LDC 2010-12 (1)	LDC 2010-12 (2)	LDC 2010-12 (3)	LDC 2010-12 (4)	LDC 2010-12 (5)	LDC 2010-12 (6)	LDC 2010-12 (7)	LDC 2010-12 (8)	LDC 2010-12 (9)	LDC 2010-12 (10)	LDC 2010-12 (11)	LDC 2010-12 (12)	LDC 2010-12 (13)
Propensity to Import (t-1)	-0.117 (0.060)*	-0.124 (0.060)**	-0.099 (0.060)	-0.117 (0.060)*	-0.113 (0.060)*	-0.114 (0.061)*	-0.130 (0.061)**	-0.132 (0.059)**	-0.107 (0.054)*	-0.126 (0.060)**	-0.116 (0.062)*	-0.133 (0.060)**	-0.120 (0.061)*
Reserve Volatility	-0.147 (0.212)	-0.150 (0.212)	-0.117 (0.210)	-0.150 (0.213)	-0.119 (0.215)	-0.138 (0.216)	-0.157 (0.212)	-0.051 (0.213)	-0.115 (0.191)	-0.162 (0.212)	-0.148 (0.213)	-0.117 (0.210)	-0.158 (0.214)
M2 (% of GDP, t-1)	0.150 (0.094)	0.159 (0.095)*	0.170 (0.094)*	0.158 (0.096)	0.136 (0.096)	0.151 (0.095)	0.151 (0.094)	0.152 (0.093)	0.029 (0.089)	0.142 (0.094)	0.149 (0.095)	0.184 (0.095)*	0.159 (0.097)
Net Port. Liab.(t-1)	-0.151 (0.127)	-0.148 (0.127)	-0.181 (0.126)	-0.152 (0.127)	-0.155 (0.127)	-0.152 (0.127)	-0.156 (0.127)	-0.165 (0.125)	-0.057 (0.116)	-0.156 (0.126)	-0.151 (0.127)	-0.104 (0.128)	-0.154 (0.127)
SWF, dummy (t-1)		0.040 (0.039)											
Swap agr., dummy (t-1)			-0.036 (0.020)*										
Macro Prud.Pol., dummy (t-1)				0.005 (0.011)									
Gross saving (t-1)					0.098 (0.116)								
Commodity Volatility						0.050 (0.179)							
Jones x Asia(t-1)							-0.922 (0.938)						
Jones x Europe(t-1)								-2.573 (1.248)**					
Jones x MENA(t-1)									0.625 (0.133)***				
Jones x West Hem.(t-1)										-3.586 (2.996)			
Jones x SubSaharan(t-1)											0.066 (0.651)		
Outward Direct Inv.(t-1)												0.345 (0.187)*	
% of manuf. export (t-1)													0.018 (0.043)
Ratio of Goods to Service exports (t-1)													
Financial openness (Chinn-Ito)													
Crawling Peg													
Fixed/Peg													
Opportunity Cost (t-1)													
Net Debt Liab.(t-1)													
Net FDI Liab.(t-1)													
Fin. exposure(t-1)													
% of fuel export (t-1)													
Commodity exp (%)													
# of Currency crisis (t-5(t-1))													
# of Banking crisis (t-5(t-1))													
Constant	0.214 (0.072)***	0.199 (0.074)***	0.197 (0.072)***	0.206 (0.074)***	0.196 (0.075)***	0.205 (0.079)**	0.274 (0.094)***	0.322 (0.088)***	0.265 (0.066)***	0.375 (0.153)**	0.212 (0.075)***	0.187 (0.073)**	0.201 (0.079)**
N	154	154	154	154	154	154	154	154	154	154	154	154	154
# of countries	58	58	58	58	58	58	58	58	58	58	58	58	58
Overall R2	0.15	0.20	0.18	0.18	0.15	0.16	0.01	0.07	0.01	0.11	0.15	0.35	0.17
W/in R2	0.07	0.08	0.10	0.07	0.08	0.07	0.08	0.11	0.25	0.09	0.07	0.10	0.07

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A3-2: Determinants of IR holding -- 2010-12: Panel, Developing Countries (LDC)

	LDC 2010-12 (14)	LDC 2010-12 (15)	LDC 2010-12 (16)	LDC 2010-12 (17)	LDC 2010-12 (18)	LDC 2010-12 (19)	LDC 2010-12 (20)	LDC 2010-12 (21)	LDC 2010-12 (22)	LDC 2010-12 (23)	LDC 2010-12 (24)	LDC 2010-12 (25)	LDC 2010-12 (26)
Propensity to Import (t-1)	-0.072 (0.065)	-0.117 (0.060)*	-0.114 (0.060)*	-0.112 (0.060)*	-0.119 (0.060)*	-0.115 (0.061)*	-0.118 (0.060)*	-0.117 (0.060)*	-0.113 (0.061)*	-0.119 (0.060)*	-0.123 (0.060)**	-0.087 (0.063)	-0.032 (0.067)
Reserve Volatility	-0.143 (0.210)	-0.146 (0.214)	-0.110 (0.213)	-0.099 (0.213)	-0.108 (0.219)	-0.144 (0.213)	-0.164 (0.213)	-0.150 (0.214)	-0.151 (0.213)	-0.155 (0.213)	-0.148 (0.212)	-0.145 (0.210)	0.060 (0.197)
M2 (% of GDP, t-1)	0.155 (0.093)*	0.150 (0.095)	0.150 (0.094)	0.146 (0.094)	0.157 (0.095)	0.154 (0.096)	0.154 (0.095)	0.150 (0.095)	0.152 (0.095)	0.158 (0.096)	0.163 (0.096)*	0.134 (0.094)	0.028 (0.095)
Net Port. Liab.(t-1)	-0.103 (0.129)	-0.150 (0.128)	-0.149 (0.126)	-0.146 (0.126)	-0.139 (0.128)	-0.141 (0.132)	-0.116 (0.132)	-0.151 (0.127)	-0.147 (0.128)	-0.153 (0.127)	-0.148 (0.127)	-0.128 (0.127)	0.030 (0.133)
SWF, dummy (t-1)													0.062 (0.060)
Swap agr., dummy (t-1)													-0.031 (0.020)
Macro Prud.Pol., dummy (t-1)													-0.008 (0.010)
Gross saving (t-1)													0.337 (0.142)**
Commodity Volatility													-0.018 (0.198)
Jones x Asia(t-1)													-1.384 (0.935)
Jones x Europe(t-1)													-2.848 (1.188)**
Jones x MENA(t-1)													0.603 (0.137)***
Jones x West Hem.(t-1)													-2.272 (3.177)
Jones x SubSaharan(t-1)													0.593 (0.654)
Outward Direct Inv.(t-1)													0.609 (0.247)**
% of manuf. export (t-1)													-0.045 (0.075)
Ratio of Goods to Service exports (t-1)	-0.041 (0.024)*												-0.024 (0.024)
Financial openness (Chinn-Ito)		-0.006 (0.058)											0.037 (0.054)
Crawling Peg			0.027 (0.020)										0.013 (0.038)
Fixed/Peg				-0.036 (0.023)									-0.010 (0.039)
Opportunity Cost (t-1)					0.015 (0.021)								-0.020 (0.023)
Net Debt Liab.(t-1)						-0.015 (0.049)							0.050 (0.055)
Net FDI Liab.(t-1)							0.072 (0.076)						0.006 (0.106)
Fin. exposure(t-1)								-0.002 (0.017)					-0.036 (0.028)
% of fuel export (t-1)									-0.049 (0.106)				-0.017 (0.131)
Commodity exp (%)										-0.023 (0.039)			-0.080 (0.072)
# of Currency crisis (t-5)t-1											-0.022 (0.027)		-0.023 (0.047)
# of Banking crisis (t-5)t-1												-0.017 (0.011)	-0.052 (0.013)***
Constant	0.241 (0.073)***	0.217 (0.079)***	0.192 (0.074)**	0.219 (0.072)***	0.187 (0.082)**	0.208 (0.076)***	0.237 (0.076)***	0.218 (0.080)***	0.220 (0.074)***	0.221 (0.074)***	0.209 (0.073)***	0.215 (0.072)***	0.596 (0.225)***
N	154	154	154	154	154	154	154	154	154	154	154	154	154
# of countries	58	58	58	58	58	58	58	58	58	58	58	58	58
Overall R2	0.23	0.15	0.17	0.14	0.16	0.16	0.15	0.11	0.16	0.17	0.17	0.19	0.00
W/in R2	0.10	0.07	0.09	0.09	0.08	0.07	0.08	0.07	0.07	0.07	0.08	0.09	0.55

* p<0.1; ** p<0.05; *** p<0.01

Table A4-1: Determinants of IR holding -- 1999-2012: Panel, Developing Countries (LDC)

	LDC 1999-2012 (1)	LDC 1999-2012 (2)	LDC 1999-2012 (3)	LDC 1999-2012 (4)	LDC 1999-2012 (5)	LDC 1999-2012 (6)	LDC 1999-2012 (7)	LDC 1999-2012 (8)	LDC 1999-2012 (9)	LDC 1999-2012 (10)	LDC 1999-2012 (11)	LDC 1999-2012 (12)	LDC 1999-2012 (13)
Propensity to Import (t-1)	0.107 (0.031)***	0.106 (0.031)***	0.106 (0.031)***	0.106 (0.031)***	0.129 (0.030)***	0.103 (0.032)***	0.113 (0.031)***	0.104 (0.031)***	0.107 (0.031)***	0.106 (0.031)***	0.106 (0.031)***	0.096 (0.032)***	0.124 (0.031)***
Reserve Volatility	-0.019 (0.008)**	-0.019 (0.008)**	-0.019 (0.008)**	-0.018 (0.008)**	-0.015 (0.008)*	-0.019 (0.008)**	-0.020 (0.008)**	-0.019 (0.008)**	-0.019 (0.008)**	-0.018 (0.008)**	-0.018 (0.009)**	-0.018 (0.008)**	-0.018 (0.008)**
M2 (% of GDP, t-1)	0.233 (0.022)***	0.234 (0.023)***	0.222 (0.024)***	0.211 (0.023)***	0.216 (0.022)***	0.232 (0.022)***	0.188 (0.024)***	0.244 (0.023)***	0.234 (0.023)***	0.229 (0.023)***	0.232 (0.023)***	0.228 (0.023)***	0.214 (0.023)***
Net Port. Liab.(t-1)	0.023 (0.035)	0.022 (0.035)	0.021 (0.035)	0.031 (0.035)	0.016 (0.034)	0.027 (0.036)	0.020 (0.035)	0.019 (0.035)	0.024 (0.035)	0.025 (0.035)	0.024 (0.035)	0.010 (0.036)	0.011 (0.035)
SWF, dummy (t-1)		-0.007 (0.014)											
Swap agr., dummy (t-1)			0.015 (0.011)										
Macro Prud.Pol., dummy (t-1)				0.023 (0.007)***									
Gross saving (t-1)					0.314 (0.044)***								
Commodity Volatility						-0.025 (0.035)							
Jones x Asia(t-1)							0.847 (0.174)***						
Jones x Europe(t-1)								-0.595 (0.321)*					
Jones x MENA(t-1)									-0.051 (0.082)				
Jones x West Hem.(t-1)										0.401 (0.223)*			
Jones x SubSaharan(t-1)											0.074 (0.269)		
Outward Direct Inv.(t-1)												0.185 (0.091)**	
% of manuf. export (t-1)													-0.146 (0.032)***
Ratio of Goods to Service exports (t-1)													
Financial openness (Chinn-Ito)													
Crawling Peg													
Fixed/Peg													
Opportunity Cost (t-1)													
Net Debt Liab.(t-1)													
Net FDI Liab.(t-1)													
Fin. exposure(t-1)													
% of fuel export (t-1)													
Commodity exp (%)													
# of Currency crisis (t-5 t-1)													
# of Banking crisis (t-5 t-1)													
Constant	0.024 (0.016)	0.024 (0.016)	0.029 (0.016)*	0.032 (0.016)**	-0.048 (0.018)***	0.029 (0.017)*	0.013 (0.015)	0.041 (0.018)**	0.024 (0.016)	0.013 (0.017)	0.022 (0.016)	0.029 (0.016)*	0.099 (0.023)***
N	777	777	777	777	777	777	777	777	777	777	777	777	777
# of countries	73	73	73	73	73	73	73	73	73	73	73	73	73
Overall R2	0.58	0.57	0.58	0.59	0.61	0.58	0.49	0.54	0.57	0.54	0.58	0.57	0.59
W/in R2	0.23	0.23	0.24	0.25	0.29	0.23	0.26	0.24	0.23	0.24	0.23	0.24	0.26

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A4-2: Determinants of IR holding -- 1999-2012: Panel, Developing Countries (LDC)

	LDC 1999-2012 (14)	LDC 1999-2012 (15)	LDC 1999-2012 (16)	LDC 1999-2012 (17)	LDC 1999-2012 (18)	LDC 1999-2012 (19)	LDC 1999-2012 (20)	LDC 1999-2012 (21)	LDC 1999-2012 (22)	LDC 1999-2012 (23)	LDC 1999-2012 (24)	LDC 1999-2012 (25)	LDC 1999-2012 (26)
Propensity to Import (t-1)	0.105 (0.032)***	0.108 (0.031)***	0.101 (0.031)***	0.102 (0.031)***	0.102 (0.032)***	0.094 (0.031)***	0.123 (0.032)***	0.073 (0.033)**	0.113 (0.031)***	0.121 (0.031)***	0.107 (0.031)***	0.109 (0.031)***	0.091 (0.035)***
Reserve Volatility	-0.018 (0.008)**	-0.018 (0.008)**	-0.018 (0.008)**	-0.020 (0.008)**	-0.017 (0.008)**	-0.009 (0.009)	-0.016 (0.008)*	-0.022 (0.008)***	-0.018 (0.008)**	-0.017 (0.008)**	-0.019 (0.008)**	-0.018 (0.008)**	-0.016 (0.009)*
M2 (% of GDP, t-1)	0.233 (0.022)***	0.236 (0.023)***	0.235 (0.022)***	0.236 (0.022)***	0.234 (0.022)***	0.230 (0.022)***	0.243 (0.023)***	0.206 (0.024)***	0.214 (0.022)***	0.218 (0.022)***	0.230 (0.023)***	0.227 (0.023)***	0.153 (0.027)***
Net Port. Liab.(t-1)	0.024 (0.035)	0.022 (0.035)	0.029 (0.035)	0.026 (0.035)	0.029 (0.035)	0.025 (0.035)	0.006 (0.036)	-0.025 (0.039)	0.025 (0.035)	0.011 (0.035)	0.026 (0.035)	0.032 (0.036)	-0.049 (0.039)
SWF, dummy (t-1)													-0.024 (0.014)*
Swap agr., dummy (t-1)													-0.009 (0.011)
Macro Prud.Pol., dummy (t-1)													0.020 (0.007)***
Gross saving (t-1)													0.264 (0.046)***
Commodity Volatility													-0.019 (0.036)
Jones x Asia(t-1)													0.559 (0.196)***
Jones x Europe(t-1)													-0.583 (0.325)*
Jones x MENA(t-1)													-0.104 (0.079)
Jones x West Hem.(t-1)													0.222 (0.250)
Jones x SubSaharan(t-1)													0.134 (0.276)
Outward Direct Inv.(t-1)													-0.001 (0.093)
% of manuf. export (t-1)													-0.036 (0.065)
Ratio of Goods to Service exports (t-1)	0.003 (0.007)												-0.013 (0.007)*
Financial openness (Chinn-Ito)		-0.017 (0.015)											-0.010 (0.016)
Crawling Peg			0.022 (0.007)***										0.011 (0.011)
Fixed/Peg				-0.020 (0.009)**									-0.021 (0.013)
Opportunity Cost (t-1)					-0.010 (0.008)								-0.008 (0.008)
Net Debt Liab.(t-1)						0.036 (0.012)***							0.019 (0.014)
Net FDI Liab.(t-1)							0.040 (0.020)**						0.020 (0.022)
Fin. exposure(t-1)								0.012 (0.004)***					0.015 (0.005)***
% of fuel export (t-1)									0.213 (0.045)***				0.154 (0.052)***
Commodity exp (%)										0.137 (0.032)***			0.008 (0.066)
# of Currency crisis (t-5 t-1)											-0.003 (0.004)		0.002 (0.005)
# of Banking crisis (t-5 t-1)												-0.005 (0.003)*	0.002 (0.003)
Constant	0.020 (0.018)	0.031 (0.017)*	0.013 (0.016)	0.029 (0.016)*	0.036 (0.018)**	0.038 (0.016)**	0.020 (0.016)	0.035 (0.016)**	-0.004 (0.016)	-0.041 (0.022)*	0.026 (0.016)	0.028 (0.016)*	0.018 (0.071)
N	777	777	777	777	777	777	777	777	777	777	777	777	777
# of countries	73	73	73	73	73	73	73	73	73	73	73	73	73
Overall R2	0.58	0.58	0.59	0.58	0.58	0.58	0.57	0.61	0.61	0.59	0.58	0.58	0.53
W/in R2	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.26	0.25	0.23	0.24	0.36

* p<0.1; ** p<0.05; *** p<0.01

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Table 1: Determinants of Holdings of International Reserves -- Developing Countries

	1999-2006	2007-09	2010-12	1999-2012
Propensity to Import (t-1)	0.098 (0.035)***	0.303 (0.160)*	-0.117 (0.060)*	0.107 (0.031)***
Reserve Volatility	-0.013 (0.007)*	0.261 (0.187)	-0.147 (0.212)	-0.019 (0.008)**
M2 (% of GDP, t-1)	0.142 (0.026)***	0.050 (0.145)	0.150 (0.094)	0.233 (0.022)***
Net Port. Liab.(t-1)	-0.101 (0.040)**	0.065 (0.127)	-0.151 (0.127)	0.023 (0.035)
Constant	0.064 (0.018)***	0.029 (0.098)	0.214 (0.072)***	0.024 (0.016)
<i>N</i>	441	182	154	777
# of countries	70	67	58	73
Overall R2	0.56	0.34	0.15	0.58
W/in R2	0.16	0.06	0.07	0.23

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 2: Determinants of Holdings of International Reserves -- Developing Countries, Full Model

	1999-2006	2007-2009	2010-2012	1999-2012
Propensity to Import (t-1)	0.077 (0.034)**	0.208 (0.097)**		0.155 (0.028)***
Reserve Volatility	0.007 (0.001)***			
M2 (% of GDP, t-1)	0.087 (0.029)***	-0.145 (0.062)**		0.077 (0.023)***
Net Portfolio Liab. (t-1)	-0.209 (0.042)***			-0.167 (0.034)***
Opportunity Cost (t-1)		0.049 (0.019)**		
Fixed/Peg				-0.025 (0.009)***
Crawling Peg		0.042 (0.025)*		
Net Debt Liabilities (t-1)		0.092 (0.032)***		0.019 (0.010)*
Fin. exposure(t-1)				0.011 (0.004)***
Financial open. (Chinn-Ito, t-1)		-0.105 (0.063)*		-0.046 (0.015)***
Swap agr., dummy (t-1)			-0.031 (0.013)**	-0.028 (0.012)**
Macro Prudential Policies, dummy (t-1)				0.033 (0.008)***
Gross saving (t-1)	0.294 (0.037)***		0.302 (0.076)***	0.238 (0.028)***
Outward Direct Inv.(t-1)	-0.217 (0.101)**		0.249 (0.137)*	
Jones x Asia(t-1)	1.161 (0.315)***	-2.068 (0.687)***		0.472 (0.154)***
Jones x Europe(t-1)	1.491 (0.430)***		-2.458 (0.748)***	
Jones x West Hem.(t-1)				0.591 (0.201)***
Jones x MENA(t-1)		-1.088 (0.635)*	0.549 (0.091)***	0.518 (0.073)***
Jones x Sub-Saharan (t-1)			0.831 (0.334)**	
Commodity Volatility	0.056 (0.025)**			
Commodity exp. (% of total) (t-1)			-0.070 (0.025)***	
Manufacturing exports (% of total: t-1)				-0.048 (0.023)**
# of Currency crisis (t-5 t-1)		0.072 (0.019)***		
# of Banking crisis (t-5 t-1)			-0.026 (0.007)***	
Constant	-0.052 (0.022)**	0.315 (0.073)***	0.256 (0.042)***	0.017 (0.021)
N	905	285	229	1,467
# of countries	128	101	86	127
Overall R2	0.11	0.09	0.04	0.36
W/in R2	0.24	0.24	0.40	0.24

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 3: Determinants of Holdings of International Reserves -- Developed Countries, Full Model

	1999-2006	2007-2009	2010-2012	1999-2012
Propensity to Import (t-1)		-0.568 (0.245)**		
Reserve Volatility	0.281 (0.050)***		1.607 (0.329)***	
M2 (% of GDP, t-1)		-0.110 (0.031)***		-0.029 (0.014)**
Opportunity Cost (t-1)	0.065 (0.012)***	-0.155 (0.038)***		-0.068 (0.015)***
Net Debt Liabilities (t-1)	0.031 (0.009)***	0.131 (0.035)***		-0.023 (0.003)***
Fin. exposure(t-1)		-0.018 (0.004)***		
Financial open. (Chinn-Ito, t-1)		-1.219 (0.241)***		
SWF, dummy (t-1)	-0.044 (0.010)***			-0.032 (0.017)*
Swap agr., dummy (t-1)		0.051 (0.009)***		0.041 (0.010)***
Gross saving (t-1)	-0.182 (0.079)**		-1.212 (0.476)**	
Commodity Volatility	-0.230 (0.048)***			
Jones x Asia(t-1)	0.758 (0.249)***			1.101 (0.294)***
Jones x Europe(t-1)	-0.752 (0.156)***			
% of manuf. export (t-1)		0.667 (0.389)*		0.318 (0.132)**
Ratio of Goods to Service exports (t-1)		-0.122 (0.043)***		
% of fuel export (t-1)		1.865 (0.329)***		0.512 (0.196)***
Commodity exp (%)		-1.809 (0.474)***		-0.484 (0.182)***
Outward Direct Inv.(t-1)			-0.189 (0.103)*	
# of Banking crisis (t-5 t-1)	-0.015 (0.004)***	0.071 (0.010)***	0.021 (0.009)**	0.018 (0.004)***
Constant	0.146 (0.026)***	1.760 (0.469)***	-0.132 (0.120)	-0.057 (0.120)
<i>N</i>	174	64	66	300
# of countries	23	22	23	23
Overall R2	0.00	0.08	0.04	0.01
W/in R2	0.50	0.83	0.49	0.35

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 4: The Proxy of Over-hoarding and Exchange Rate Depreciation in 2012-13

<i>Dep. Var.: % of Depreciation 2012-13</i>						
<i>Model</i>	Prediction errors 2010-12			Prediction errors as		
	1999-2006 (1)	2007-09 (2)	2010-2012 (3)	1999-2012 (4)	1999-2006 (5)	2007-09 (6)
Pred. errors.	-0.033 (0.025)	-0.052 (0.022)**	-0.053 (0.029)*	-0.096 (0.057)*	-0.031 (0.025)	-0.056 (0.024)**
Constant	0.020 (0.008)**	0.031 (0.011)***	0.016 (0.009)*	0.020 (0.008)**	0.023 (0.009)**	0.037 (0.012)***
Adjusted R2	-0.00	0.06	0.02	0.03	-0.01	0.07
<i>N</i>	82	64	64	77	69	55

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Standard errors are robust standard errors.

Figure 1: International Reserve Holding as a ratio to GDP (a) and to the world total (b)

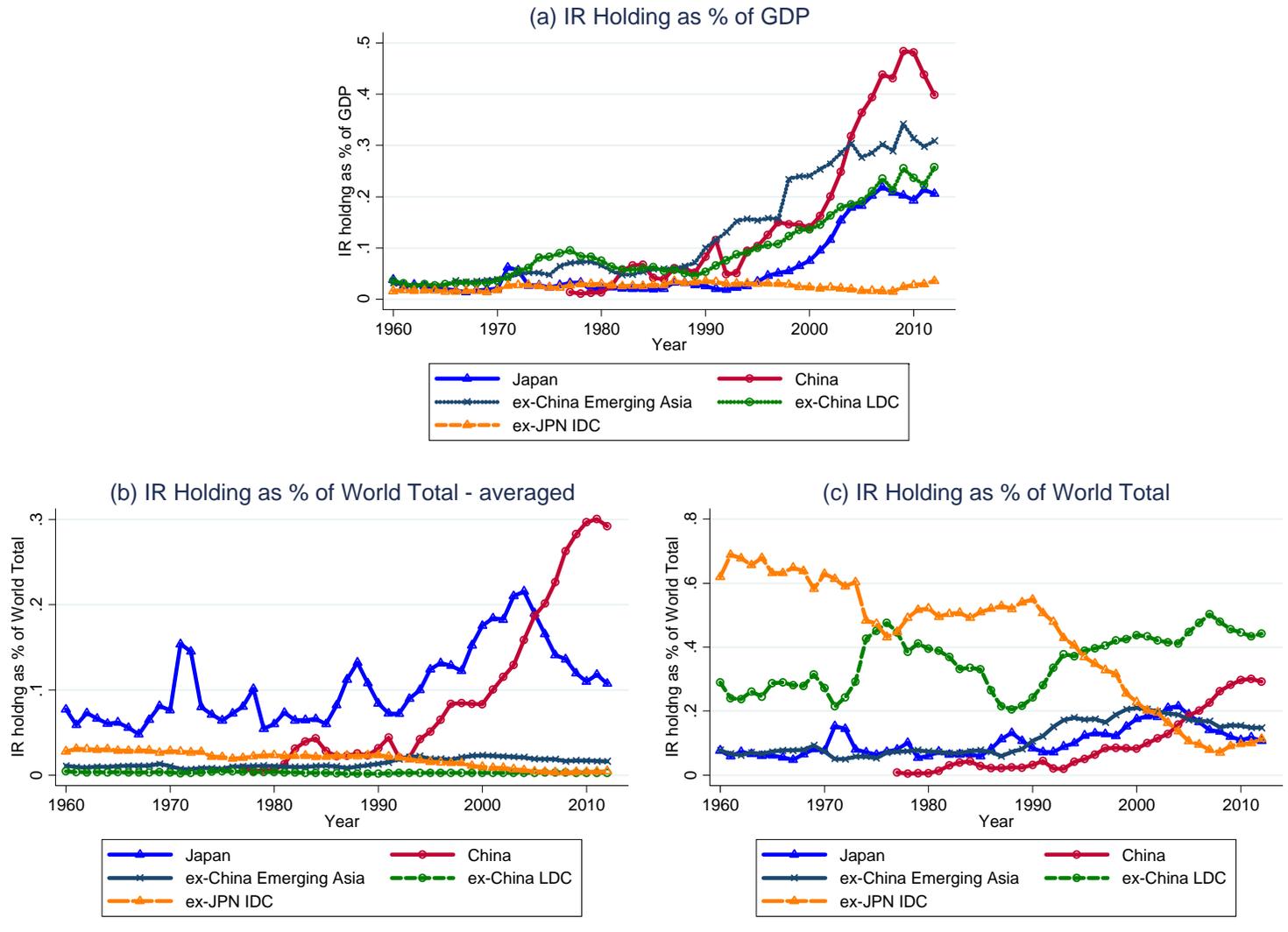


Figure 2: Predictions with Different Estimation Model

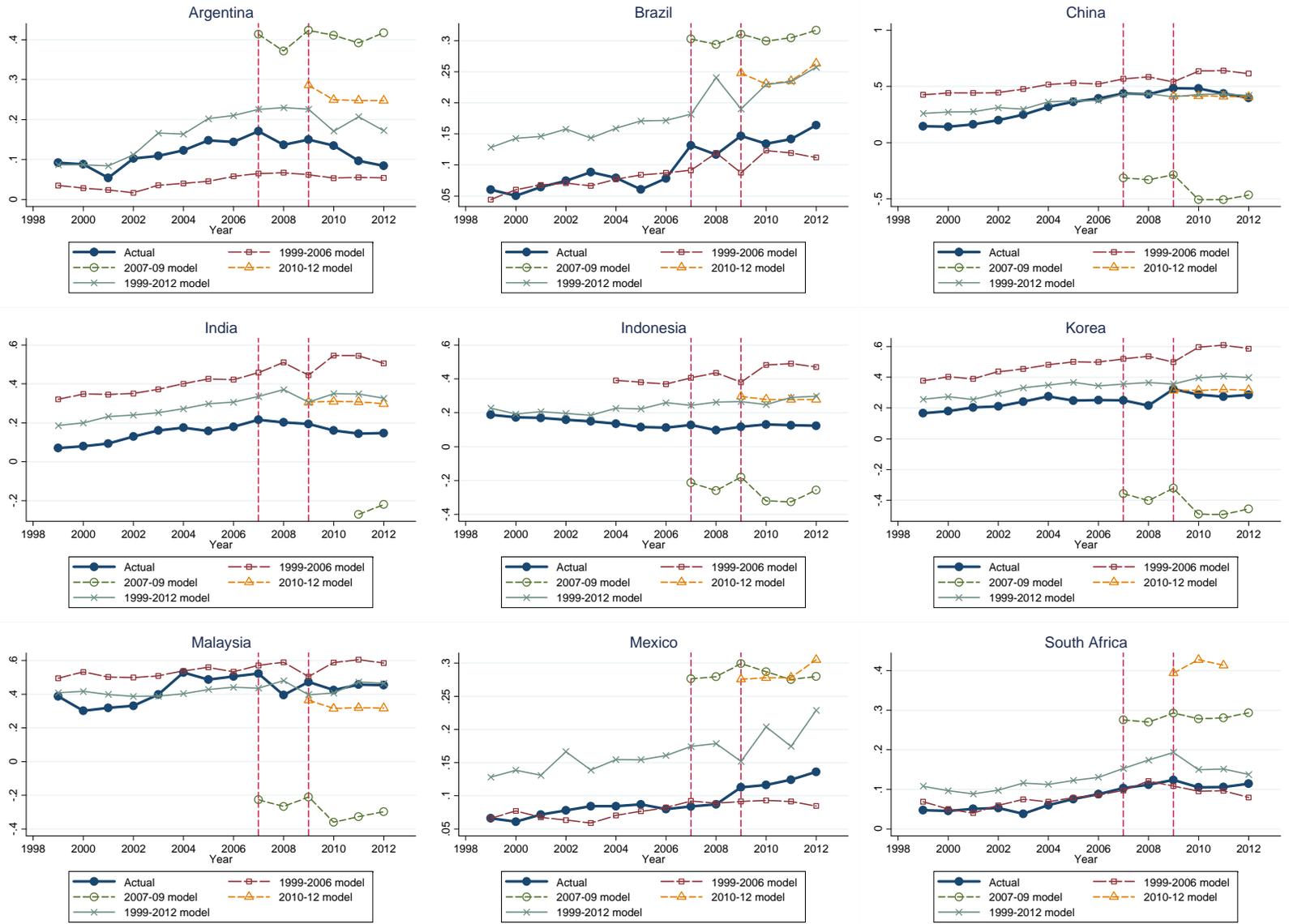


Figure 2-cont: Predictions with Different Estimation Model

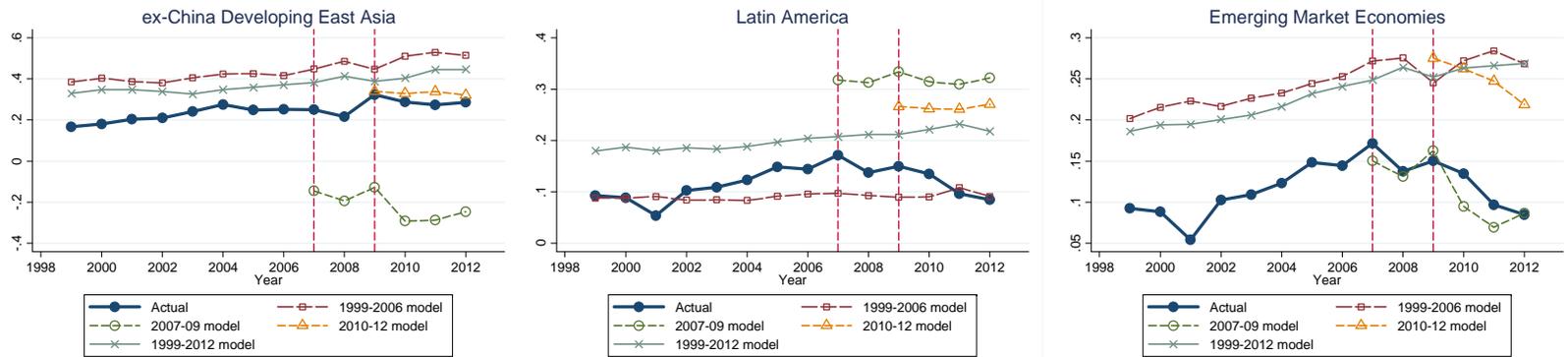
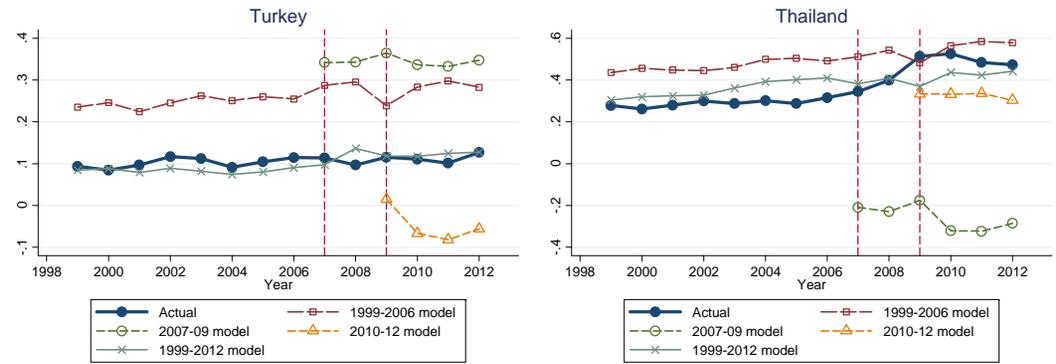
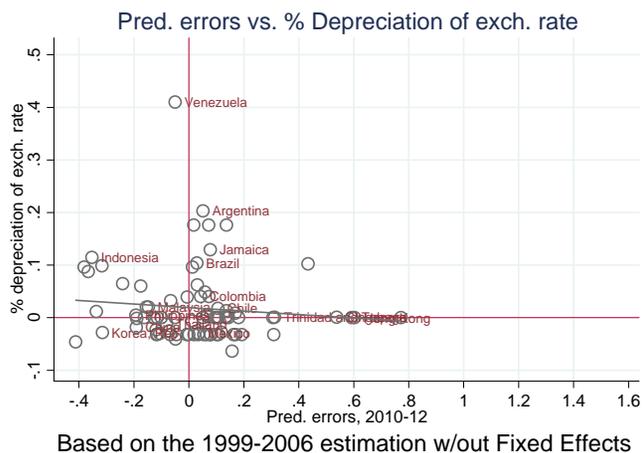
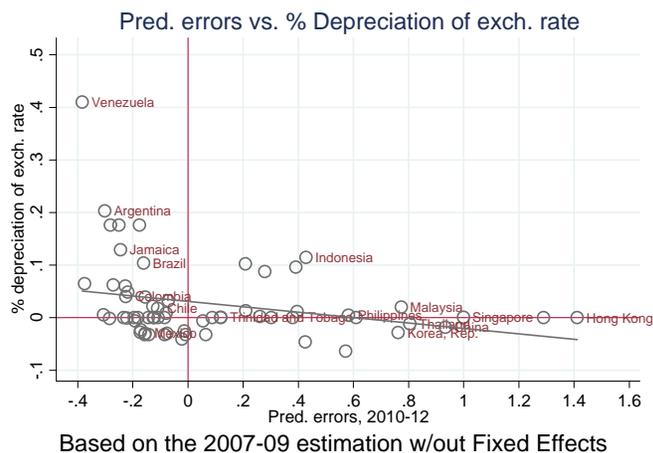


Figure 3: Over-herding and Exchange Rate Depreciation

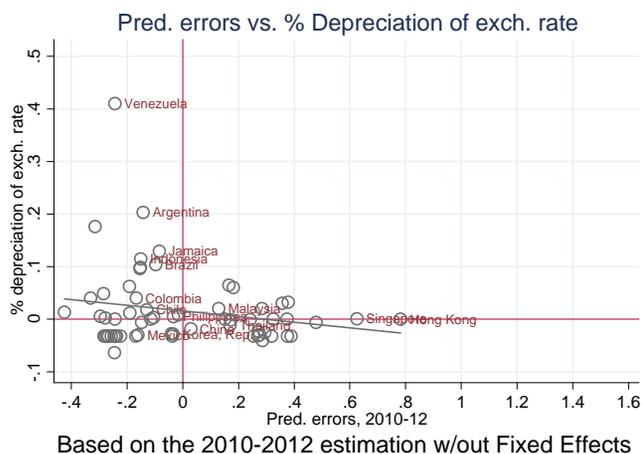
(a) 1999-2006 model



(b) 2007-09 model



(c) 2010-12 model



(d) 1999-2012 model

