Can Reserve Accumulation be Counterproductive?: The Unintended Consequences of Foreign Exchange Intervention

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Abstract

Central Banks around the world increasingly intervene in the foreign exchange market for a variety of reasons, such as providing a protective buffer in the event of a sudden stop or reversal of capital flows. As a result, there has been an unprecedented accumulation of foreign exchange reserves on the balance sheets of central banks around the world, especially in developing and emerging economies. Therefore, several central banks have built some capacity to act as a lender of last resort, even when emergency liquidity required is not denominated in their own currency, thereby reducing the probability of default by borrowers in their country in the event of a financial crises. This paper examines whether the accumulation of reserves due to foreign exchange intervention can be counterproductive by encouraging the inflow of volatile capital flows that are linked to the occurrence of financial crises. Using panel data regression analysis, this paper finds that episodes of high reserve accumulation are likely to be followed by surges in inflows of capital within one year and five years, and a heightened probability of the occurrence of a currency crisis within five years. However, a higher level of foreign exchange reserve accumulation is associated with a lower probability of systemic banking crises.

1 Introduction

Foreign exchange intervention by central banks can be highly effective in terms of several criterion. As is discussed in Dutt (2018), foreign exchange intervention can be effective in moving the exchange rate in a desired direction, it can slow the pace of appreciation of the exchange rate, it can reduce volatility in exchange rates, it can smooth the path of exchange rates, and it can stem pressures of currency appreciation in the face of capital inflows in emerging market economies. In addition to exchange rate related policy objectives, official reserve holdings can lower the cost of private debt and equity capital. Most importantly, foreign exchange reserves provide a buffer against a freely falling currency in the event of a sudden stop or reversal in capital flows. In particular, Aizenman and Lee (2005) show that the purpose behind this reserve accumulation has been precautionary. Jeanne and Rancière (2007) also find that the negative impact of a reversal of capital flows on domestic absorption is mitigated by the reduction in official reserve holdings.

Moreover, official reserve interventions is likely to reduce the likelihood of a sovereign default on external debt. Additionally, since private borrowers in most countries suffer from the 'original sin', that is, the inability of undertake external borrowing in their currency, the official reserve interventions are also likely to reduce the currency risk that lenders undertake. Therefore, official reserve holdings are likely to make lending to countries in which central banks hold foreign exchange reserves as relatively lower credit risks. However, the costs of this foreign exchange intervention are usually considered to be marginal and of second order importance (Adler and Mano, 2016). Dutt (2018) argues that the opportunity cost of holding these reserves are substantial and related to the absence of an International Lender of Last Resort. This paper argues that, in addition to the opportunity costs of holding foreign exchange reserves on the balance sheets of Central Banks, reserve accumulation may be imposing an indirect cost on countries by creating moral hazard for international lenders, and encouraging higher capital inflows. We argue that reserve accumulation is positively associated with higher capital inflows in the future.

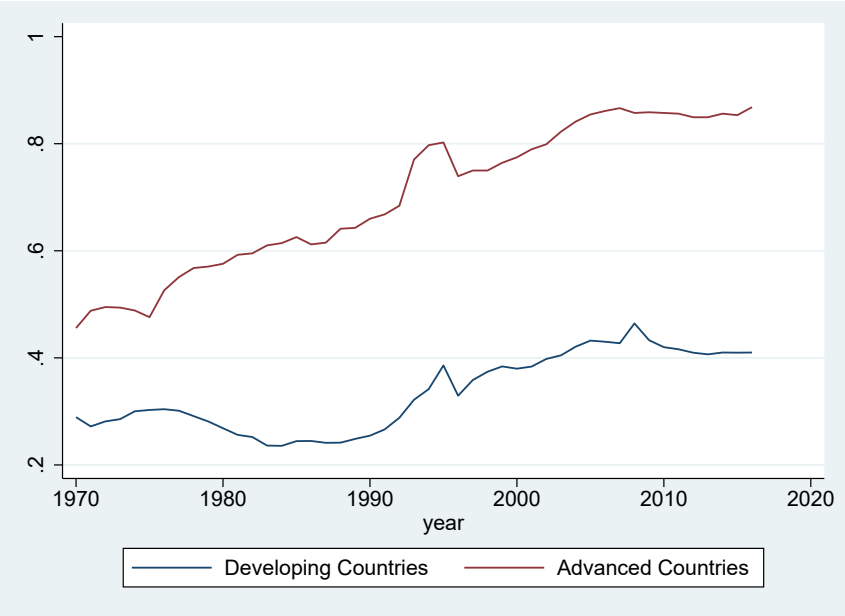
This question is relevant because the one of the best predictors of financial crises can be shown to be excessive credit growth (Schularick and Taylor, 2009). In particular, gross flows of capital can serve as a source of significant instability, even if net flows do not reflect an imbalance in the balance of payments. The relationship between the official reserve holdings and the net external account is the following accounting identity

$$\begin{aligned} \text{Balance of Payments} &\equiv \text{Current Account} + \text{Capital Account} \\ &\quad + \text{Official Reserve Position} \\ &\equiv 0 \end{aligned} \tag{1}$$

there is no such obvious relationship between the official reserve position and the gross inflow of capital into the economy. Determining this relationship is especially important because of the increasing degree of capital account openness, as is evident from Figure 1. Moreover, since economists increasingly argue that official reserve holdings are a substitute for capital controls, it is natural to examine the role reserve holdings play in the management of the capital account or the lack thereof.

This paper presents also presents evidence that questions the mitigating influence of reserve holdings on the occurrence of financial crises.

Figure 1: Capital Account Openness over Time



Source: Author's Calculations

The rest of the paper is structured as follows. Section 2 surveys the existing literature on the topic. Section 3 lays out the central hypothesis of the paper. Section 4 describes the data used in this study and its sources, while Section 6 presents the methodology used to examine the hypothesis presented in Section 3 and our results. Section 7 discusses the results and concludes.

2 Literature Review

There is some limited literature that directly engages with the question of the relationship between reserves accumulated as a result of foreign exchange accumulation and capital flows. Dooley (2000) builds a model of crisis in emerging market economies that develops without a necessary imbalance in economic "fundamentals" an inconsistent policy regime. The model in Dooley (2000) is based on an alternative policy conflict between the holding of foreign exchange reserves as a form of self-insurance, and the yield differential relative to international returns generated by the availability of free insurance, which in turn generates a private gross capital inflow. When the government reserves are matched by its contingent insurance liabilities, the yield on domestic liabilities falls below its market rate, and investors sell their insured assets to the government exhausting its reserves. However, a crucial feature of this model is something that Dooley (2000) calls "appropriation", which is defined as "any activity that benefits the intermediary or its principle at the expense of the asset values." As an example, Dooley (2000) cites governments instructing banks it owns or controls to lend to firms that do not earn the competitive rate of interest in order to promote exports or employment, or managers of a bank booking a loan at more than its market value and investing the difference offshore. Appropriation, as per Dooley's definition, seems to be describing special instances of government policy or corrupt practices that need not always be taking place. Furthermore, the model in Dooley (2000) is based on an unexpected increase in the government's net assets, and it is not clear why such a shock should necessarily arise.

Acharya and Krishnamurthy (2018) theoretically examine the role of reserves management and capital controls as ex-post and ex-ante safeguards, respectively, against sudden stops. They argue that, absent capital controls, the safeguard provided by reserves is partly undone by short term capital flows due to the moral hazard provided by reserves in the event of a sudden stop. They also analyze movements in external debt and reserves in India based on their model. In the period between June 2013 and October 2017, they show that higher liquidity provided by higher reserve accumulation vis-à-vis short term external debt is associated with more favorable emerging market asset price outcome.

Fatum and Yetman (2018) explore whether the accumulation of foreign reserves in 10 Asia-Pacific economies is systematically associated with risk-taking using an event study approach to examine responses to official announcements of reserve stocks. They find little evidence of reserve accumulation having a systematic impact on risk-taking, measured by implied volatility of out-of-the-money currency options, CDS spreads on sovereign US dollar-denominated bonds, and equity price indices. However, Sengupta (2010) finds an empirically robust correlation between foreign exchange reserve accumulation and dollar-denominated debt held on the balance sheets of 1500 non-financial firms from the six largest Latin American economies over the sample period, 1995–2007. In light of these region specific, but contradictory results related to the research question in this paper, further investigation is required.

The literature on capital flows hypothesizes that capital flows to wherever the returns to capital are the highest. In neoclassical theory, this would suggest that capital flows to wherever the marginal productivity of capital is the highest. Moreover, given the assumption of diminishing marginal product of capital, the relative average scarcity of capital in developing countries and emerging market economies, and the relative average abundance of capital in advanced countries, standard neoclassical theory predicts that capital should flow from advanced economies to developing and emerging market economies. Several studies show that, after 1970, net flows have been from developing countries to advanced economies (For example, Obstfeld and Taylor (2004); Gourinchas and Jeanne (2013)). This is known as the Lucas Paradox in the literature, and Lucas (1990) attributed the inconsistency with neoclassical theoretical predictions to differences in human capital and capital market imperfections. Gourinchas and Jeanne (2013) show that cross-country correlation between productivity growth and net flows over the period 1980-2000 is negative, or at best, zero. Obstfeld and Taylor (2004) show that most capital flows are between rich countries and are therefore indicate "diversification finance" as opposed to "development finance."

Another explanation of capital flows follows directly from the condition of covered interest parity, which views capital flows as being driven by global asset market decisions. In the absence of capital market imperfections and impediments to capital mobility, capital will flow in order to exploit arbitrage opportunities: equilibrium is achieved when rate of return on assets in different countries is equalized. Covered interest parity assumes perfect asset substitutability, and therefore the only factor that drives capital flows is the rate of return. The Portfolio Balance Model, on the other hand, does not assume perfect asset substitutability, and argues the capital flows are driven by portfolio decisions of investors based on a variety of factors such as interest rate differential, expected change in exchange rates, and risk premium.

There is also a large and rich empirical literature on the determinants of capital flows. In general, the literature classifies the determinants of capital flows into supply-push factors and demand-pull factors. Supply or push factors refer to global determinants of capital flows, will demand or pull factors refer to country-specific factors that attract capital flows (Felices and Orskaug, 2008). The discussion of supply push factors has assumed importance in light of large co-movements of flows of capital, especially immediately preceding and during the recent

global financial crisis. Rey (2015) shows that across countries capital flows to different regions have a strong common component, and that were negatively correlated with the Volatility Index (VIX) of the Chicago Board Options Exchange, which is taken as an indicator of global expectations. Capital flows are also shown to negatively correlated with the federal funds rate. Shin (2011) argues that global lending by banks depends on their balance sheet capacity, which in turn depends on the amount of bank capital and the degree of permitted leverage. Therefore, Shin suggests that cross-border banking and fluctuating leverage transmit permissive financial conditions globally. Moreover, several regulatory changes allowed for the creation of permissive financial conditions. Bruno and Shin (2013) make a similar argument.

On the other hand, several studies emphasize the demand-pull factors of capital flows. Milesi-Ferretti and Tille (2011) argue that the collapse of capital flows during the financial crisis can be attributed to a collapse in investor confidence. However, the impact of this shock on a specific country depended on the extent and nature of international financial linkages, macroeconomic conditions, and dependence on world trade. Specifically, there was a capital retrenchment out of countries with large net external debt liabilities, and large exposure to liquidity risk. Portes and Rey (2005) argue that market size, efficiency of the transactions technology, and distance are important determinants of capital flows. Other studies emphasize the importance of more structural and institutional explanations of capital flows. Alfaro et al. (2007) argue that legal origins, and components of institutional quality such as investor protection, and macroeconomic policy plays an important role in determining capital flows and their volatility in the period 1970-2000. Similarly, Papaioannou (2009) argues that institutional underdevelopment such as the weak protection of property rights, legal insufficiency, and high risk of expropriation impedes flow of capital to developing countries.

Increasingly, several studies argue that these factors are not mutually exclusive, and both supply-push and demand-pull factors play a role in determining capital flows. Calvo et al. (1996) emphasize the importance of interest rates in developed countries, the external debt burden of developing countries, and creditworthiness of debtor countries in determining capital flows to developing countries. Ahmed and Zlate (2014) show that growth differentials, interest rate differentials, and global risk aversion are important drivers of capital flows to emerging market economies. The first two are demand-pull factor while global risk aversion is a supply-push factor. Felices and Orskaug (2008) use a joint estimation of demand and supply systems as both types of factors, push and pull, could be part of both demand and supply functions. They argue that supply of flows to emerging market economies depend on interest rate spreads, sovereign credit ratings, global GDP growth, and US high-yield spreads. More recently, Ghosh et al. (2014) study the characteristics of surges in net capital flows between the period 1980–2011 for 56 emerging market economies, as they find that they have characteristics that are distinct from normal net capital flows. They find that global factors, such as the US interest rate and global risk (measured by volatility in S&P 500 index returns) play a role in determining the occurrence of surge episodes, as they are synchronized across countries and decades. However, whether an economy experiences a surge in net capital inflows also depends on its attraction as an investment destination. In particular, they find that external financing need (measured by current account deficit), financial openness, and exchange rate regime are correlated to the magnitude of net capital inflows in surge episodes. Barrot and Serven (2018) find that while gross capital flows exhibit considerable co-movement, there are differences in the degree of co-movement between countries and country groups. Their estimated common factors dominate capital flows in advanced economies, but local or idiosyncratic factors dominate capital flows in emerging economies. Additionally, they argue that the importance of global factors is also not stable over time, as common factors display an increasing importance in explaining the pattern of gross inflows and outflows of capital until 2008, after which the effect of common factors exhibit a decline. Interestingly, they also find that the exposure of countries to global

cycles is related to their policy framework, as some factors like financial openness amplify the effects of the global cyclical factors on gross flows in a particular country. Clearly, several country-specific factors play a role in determining capital flows, and credit worthiness and risk assessment is an important determinant. In this regard, the role played by reserves in improving credit worthiness, and thereby encouraging capital flows, has not been assessed in the literature.

The literature on early warning systems and prediction, and currency crises in particular, is also insightful. While there are several studies that explore the best predictors of crises, Kaminsky et al. (1998), Hawkins and Klau (2000), and Frankel and Saravelos (2010) provide comprehensive surveys of this literature. Kaminsky et al. (1998) examine the existing evidence on currency crises by reviewing 28 theoretical and empirical studies on currency crises till 1997, and propose an early warning system for currency crises. They find that individual variables that are consistently found to be useful indicators of currency crises are international reserves, real exchange rate, credit growth, credit to the public sector, and domestic inflation. Hawkins and Klau (2000), on the other hand, only find that short-term debt to foreign exchange reserves as an important predictor of crises under some conditions. Frankel and Saravelos (2010) review 83 studies in this literature, based on which they conduct an empirical investigation into country vulnerability to crises during 2008–09. They find that foreign exchange reserves, the real exchange rate, the growth of credit, GDP, and the current account are the most frequently statistically significant indicators in the literature surveyed. Moreover, of these and other indicators, they find that the level of reserves stood out as a key leading indicator of crisis incidence during 2008–09.

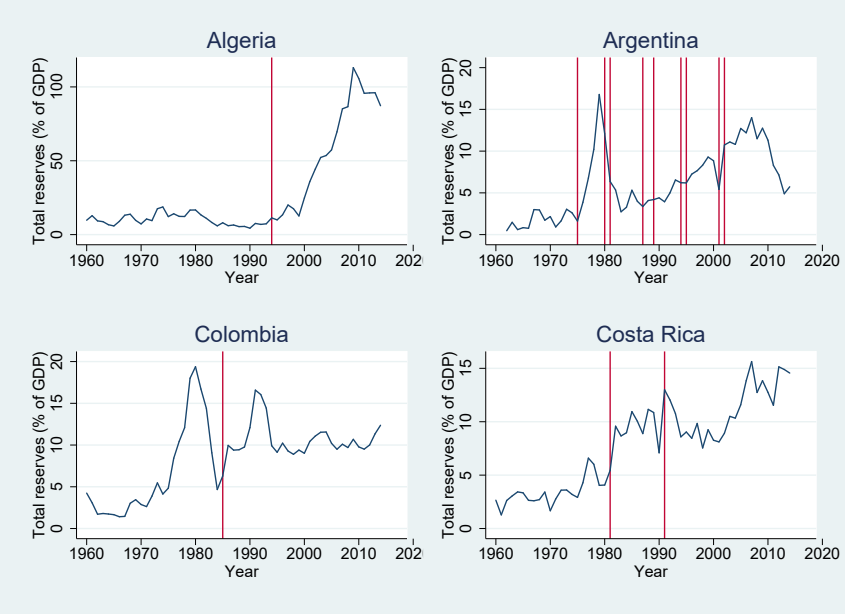
It is important to note here that in this literature, it appears that a *decline* in reserve holdings is taken as an indicator of crisis incidence, in contrast to the relationship being posited in this paper. However, there are reasons to be suspicious of this result. Even though there is variation in the definition of crisis in the early warning system literature, most of them use an exchange rate pressure index, which is a composite of exchange rate, interest rates, and international reserves. Therefore, international reserves figure among both the dependent and independent variables in several studies in the early warning system indicators. Even though the indices and explanatory variables used are usually not contemporaneous in the econometric models, there is reason to suspect a bias in the results. Moreover, the tendency that this paper posits is likely to not be observed immediately before a crisis, as in that period, central banks spring into operation in an attempt to prevent the crises. This is likely to take the form of decumulation of reserves. Figures 2 through 5 show the trend in reserves as a share of GDP for some randomly selected developing economies over time. In these figures, the vertical red line marks the year of a currency crisis. In several instances, there is a sharp decline in reserves as a share of GDP immediately preceding a currency crisis. However, in several instances, there is also a sharp increase in reserves as a share of GDP immediately preceding the sharp decline before the currency crisis. Figure 6 shows that this is also observed in advanced economies. Therefore, a more careful investigation into the role of reserves in the period leading up to a financial crisis is warranted.

3 Central Hypothesis

The hypothesis of this paper is that reserve holdings may be imposing an additional indirect cost on countries in which Central Banks hold a large quantity of foreign exchange reserves, based on the following dynamic:

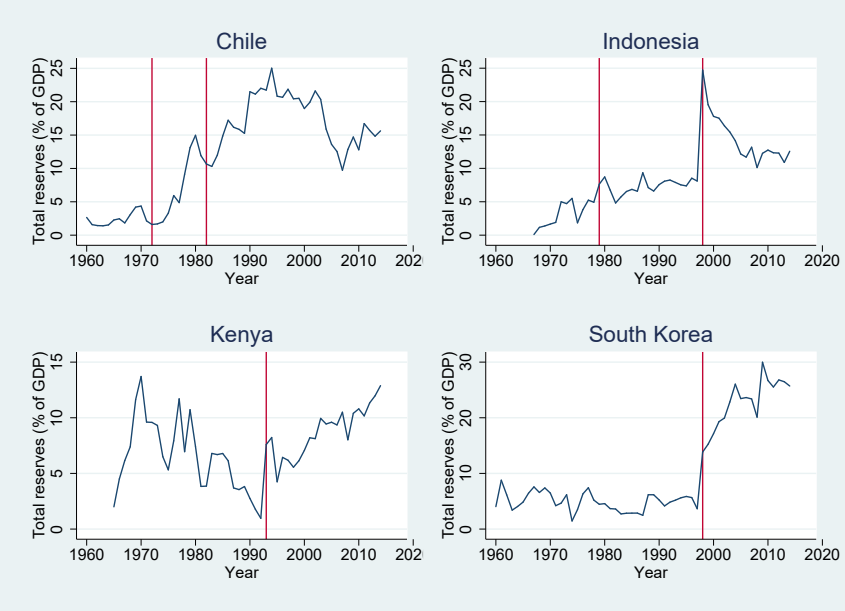
1) Central banks accumulate foreign exchange reserves to protect against currency/sovereign

Figure 2: Trends in Foreign Exchange Intervention and Crisis in Selected Developing Economies



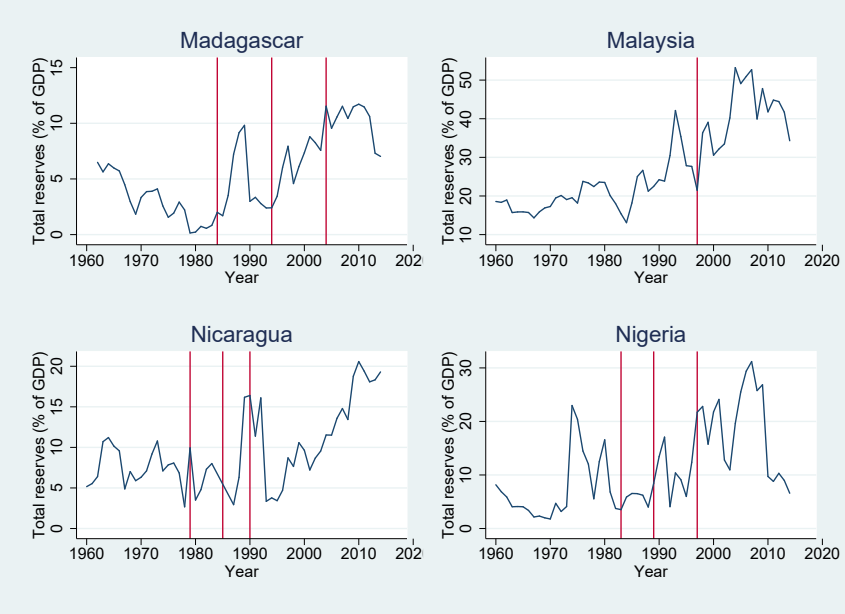
Source: Author's Calculations

Figure 3: Trends in Foreign Exchange Intervention and Crisis in Selected Developing Economies



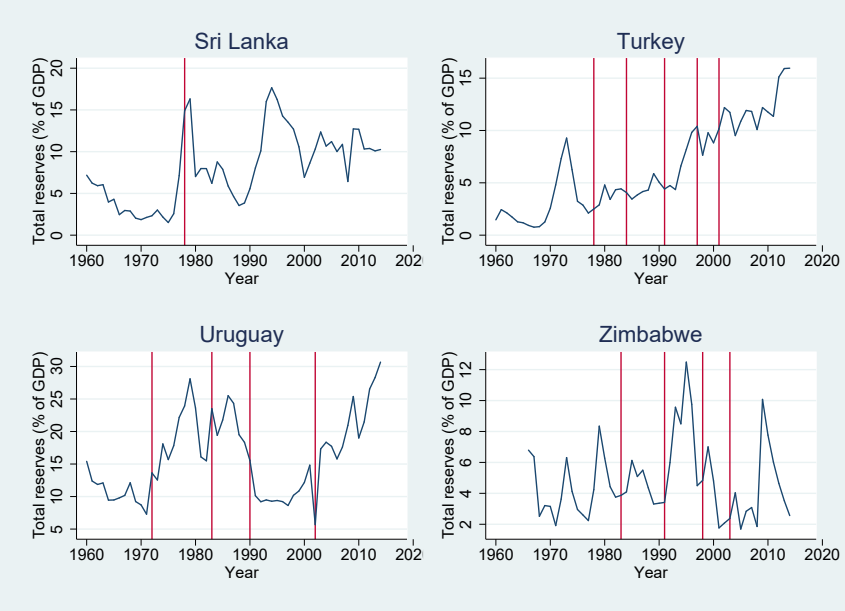
Source: Author's Calculations

Figure 4: Trends in Foreign Exchange Intervention and Crisis in Selected Developing Economies



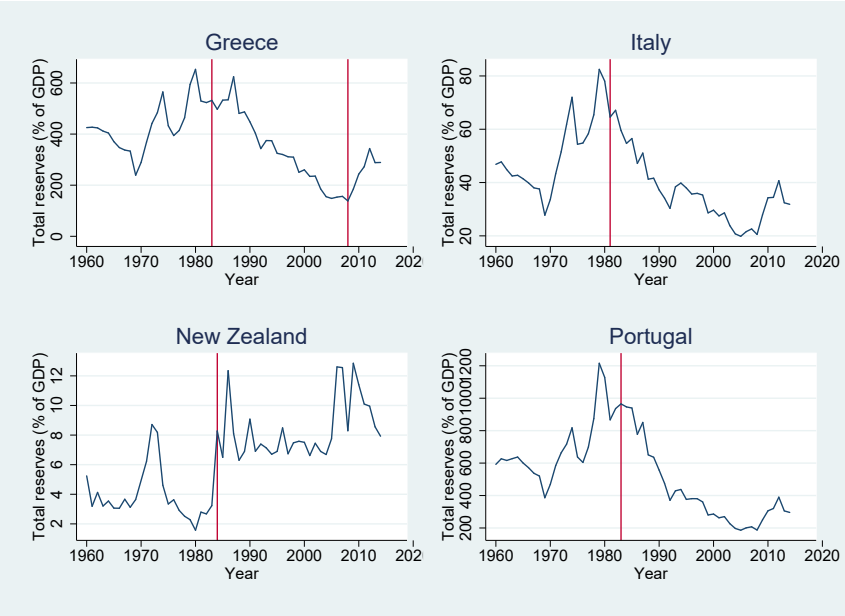
Source: Author's Calculations

Figure 5: Trends in Foreign Exchange Intervention and Crisis in Selected Developing Economies



Source: Author's Calculations

Figure 6: Trends in Foreign Exchange Intervention and Crisis in Selected Advanced Economies



Source: Author's Calculations

debt/financial crises

2) Accumulation of foreign exchange reserves reduces the probability of a currency/sovereign debt/financial crises

3) Reduced probability of crisis makes investment in country less risky, ceterus paribus

4) Reduced perception of risk encourages gross inflow of capital into an economy

5) Increased gross flow of capital into an economy increases likelihood of currency/sovereign debt/financial crises

Therefore, even though central bank reserve holdings are meant to act as a buffer against the effects of volatile capital flows, they may contribute to creating the situation they are meant to prevent by creating moral hazard for foreign lenders. This is because with the accumulation of foreign exchange reserves with the central banks through foreign exchange intervention increases their ability to bail out the domestic borrowers borrowing from international lenders in foreign currency. In other words, it affords central banks the space to act as a lender of last resort in instances in which the assets at the risk of default are denominated in a currency other than the one that it issues. An expectation of bailout is reasonable, even without an explicit promise of bailout. As argued by Corsetti et al. (1999),

> *...no ex-ante announcement by policy makers can convince the public that ex-post (that in the midst of a generalized financial turmoil) the government would cross its arms and let the financial system proceed towards its debacle.* (Corsetti et al., 1999)

Even the use of these reserves to stabilize the currency in the wake of a generalized outflow of capital from the economy guarantees, to a certain extent, an exchange rate within a certain range for the first lenders out of the door, maintaining the feasibility of returns on their investment for foreign lenders. This safety afforded by the accumulation of reserves on the margin

can conceivably encourage further capital inflows into the economy. Since the volume of lending or capital flows have implications for financial stability, determining whether high reserve accumulation encourages a higher volume of lending is important.

This paper tests this hypothesis by examining the relationship between reserve accumulation, gross capital inflows, net capital inflows, and the occurrence of crises. Specifically, it explores whether high reserve accumulation leads to higher capital inflows in an economy and financial crises, accounting for other determinants of capital flows.

4 Data

The dataset used in this study has been constructed using several publicly available sources. The main source of data is the International Financial Statistics and the Global Debt Database of the International Monetary Fund. This has been supplemented with other datasets whenever needed.

The key dependent variables used in this study are gross capital inflows, gross capital outflows, net capital inflows, and crisis variables.

4.1 Capital Flows

Data on capital flows is obtained from the IMF International Financial Statistics. However, the coverage of data is better in the dataset constructed in Lane and Milesi-Ferreti (2017). Gross capital inflows are defined as the change in total liabilities for each country, and gross capital outflows are defined as the change in total assets for each country. Therefore, data on gross and net capital flows are the same as those used in Lane and Milesi-Ferreti (2017). Lane and Milesi-Ferreti (2017) supplement the data on the international investment position of economies in the International Financial Statistics from country reports, and bilateral data on portfolio, foreign direct investment, and bank holdings, allowing for better data availability. Capital inflows measure net purchases or sale by nonresidents of domestic assets, and capital outflows measure net purchases or sale of foreign assets by residents. Data is denominated current US Dollars, which is then scaled by Nominal GDP measured in current US Dollars, and converted to natural logarithmic form.

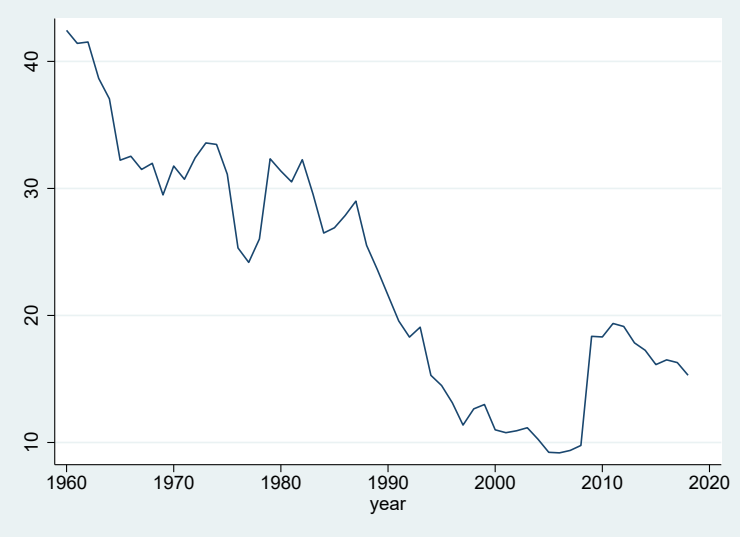
4.2 Crisis Data

This paper draws on the work of Laeven and Valencia (2018) for defining crisis variables. For the period 1970–2017, Laeven and Valencia (2018) identify three types of crises: systemic banking crisis, currency crisis, and sovereign debt crises. In the case of the first two types of crises, this dataset identifies the first year of the crises, while in the case of a sovereign debt crisis, the dataset records the year of a sovereign default. We define four variables *sb*, *cc*, and *sd*, which take a value of 1 for the country-year of a systemic banking crisis, currency crisis, and sovereign default, respectively, and zero otherwise.

4.3 Foreign Exchange Reserves

The key independent variable, on the other hand, used in the study is foreign exchange reserves accumulated by central banks, both including and excluding gold reserves. In general, since the key role played by reserves posited in this paper is the provision of immediate international liquidity, foreign exchange reserves should be considered excluding gold reserves. This assumption is supported by Figure 7, which shows that a decreasing proportion of foreign exchange reserves are held in the form of gold.

Figure 7: Proportion of Gold, % of Total Reserves



Source: Author's calculations

Data on Foreign exchange reserves are obtained from the International Financial Statistics, and supplemented by the dataset in Lane and Milesi-Ferreti (2017). Reserves are scaled by the GDP in order to facilitate comparison across countries and over time, and converted to natural logarithmic form.

4.4 Country Classification

In this paper, the World-Bank income classifications are used in order to classify countries into *High Income* countries, *Upper-Middle Income* countries, *Lower-Middle* Income countries, and *Low-Income* countries. Countries in the *Upper-Middle Income*, *Lower-Middle Income*, and *Low-Income* country categories are classified as *Developing* countries, while *High-Income* countries are classified as *Advanced* countries. We obtained the historical classification of countries, which takes into account how countries have moved from one country group to another. However, since there is not much movement of countries between country groups, specifically from the *Developing* country classification to *Advanced* country classification, we have used the classification of countries as it stands in 2017.

It is questionable whether per-capita income (on which the World Bank income classifications are based) adequately characterizes the level of development. Therefore, we also have data on the World Bank classification of countries into operational lending categories of International Development Association (*IDA*), which includes countries that do not have the financial ability to borrow from the International Bank of Reconstruction and Development, countries that

can borrow from the International Bank of Reconstruction and Development (*IBRD*), and *Blend*, which includes countries that are eligible for both *IDA* and *IBRD* loans. Based on this classification, we classify any of the countries in *IDA*, *IBRD*, and *Blend* groups into the *Developing by Lending* country category, and all other countries in the *Advanced by Lending* country category. This classification is used to check the robustness of our results.

The full list of countries in all the categories mentioned that are used in the analysis in this paper are mentioned in the Appendix.

4.5 Control Variables

In addition to these key variables, several other control variables are also included in this study. In general, we want to control for other factors that are found in the literature to have an impact on determining capital inflows. As in Ghosh et al. (2014), we classify the control variables into push and pull factors. The push, or global, factors used as control variables are the volatility in S&P 500 returns[1] and the global commodity price index. The pull, or country-specific, factors that are controlled for include n=log real GDP per capita, log real GDP growth rate, log of the current account as share of GDP, de jure capital account openness (measured by the Chinn-Ito index), interest rate on domestic government treasury bills, and the exchange rate regime. A full list of variables and sources are listed in the Appendix A.

5 Descriptive Statistics

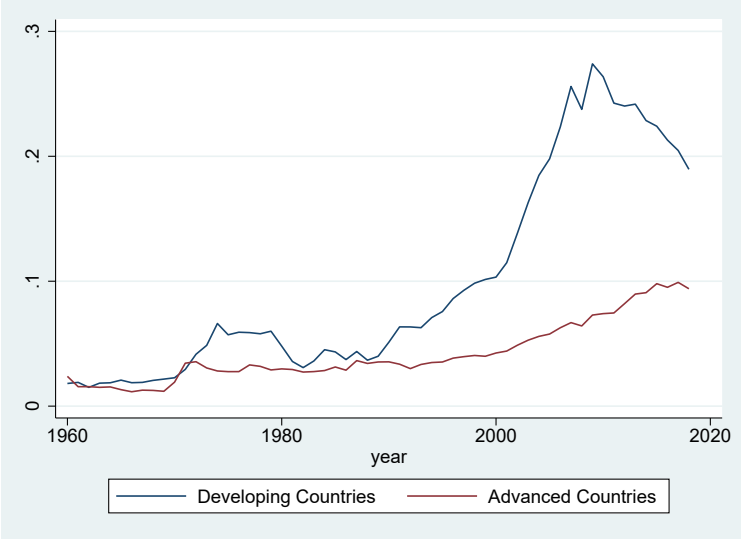
In the period under consideration, the reserve accumulation as a result of foreign exchange intervention has increased to unprecedented levels, especially towards the end of the last decade. This trend is specifically marked in Developing Economies as compared to Advanced Economies, as can be seen in Figure 8

During the same period, the trends in gross capital inflows and outflows can be seen in Figure 9. Interestingly, while there is not an immediately apparent trend in capital and capital outflows, it is evident that positive inflows and outflows are much higher in advanced economies than in developing economies. However, in comparison, while foreign exchange reserve holdings is increasing in both country groups, it is higher in developing economies. Additionally, there is a marked coordinated increase in foreign exchange reserve accumulation in both country groups, when there is also a marked increase in capital inflows. This is also seen in the trends in the change in reserve accumulation as can be seen in Figure 10.

The trend in external debt in both country groups are shown in Figure 11. It shows the increase in foreign exchange reserve accumulation, has happened despite the decline in the total stock of external debt in both country groups since the mid-2000s, followed by a modest recovery since 2009. Furthermore, while the level of external debt as a share of GDP was much higher in advanced economies in the advanced economies, the level of external debt as a share of GDP in advanced economies after the global financial crisis is comparable to that in developing economies. Of the total external debt, short term external debt as a share of GDP has also

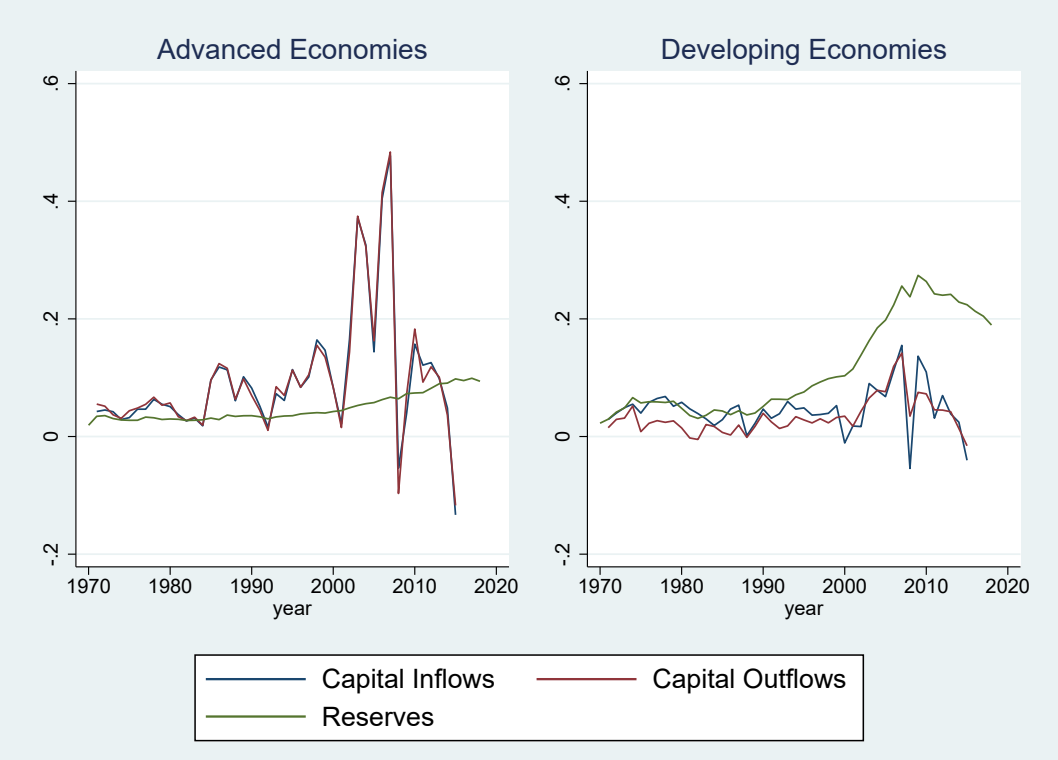
[1]We use this as opposed to the more traditionally used Volatility Index or VIX of the the Chicago Board Options Exchange (CBOE) as data on VIX is only available since 1990. VIX is calculated as "30-day expected volatility of the U.S. stock market, derived from real-time, mid-quote prices of S&P 500 Index call and put options." In comparison, our measure is a rolling standard deviation of closing values of the daily S&P 500 Index for each year.

Figure 8: Trend in Foreign Exchange Reserves (share of GDP), 1970–2017



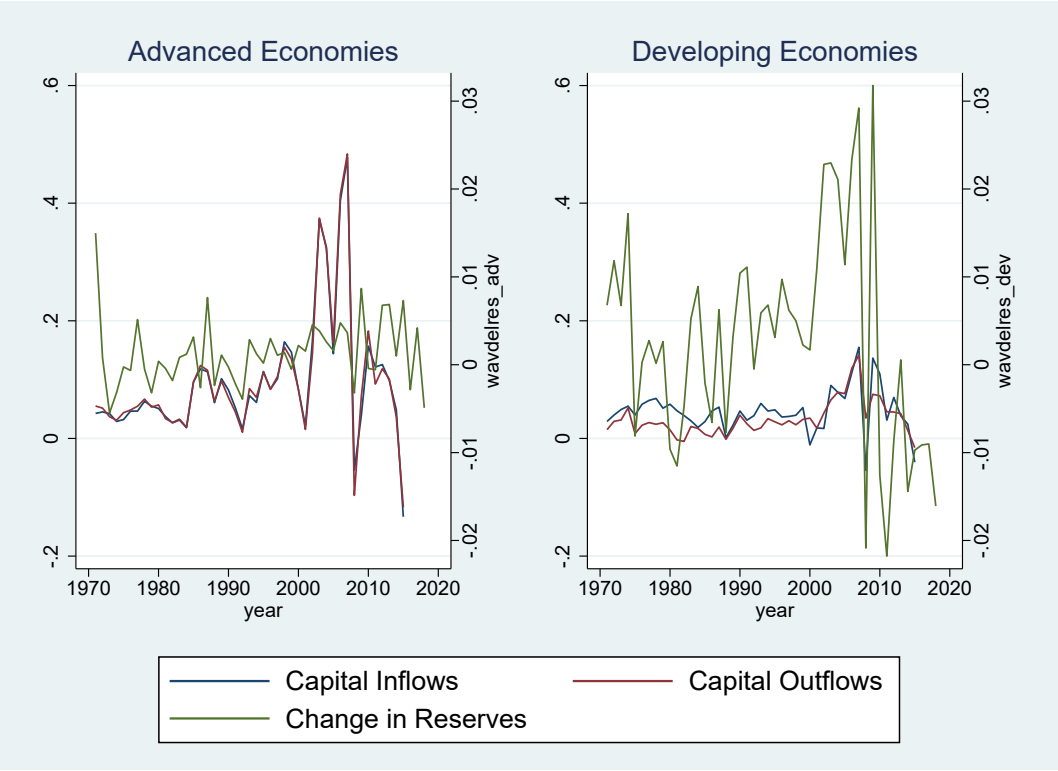
Source: Author's Calculations

Figure 9: Trend in Capital Inflows, Outflows, FX Reserves (share of GDP), 1970–2017



Source: Author's Calculations

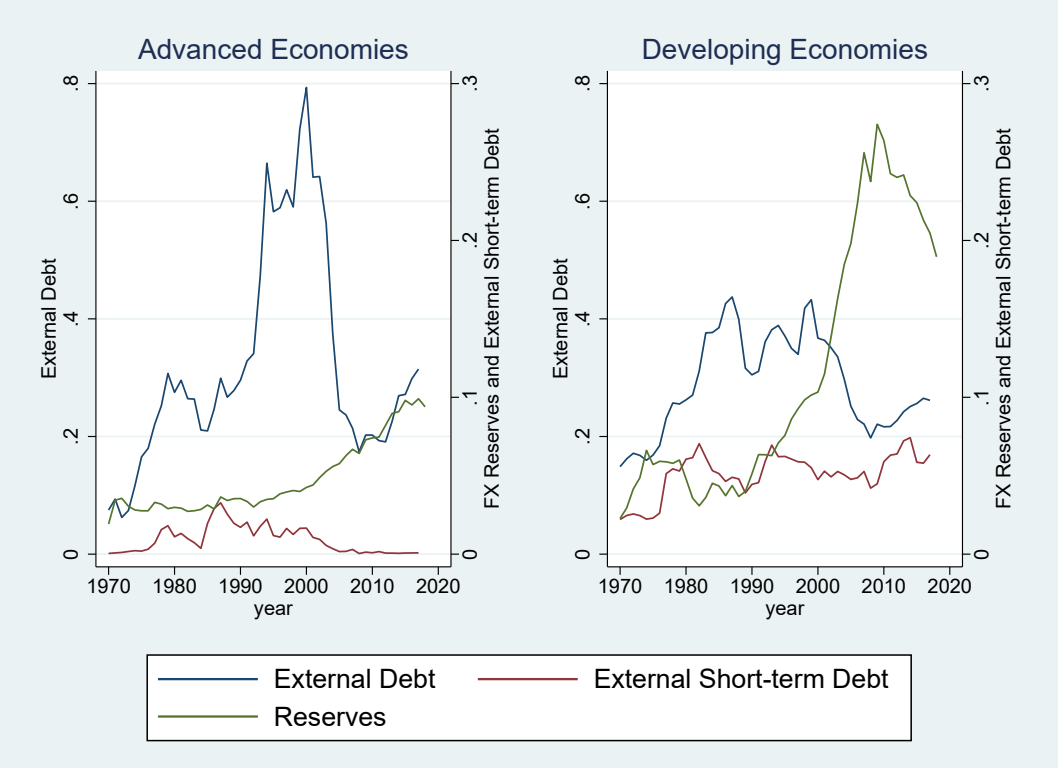
Figure 10: Trend in Capital Inflows, Outflows, Change in FX Reserves (share of GDP), 1970–2017



Source: Author's Calculations

declined in advanced economies. However, short term external has recovered in developing economies, while this is not the case in advanced economies. This trend is significant for our hypothesis, especially in light of the high levels of reserve accumulation in developing economies as compared to that in advanced economies, as is shown in Figure 8.

Figure 11: Trend in Total and Short-term External Debt, and FX Reserves (share of GDP), 1970–2017



Source: Author's Calculations

Table 1 summarizes the trends in Reserves as a share of GDP, Gross Capital inflows as a share of GDP, Net Capital Inflows as a share of GDP, External Debt as a share of GDP, and Short-term External Debt as a share of GDP by decade. The summary statistics are weighted by real GDP. It is interesting to note that net capital inflows are, on average, much smaller than the gross capital inflows. Furthermore, the average trends in gross capital inflows are not mirrored in the trends in net capital inflows. Therefore, a closer look at both gross and net capital inflows is warranted.

6 Methodology and Results

In order to determine the impact of the high levels of reserves on capital inflows into an economy and crisis, we examine the correlations between reserves accumulated as a share of GDP with the inflows of capital. There are a host of endogeneity concerns that the analysis has to contend with. Given that high levels of capital inflows are likely to also facilitate foreign exchange intervention that leads to accumulation of foreign exchange reserves, there is a serious concern of reverse causation. In order to address these concerns as we conduct our analysis, we use dynamic panel data methods. The data has been analyzed using the STATA 16 software.

Table 1: Mean, Standard Deviation, and Median of key variables by decade

		1970-1979	1980-1989	1990-1999	2000-2009	2010-2018
Reserves	Mean	0.020	0.024	0.029	0.060	0.079
	SD	0.023	0.022	0.039	0.98	0.129
	Median	0.011	0.021	0.019	0.015	0.015
Gross Inflows	Mean	0.044	0.060	0.101	0.189	0.062
	SD	0.043	0.061	0.197	0.717	0.528
	Median	0.029	0.049	0.082	0.107	0.056
Net Inflows	Mean	0.0001	-0.0001	0.0002	0.0002	0.0006
	SD	0.0006	0.0006	0.0024	0.0031	0.0063
	Median	0.0000	0.0000	-0.00003	-0.00001	-0.0000
External Debt	Mean	0.080	0.076	0.343	0.274	0.293
	SD	0.066	0.095	0.267	0.128	0.127
	Median	0.120	0.111	0.197	0.229	0.265
Short-term Debt	Mean	0.003	0.007	0.060	0.047	0.058
	SD	0.002	0.008	0.044	0.034	0.035
	Median	0.004	0.007	0.062	0.037	0.048

The key variables in the analysis are likely to exhibit persistence over time, that is, there is likely to be serial autocorrelated. This is true for capital inflows, reserves, and change in reserves. When we check for serial autocorrelation in the panel using Wooldridge's test for panel serial autocorrelation, we can reject the null hypothesis of no serial autocorrelation[2]. Furthermore, reserves as a share of GDP is likely to be an endogenous variable and capital inflows and reserves are likely to be highly correlated: it would not be surprising if reserve accumulation if higher with higher capital inflows. Therefore, in order to examine the effects of reserves accumulation on capital inflows, we cannot use contemporaneous values of reserves. We use lagged values of the stock of foreign exchange reserves accumulated through foreign exchange intervention. In order to account for this, we estimate a Difference GMM model.

$$y_{it} = X_{it}\beta_1 + Z_{it}\beta_2 + \alpha_i + u_{it}$$

where $t = 1, 2, ..., T$, $i = 1, 2, ..., n$, y_{it} is the dependent variable, X_{it} is the $1 \times k$ vector of independent variables, Z_{it} is the vector of control variables. This is estimated by taking the first difference of this equation (thereby getting rid of the country fixed effects) and estimating the Arellano-Bond estimator using the Generalized Methods of Moments. They key independent variable used is the lagged values of the reserves to GDP ratio. We use five lags of the reserves to GDP ratio as the independent variable. Additionally, in our difference GMM estimation, we also use the five lags of the dependent variable as independent variables. Countries that have continued to increase their reserves year-over-year are also considered distinctly. Specifically, we define a binary variable *consistent* that takes the value 1 if there has been a consistent increase in reserves for five consecutive preceding years, and zero otherwise. In addition, we also estimate a simple Fixed Effects model, with country and year fixed effects, system GMM model, to examine the robustness of our results across specifications. In order to preserve efficiency, we limit the number of lags used as instruments in our difference and system GMM estimation to five.

We also estimate the system GMM model with an external instrumental variable. We construct

[2]The F-statistic for Wooldridge test for autocorrelation in panel data is 8.7557, at which we can reject the null hypothesis of no first-order autocorrelation. This is obtained in STATA using the *xtserial* command

a Bartik-style shift share instrument for capital flows. It is constructed as follows:

$$\text{Shift Share}_{it} = \text{share}_i \times \text{total inflows}_t$$

where $t \geq 1980$, and

$$\text{share}_i = \frac{1}{5} \sum_{t=1975}^{1979} \frac{\text{inflows}_{it}}{\text{total inflows}_t}$$

In other words, it is the average share of a country's gross capital inflows in the total capital inflows in a given year for the five years between 1975–1979. The shift share instrument uses this share to predict the distribution of gross capital inflows between countries in a given year based on the average shares in the years 1975–1979. Like lagged values of gross capital inflows, we expect this instrument to provide a structural determinant our reserves variable. This shift-share variable is a valid instrument for reserves as a historical determinant of the level of capital inflows into an economy, as the higher share of total inflows that a country has historically received can serve as a guide for provision of foreign exchange reserves as a buffer for capital flows in the present.

Table 2 shows the results from our Dynamic Panel Data analyses. The different columns reports the coefficients for our different estimators, using both push and pull factors as control variables. Interestingly, across all specifications, the coefficient on the first lag is positive (and significant in columns 2, 3, and 4). These coefficients suggest a 1 percent increase in reserves to GDP ratio is associated with a 0.006–0.62 percent increase in gross capital inflows as a share of GDP. The coefficients on the second lag and third lag are all negative (except for third lag in column 3), but insignificant. The coefficients on the fifth lag are consistently positive and significant across specifications, except for in Column 4. These results suggest that a 1 percent increase in reserves to GDP ratio is associated with a 0.006–0.007 percent increase in gross capital inflows as a share of GDP in five years. However, these results are tempered by the consistently negative coefficients on the fourth lag of our reserves variable, but only statistically significant in Columns 1 and 3.

The coefficients on the current account variable are negative and significant in Columns 1 and 2. This is consistent with the result in Ghosh et al. (2014): higher gross capital inflows are associated with a current account deficit, implying that an economy's total financing need is associated higher gross capital inflow. It is also important to note that the coefficient on the Chinn-Ito index is positive and significant in columns 2 and 4, providing some evidence that countries with greater capital account openness also experience greater gross capital inflows.

We conduct the same analysis for Net Capital Flows, to see if the patters on gross inflows can also be seen in net inflows as a share of GDP [3]. The results are shown in Table 3. The coefficients on the first lag of reserves to GDP are positive and significantly related to net capital inflows in columns 2 and 4. The coefficients on the second and third lag are consistently negative, but not statistically significant. The coefficients on the fourth lag are all consistently positive, but not statistically significant. The coefficients on the fifth lag do not display a consistent sign across specifications and are not statistically significant either. Similar to the results in 2, the coefficients on the Chinn-Ito index are positive and significant in Columns 2 and 4.

[3] We exclude the current account control variable as it is tautologically related to net capital flows, as shown in Equation 1.

Table 2: Dynamic Panel Regression results for Gross Capital Inflows

	(1) Fixed Effects	(2) Difference GMM	(3) System GMM	(4) System GMM w/ IV
l1.logreserves	0.006	0.006**	0.041*	0.062**
	(0.004)	(0.003)	(0.024)	(0.029)
l2.logreserves	-0.002	-0.003	-0.002	-0.002
	(0.003)	(0.003)	(0.002)	(0.004)
l3.logreserves	-0.002	-0.001	0.002	0.001
	(0.005)	(0.003)	(0.003)	(0.005)
l4.logreserves	-0.005**	-0.004	-0.006*	-0.009
	(0.002)	(0.003)	(0.003)	(0.006)
l5.logreserves	0.006*	0.007**	0.007*	0.006
	(0.004)	(0.003)	(0.004)	(0.007)
l1.consistent	0.001	0.000	0.003	-0.008
	(0.002)	(0.004)	(0.005)	(0.008)
Volatility	-0.001***	0.000	-0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Commodity Index	0.001**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Current Account	-0.071**	-0.105**	0.084	0.167
	(0.032)	(0.047)	(0.137)	(0.264)
Per-capita Income	0.024**	0.009	-0.029	0.008
	(0.011)	(0.009)	(0.026)	(0.028)
GDP growth	0.035	0.009	-0.078	0.005
	(0.029)	(0.017)	(0.059)	(0.056)
Chinn-Ito Index	0.015	0.019***	0.047	0.143*
	(0.009)	(0.007)	(0.039)	(0.079)
Interest Rate	0.001**	0.001	-0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.002)
ER Regime	-0.001	-0.002	0.014	0.013
	(0.001)	(0.002)	(0.014)	(0.013)
Constant	2.881***	3.974***	4.049***	3.264***
	(0.231)	(0.309)	(0.428)	(0.436)
N	1085	1009	1089	938

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the Fixed Effects Model, five lags of the dependent variable are included as control variables.

Table 3: Dynamic Panel Regression results for Net Capital Inflows

	(1) Fixed Effects	(2) Difference GMM	(3) System GMM	(4) System GMM w/ IV
l1.logreserves	0.0127	0.0173***	-0.0141	0.0899**
	(0.0085)	(0.0047)	(0.0237)	(0.0372)
l2.logreserves	-0.0072	-0.0062	-0.0001	-0.0124
	(0.0063)	(0.0060)	(0.0067)	(0.0104)
l3.logreserves	-0.0109	-0.0092	-0.0116	-0.0111
	(0.0119)	(0.0060)	(0.0084)	(0.0102)
l4.logreserves	0.0095	0.0066	0.0163	0.0066
	(0.0152)	(0.0059)	(0.0121)	(0.0117)
l5.logreserves	0.0027	0.0023	-0.0054	-0.0054
	(0.0080)	(0.0048)	(0.0057)	(0.0098)
l1.consistent	0.0036	0.0037	-0.0034	-0.0001
	(0.0049)	(0.0060)	(0.0064)	(0.0096)
Volatility	0.0001	-0.0001	-0.0000	-0.0001
	(0.0014)	(0.0000)	(0.0000)	(0.0001)
Commodity Index	0.0001	0.0002***	0.0001	0.0003**
	(0.0009)	(0.0000)	(0.0001)	(0.0001)
Per-capita Income	-0.0537	-0.0127	0.0221	-0.1526***
	(0.0400)	(0.0163)	(0.0519)	(0.0425)
GDP growth	0.0621	-0.0095	0.0432	-0.1343*
	(0.0540)	(0.0305)	(0.0397)	(0.0788)
Chinn-Ito Index	0.0322	0.0536***	-0.0727	0.1223*
	(0.0223)	(0.0130)	(0.0623)	(0.0694)
Interest Rate	-0.0008	-0.0000	0.0005	-0.0035*
	(0.0009)	(0.0007)	(0.0016)	(0.0021)
ER Regime	0.0016	0.0009	0.0076	0.0355
	(0.0041)	(0.0031)	(0.0121)	(0.0233)
Constant	-0.7218	-0.7344***	-2.0943***	0.3477
	(0.5440)	(0.2206)	(0.5869)	(0.6219)
N	980	902	1040	820

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the Fixed Effects Model, five lags of the dependent variables are used as control variables

We estimate these models for external debt as a share of GDP and external short-term debt as a share of GDP, but we do not find a relationship that is statistically significant across any lags of the reserves to GDP ratio, and is not reported.

6.1 Relatively High Reserve Accumulation

Since the relationship between capital inflow and reserves is posited in this paper is one of creating moral hazard for international lenders, the volume of reserves held by a central bank relative to other central banks are likely to be a more relevant determinant of the volume of capital flows received by a country rather than the absolute volume of foreign exchange reserves held in a country by a central bank relative to its GDP. Therefore, we examine the role played by the holding of FX reserves in countries relative to all other countries in a given year. In order to do this, we determine the location of a country's reserve accumulation in the distribution of reserve accumulation in a given year. We still consider distribution of the foreign exchange reserves relative to GDP since the size of the economy would determine whether the reserve holdings of a Central Banks are sizeable in the economy under consideration.

Therefore, instead of considering reserves as a share of GDP as the independent variable, we calculate the standard score of the reserves holdings of a country in a given year, that is, we calculate the number of standard deviations away the foreign exchange reserve holding of a country is from the average foreign exchange reserve holding in any year. We estimate our model using the lagged values of the foreign exchange reserves standard score in order to answer the question: is a relatively higher accumulation of foreign exchange reserves causally related to higher capital inflows into an economy. The results are shown in Table 4.

Interestingly, in Table 4, the coefficient on the first lag is positive in all four specifications, and significant in three of those. Furthermore, the coefficients on the fifth lag are also positive in all of our specification, but statistically significant only in our difference GMM and system GMM models. The coefficients on our other lags are mixed, with some being positive and some being negative. However, none of these coefficients are statistically significant. Our result provide evidence that higher reserve accumulation as compared to other countries in a given year is associated with higher gross capital inflows within within one year and within five years.

We also calculate the standard score of the gross capital inflows and net capital inflows received by a country in every year. We then ask: is it the case that a higher reserve accumulation relative to other countries is associated with higher gross capital inflow relative to other countries in a year? Table 5 shows the results for this investigation. Notably, the results in this table are consistent with those in Table 4: the first and fifth lag of the standard score of reserves as a share of GDP are positively and significantly associated with a higher standard score of gross capital inflows as a share of GDP.

We conduct a similar analysis for net flows, that is, we analyze whether higher net capital inflows and the standard score of net capital inflows are causally related to high relative reserves as a share of GDP. Unlike the results for gross capital inflows, we do not find similar, systematic, and robust results for net capital inflows. The regression results for net capital inflows and standard score for the net capital inflows are available in Table 16 and Table 17, respectively, in Appendix C.

Table 4: Impact of Relative Reserve Accumulation on Gross Capital Inflow

	(1) Fixed Effects	(2) Difference GMM	(3) System GMM	(4) System GMM w/ IV
l1.$Z_{reserves}$	0.012	0.012*	0.142*	0.178**
	(0.015)	(0.007)	(0.076)	(0.083)
l2.$Z_{reserves}$	0.002	0.001	0.003	0.005
	(0.013)	(0.009)	(0.012)	(0.015)
l3.$Z_{reserves}$	-0.009	-0.007	0.004	0.003
	(0.015)	(0.009)	(0.012)	(0.015)
l4.$Z_{reserves}$	-0.013	-0.012	0.002	0.009
	(0.011)	(0.009)	(0.014)	(0.021)
l5.$Z_{reserves}$	0.020	0.026***	0.028*	0.034
	(0.014)	(0.007)	(0.014)	(0.022)
Volatility	-0.001**	0.000	0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Commodity Index	0.001**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Current Account	-0.075**	-0.115**	0.290	0.434
	(0.033)	(0.047)	(0.211)	(0.377)
Per-capita Income	0.021	0.008	-0.000	-0.011
	(0.013)	(0.009)	(0.027)	(0.037)
GDP Growth	0.036	0.007	-0.072	0.026
	(0.028)	(0.017)	(0.063)	(0.063)
Chinn-Ito Index	0.014	0.017**	0.033	0.105
	(0.010)	(0.007)	(0.038)	(0.064)
Interest Rate	0.001**	0.000	-0.001	-0.002
	(0.000)	(0.000)	(0.001)	(0.002)
ER Regime	-0.001	-0.001	0.009	0.007
	(0.001)	(0.002)	(0.011)	(0.014)
Constant	2.886***	4.098***	3.504***	3.030***
	(0.205)	(0.308)	(0.433)	(0.459)
N	1085	1009	1089	938

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the Fixed Effects model, five lags of the dependent variable are also used as controls

Table 5: Impact of Relative Reserve Accumulation on Relative Gross Capital Inflow

	(1) Fixed Effects	(2) Difference GMM	(3) System GMM	(4) System GMM w/ IV
l1.$Z_{reserves}$	0.439	0.370**	2.932*	3.074*
	(0.415)	(0.166)	(1.639)	(1.599)
l2.$Z_{reserves}$	-0.108	-0.115	0.006	-0.076
	(0.343)	(0.214)	(0.289)	(0.402)
l3.$Z_{reserves}$	-0.123	0.007	0.278	0.278
	(0.435)	(0.217)	(0.291)	(0.367)
l4.$Z_{reserves}$	-0.432	-0.453**	-0.005	0.113
	(0.424)	(0.221)	(0.309)	(0.363)
l5.$Z_{reserves}$	0.526*	0.604***	0.615	0.716
	(0.313)	(0.177)	(0.381)	(0.486)
Volatility	-0.033	0.001*	0.001	0.001
	(0.021)	(0.001)	(0.001)	(0.001)
Commodity Index	0.021	0.000	0.002	0.002
	(0.013)	(0.001)	(0.001)	(0.002)
Current Account	-1.755**	-2.247**	7.103	2.506
	(0.830)	(1.097)	(4.958)	(5.943)
Per-capita Income	0.362	0.080	-0.231	0.328
	(0.279)	(0.228)	(0.727)	(0.608)
GDP growth	1.036	0.615	-0.725	-0.567
	(0.807)	(0.405)	(0.962)	(1.079)
Chinn-Ito Index	0.233	0.253	1.329	1.500
	(0.229)	(0.167)	(1.607)	(1.568)
Interest Rate	0.009	0.014	-0.016	-0.020
	(0.006)	(0.010)	(0.033)	(0.032)
ER Regime	0.000	-0.005	0.069	0.136
	(0.018)	(0.043)	(0.147)	(0.302)
Constant	-21.455***	-1.664	-1.943	-3.919
	(7.335)	(2.772)	(10.159)	(7.470)
N	1085	1009	1089	938

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the Fixed Effects model, five lags of the dependent variable are also used as controls

6.2 Quantile-specific effects

It may be the case that higher levels of reserve accumulation have a qualitatively different impact on capital inflows than lower levels of reserve accumulation, and are not simply scaled up impacts as those compared to lower levels of reserve accumulation. If this is the case, a difference GMM analysis may not be sufficient, and we need a panel data quantile regression approach. Therefore, we estimate a panel quantile data regression model with fixed effects for each quantile, with five lags of the reserves to GDP ratio[4]. Table 6 shows the results with five lags of the reserves to GDP ratio as the independent variables, controlling for both push and pull factors, and Figure 12 plots the coefficients against the quantile for different lags of the reserves to GDP ratio.

The quantile regression results in reveal some interesting patterns. The coefficient on the third and fifth lags are consistently positive over all the quantiles. For the fifth lag this is consistent with the results of our dynamic panel data analysis as the coefficient on the the fifth lag was positive and significant across specifications. Furthermore, the coefficients on the fifth lag increase with the quantile: the coefficients increase between the 40th percentile and the 80th percentile. The coefficients on the second lag of reserves increase from being negative to being positive, as there is a sharp upward trend in the coefficients from the 30th percentile. To the contrary, the coefficients in the first and fourth lags decrease from the 30th and 40th percentile, respectively.

Figure 12: Quantile Regression Coefficients for Impact of Reserves on Capital Inflow, by lags

[4]This model has been estimated using *qregpd* STATA module using the Markov Chain Monte Carlo optimization

Table 6: Quantile Regression results for Gross Capital Inflows

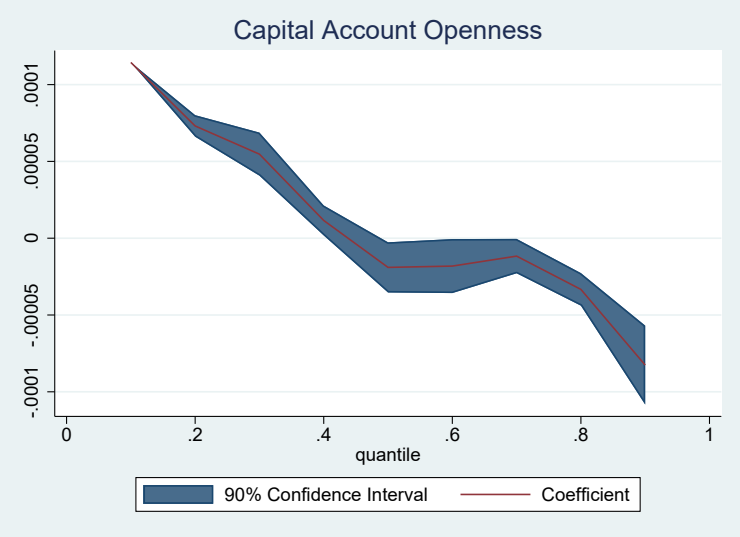
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Quantile	10th	20th	30th	40th	50th	60th	70th	80th	90th
l1.logreserves	0.00008***	0.00018**	0.00010	-0.00004	-0.00062***	-0.00027***	-0.00046***	-0.00082***	0.00016
	(0.00000)	(0.00009)	(0.00007)	(0.00008)	(0.00009)	(0.00010)	(0.00004)	(0.00007)	(0.00014)
l2.logreserves	-0.00146***	-0.00081***	-0.00051***	-0.00123***	-0.00060***	-0.00081***	-0.00012	0.00067***	0.00100***
	(0.00000)	(0.00010)	(0.00009)	(0.00012)	(0.00022)	(0.00013)	(0.00010)	(0.00012)	(0.00018)
l3.logreserves	0.00101***	0.00063***	0.00136***	0.00159***	0.00101***	0.00098***	0.00022**	0.00032**	0.00052**
	(0.00000)	(0.00006)	(0.00009)	(0.00008)	(0.00014)	(0.00016)	(0.00010)	(0.00016)	(0.00026)
l4.logreserves	0.00003***	-0.00051***	-0.00111***	-0.00102***	-0.00064***	-0.00082***	-0.00087***	-0.00037***	-0.00088***
	(0.00000)	(0.00005)	(0.00010)	(0.00014)	(0.00011)	(0.00011)	(0.00008)	(0.00008)	(0.00025)
l5.logreserves	0.00134***	0.00107***	0.00082***	0.00118***	0.00119***	0.00102***	0.00143***	0.00039***	-0.00050***
	(0.00000)	(0.00007)	(0.00006)	(0.00012)	(0.00006)	(0.00008)	(0.00007)	(0.00010)	(0.00013)
l1.consistent	0.00023***	-0.00010	0.00004	0.00023	0.00061***	0.00045***	0.00016	0.00030***	-0.00060***
	(0.00000)	(0.00008)	(0.00008)	(0.00015)	(0.00009)	(0.00010)	(0.00016)	(0.00010)	(0.00012)
Volatility	-0.00002***	-0.00001***	-0.00001***	-0.00002***	-0.00000**	-0.00001***	-0.00001***	-0.00000	0.00001***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Current Account	-0.02534***	-0.02803***	-0.02817***	-0.02526***	-0.01164***	-0.01625***	-0.00815***	-0.01724***	-0.02019***
	(0.00000)	(0.00044)	(0.00090)	(0.00090)	(0.00226)	(0.00073)	(0.00100)	(0.00085)	(0.00228)
Commodity Index	-0.00002***	-0.00001***	0.00000	-0.00001***	-0.00001***	-0.00001***	-0.00002***	-0.00002***	-0.00001***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Per-capita Income	0.00004***	0.00024***	0.00057***	0.00013**	0.00033***	0.00043***	0.00042***	0.00082***	0.00078***
	(0.00000)	(0.00002)	(0.00005)	(0.00005)	(0.00010)	(0.00003)	(0.00002)	(0.00003)	(0.00005)
GDP growth	0.00556***	0.01004***	0.01081***	0.00962***	0.00910***	0.00784***	0.00992***	0.00812***	0.00712***
	(0.00000)	(0.00029)	(0.00046)	(0.00078)	(0.00066)	(0.00053)	(0.00045)	(0.00035)	(0.00118)
Interest Rate	0.00011***	0.00007***	0.00005***	0.00001*	-0.00002*	-0.00002*	-0.00001*	-0.00003***	-0.00008***
	(0.00000)	(0.00000)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00002)
Chinn-Ito Index	0.00049***	-0.00003	-0.00024	0.00041***	-0.00010	0.00024***	0.00079***	-0.00034**	0.00022
	(0.00000)	(0.00009)	(0.00018)	(0.00012)	(0.00012)	(0.00008)	(0.00019)	(0.00013)	(0.00014)
ER Regime	-0.00021***	0.00018***	0.00024***	0.00019***	-0.00000	-0.00010***	-0.00033***	-0.00029***	0.00006
	(0.00000)	(0.00001)	(0.00002)	(0.00003)	(0.00003)	(0.00003)	(0.00002)	(0.00002)	(0.00008)
N	1085	1085	1085	1085	1085	1085	1085	1085	1085

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

If we consider the coefficients on the Chinn-Ito index over different quantiles, shown in Figure 13, they decrease with the higher quantiles of capital account openness. In addition, the coefficient go from being positive to being negative around the 40th percentile. The decline in coefficients, which suggest a decline in impact of gross inflows with increasing capital account openness for higher quantiles of the Chinn-Ito index is somewhat counterintuitive.

Figure 13: Quantile Regression Coefficients for Impact of Capital Account Openness on Gross Capital Inflow



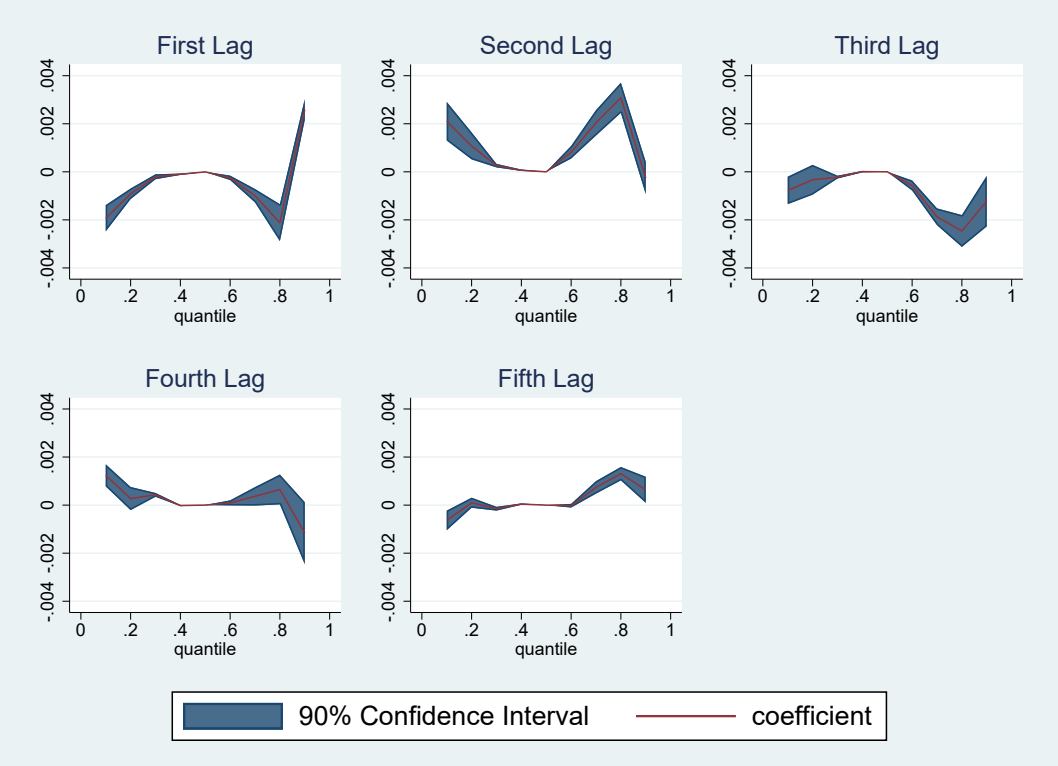
The variation of the impacts of reserves to GDP on capital inflows is even more evident when we consider net capital inflows. Figure 14 show the results for relationship between the different quantiles of the lags of the reserves to GDP ratio on net capital inflows. In particular, it appears that there is a qualitative change in the relationship between reserves and capital inflows at the 70th or 80th percentile of reserves to GDP ratio. The full quantile regression results for the net capital account are shown in Table 18 in Appendix C.

The results of the quantile regressions confirms the hypothesis that higher levels of reserve accumulation may be qualitatively different from lower levels of reserve accumulation insofar as their impact on gross capital inflows are concerned. Therefore, it may be worthwhile to consider the the higher quantiles of reserve accumulations distinctly from the lower quantiles.

6.3 Highest Quantiles of Reserve Accumulation

Given the results of our quantile regression analysis, we identify the episodes of reserve accumulation in the top 30th percentile of the distribution. Following the algorithm used in Ghosh et al. (2014) to define surges in net capital inflows, we define a high accumulation episode as one which is in the top 30th percentile of the level of accumulated reserves at the level of a country over time, and in the top 30th percentile of all observations. We define these observations as those that meet our *global* criteria for high reserve accumulation. In addition we also identify the high accumulation episodes as those that are only in the top 30th percentile of the level of accumulated reserves at the level of a country over time. These observations are those that meet our *local* criteria for high reserve accumulation. Based on these definitions, we identify 246 global episodes of high accumulation 498 local episodes of higher reserve accumulation. Tables 7 and 8 summarize the characteristics of levels of reserves, gross inflows, net inflows, external debt, and short term external debt as a share of GDP for global and local instances of high

Figure 14: Quantile Regression Coefficients for Impact of Reserves on Capital Inflow, by lags



reserve accumulation.

Table 7: Mean and Standard Deviation of key variables in Global Instances of High Reserve Accumulation

		1970-1979	1980-1989	1990-1999	2000-2009	2010-2018
Reserves	Mean		0.162	0.298	0.240	0.252
	SD		0	0.216	0.126	0.136
	Median		0.162	0.227	0.199	0.233
Gross Inflows	Mean		0.083	0.111	0.095	0.068
	SD		0	0.140	0.2	0.163
	Median		0.083	0.082	0.072	0.063
Net Inflows	Mean		0.0000	-0.0005	-0.001	0.001
	SD		0	0.002	0.004	0.008
	Median		0.000	-0.0009	-0.001	-0.0001
External Debt	Mean			0.105	0.278	0.283
	SD			0	0.117	0.126
	Median			0.105	0.252	0.230
Short-term Debt	Mean			0.0001	0.049	0.060
	SD			0	0.032	0.038
	Median			0.0001	0.041	0.043
	N	0	1	10	116	119

The increasing number of episodes of high reserve accumulation over time is consistent with the pattern of increase foreign exchange intervention since the 1990s. Comparing the descriptive statistics of the global episodes of high reserve accumulation with the descriptive statistics presented in 1, it is interesting to note that except for the decade 2000–09, the average gross

capital inflows are higher in the identified episodes of global high reserve accumulation.Similarly, average short-term external debt is higher in the last two decades (2000–09 and 2010–18) in our global episodes of high reserve accumulation as compared to our entire sample. On the contrary, except for the decade 2010–18, net capital inflows are on average lower in the global episodes of high reserve accumulation in every other decade. Furthermore, average external debt is lower in every decade in our global episodes of high reserve accumulation, except 2000–09. However, the average net capital inflows, external debt, and short-term external debt are higher in every decade in the episodes of high reserve accumulation.

Table 8: Mean and Standard Deviation of key variables in Local Instances of High Reserve Accumulation

		1970-1979	1980-1989	1990-1999	2000-2009	2010-2018
Reserves	Mean	0.053	0.034	0.025	0.141	0.214
	SD	0.015	0.024	0.046	0.141	0.142
	Median	0.051	0.036	0.006	0.163	0.192
Gross Inflows	Mean	0.071	0.064	0.081	0.107	0.050
	SD	0.058	0.067	0.060	0.848	0.360
	Median	0.046	0.062	0.082	0.074	0.057
Net Inflows	Mean	0.00003	-0.00002	0.0004	-0.0004	0.001
	SD	0.001	0.001	0.002	0.003	0.008
	Median	-0.00002	0.0000	-0.00003	-0.00001	-0.00004
External Debt	Mean			0.714	0.262	0.287
	SD			0.398	0.107	0.110
	Median			0.528	0.242	0.247
Short-term Debt	Mean			0.042	0.044	0.058
	SD			0.013	0.030	0.033
	Median			0.037	0.036	0.044
	N	25	52	85	175	161

Considering the episodes of locally high reserve accumulation, average gross inflows and average net inflows are lower than averages in table 1 in every decade. This is also the case for average external debt, except for the decade 1990–99, and for average short-term external debt. In comparison, the average net capital inflows are higher in all decades during the episodes of locally high reserve accumulation.

In addition to defining episodes of globally and locally high reserve accumulation due to foreign exchange intervention, we identify episodes of surges in gross capital inflows and net capital inflows, using both local and global criterion is described above. We identify 430 global and 505 local surges in gross capital inflows and 203 global and 427 local surges in net capital inflows.

6.4 Occurrence of Capital Inflow Surges and Crises

We examine whether the occurrence of surges in capital inflows is related to higher reserve accumulation in the preceding years. Specifically, we estimate a panel logistic regression model with our surge variable, for both gross inflows and net inflows, as the dependent variables. The results for gross inflows are shown in Table 9, while those for net flows are shown in Table 10. We estimate the model used lagged values of the reserves and the control variables we used in our fixed effects model, the results for which are shown in Column (1). Next, we estimate the model with the standard score of the country's reserve accumulation in five years prior to the current year as the independent variable, with the same controls, and the results are shown in

Column (2). Column (3) shows the estimates of the model when high reserve episodes are used as the independent variable. In other words, Column (3) shows the result for the examination of whether the episodes of high reserve accumulation are likely to be associated with a surge in gross capital inflows within one, two, three, four, or five years. Column (4), on the other hand estimates the model with the level of reserve accumulation in the episodes of high reserve accumulation. We do this by interacting our episode of high reserve accumulation variable with our reserves variable.

Table 9: Logistic Regression Results for Surges in Gross Capital Inflows

	(1)	(2)	(3)	(4)
	Reserves	$Z_{Reserves}$	High Reserve Episodes	Reserves in High Reserve Episodes
l1	0.140	0.288	0.596**	-0.307
	(0.252)	(0.674)	(0.269)	(0.385)
l2	-0.128	-0.039	-0.533*	0.495
	(0.329)	(0.887)	(0.304)	(0.459)
l3	0.031	0.124	-0.154	0.211
	(0.324)	(0.883)	(0.315)	(0.453)
l4	-0.138	-0.976	0.196	-0.287
	(0.323)	(0.923)	(0.329)	(0.457)
l5	0.356	1.486**	-0.601**	1.131***
	(0.256)	(0.719)	(0.298)	(0.397)
volatility	-0.005**	-0.005**	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Per-capita income	1.527*	1.548*	2.271***	1.982**
	(0.851)	(0.850)	(0.873)	(0.887)
GDP growth	3.104*	3.305*	3.001*	2.575
	(1.743)	(1.730)	(1.744)	(1.784)
Current account	-21.857***	-22.513***	-22.624***	-20.838***
	(4.442)	(4.449)	(4.502)	(4.453)
Interest rate	-0.052	-0.061	-0.048	-0.041
	(0.039)	(0.040)	(0.039)	(0.040)
Chinn-Ito Index	0.615	0.536	0.578	0.804
	(0.610)	(0.608)	(0.591)	(0.621)
N	1018	1018	1018	1018

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficients and standard errors for the control variables *commodity index* and *ER Regime* are not shown in the interest of space, and are available on request.

Our results indicate that in the case of gross capital inflows, there is no significant relationship between the occurrence of a surge in gross capital inflows and the lagged values of the reserves to GDP ratio (Column 1). However, when we consider the standard score of the reserves accumulation of a country in a given year, the coefficient on the fifth lag is positive and significant. Specifically, the coefficient on the fifth lag is positive and significant, which means that a unit increase in the standard score of reserves as a percentage of GDP is associated with an increase in the odds of occurrence of a surge in capital inflow by 4.42 within five years. However, when we consider episodes of high reserve accumulation, the coefficients on the first, second, and fifth lags are significant. Specifically, a unit increase in the standard score is associated with an increase in the odds of the occurrence of a surge in gross capital inflows by 1.81 within a year. However, the coefficients on the second and fifth lag are negative and significant. The

level of reserves in a high reserve episodes is also associated with a statistically significantly higher probability of a surge in gross capital inflows within five years. By contrast, the results in table 10 show that a high reserve episodes or reserve accumulation is not associated with a statistically significant higher probability of a surge in net capital inflows.

Table 10: Logistic Regression Results for Surges in Net Capital Inflows

	(1)	(2)	(3)	(4)
	Reserves	$Z_{Reserves}$	High Reserve episodes	Reserves in High Reserve episodes
l1	-0.149	-0.128	-0.372	0.051
	(0.304)	(1.064)	(0.377)	(0.486)
l2	-0.219	-0.211	0.116	-0.311
	(0.423)	(1.357)	(0.393)	(0.599)
l3	0.481	1.550	0.194	0.418
	(0.428)	(1.368)	(0.405)	(0.605)
l4	-0.177	-2.956**	-0.467	0.128
	(0.410)	(1.489)	(0.414)	(0.584)
l5	0.325	1.794	0.316	0.257
	(0.319)	(1.198)	(0.376)	(0.485)
volatility	-0.004	-0.003	-0.004	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Per-capita income	-3.968***	-3.481***	-3.332***	-3.750***
	(1.178)	(1.133)	(1.192)	(1.238)
GDP growth	0.469	1.028	1.201	0.501
	(2.262)	(2.235)	(2.210)	(2.257)
Interest rate	-0.090*	-0.081	-0.077	-0.086
	(0.054)	(0.054)	(0.054)	(0.054)
Chinn-Ito Index	0.704	0.904	0.880	0.768
	(0.973)	(0.983)	(0.976)	(0.978)
N	490	490	490	490

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficients and standard errors for the control variables *commodity index* and *ER Regime* are not shown in the interest of space, and are available on request.

We also try to assess whether the occurrence of crises are associated with episodes of high reserve accumulation in the preceding years. Table 11 shows the logistic regression results for the occurrence of currency crises. Column (1) shows the results for the model estimated with the lagged values of the reserves variable as the independent variables. Column (2) shows the results for the model estimated with the standard score of reserves as a share of GDP in the preceding five years as independent variables. Column (3) shows the result for the logistic regression model with the occurrence of an episode of high reserve accumulation in the preceding five years as independent variables. Finally, Column (4) shows the results for the logistic regression model with the interaction between episodes of high reserve accumulation and level of reserves in the preceding five years. The probability of occurrence of currency crisis decreases with an increase in reserve accumulation in the year prior to a crisis as the coefficients on the first lag are negative and significant. However, higher reserve accumulation two years prior is associated with a statistically significant higher odds of the occurrence of a currency crisis when considering the level of reserves as a share of GDP. This is evident from the coefficients presented in Column (1). Higher reserve accumulation and a high reserve accumulation episode five years prior is

also associated with a higher probability of occurrence of a currency crisis (Columns (1), (2), and (3)).

Table 11: Logistic regression results for Currency Crises

	Reserves	$Z_{Reserves}$	High Reserve episodes	Reserves in High Reserve episodes
l1	-3.423*	-35.215*	-21.733	3.278
	(2.064)	(18.382)	(3355.419)	(4.268)
l2	4.496*	4.841	-17.347	7.721
	(2.439)	(14.547)	(2875.298)	(8.369)
l3	-2.560	-0.820	-4.581	-0.817
	(2.698)	(13.684)	(3.681)	(2.145)
l4	-2.519	-13.328	2.504	-0.684
	(2.456)	(15.447)	(2.720)	(1.573)
l5	8.106*	41.618*	7.844**	-2.324
	(4.496)	(21.778)	(3.424)	(1.890)
volatility	0.015	-0.018	0.012	-0.009
	(0.018)	(0.027)	(0.020)	(0.017)
Per-capita Income	-17.044**	-17.174**	1.385	3.091
	(8.023)	(8.546)	(8.988)	(3.459)
GDP Growth	-3.193	-25.297	-14.679	-8.828
	(8.107)	(16.920)	(10.470)	(6.584)
Current Account	-56.873	-94.880	-84.087	-40.154
	(54.463)	(72.273)	(55.331)	(25.819)
Interest Rate	0.363	0.323	0.732*	0.469***
	(0.227)	(0.330)	(0.376)	(0.174)
Chinn-Ito Index	-18.138**	-9.974	-6.038	-3.960
	(8.158)	(10.476)	(5.544)	(3.230)
N	255	255	255	424

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficients and standard errors for the control variables *commodity index* and *ER Regime* are not shown in the interest of space, and are available on request.

A similar result is not observed for systemic banking crises. In other words, we do not find evidence of higher reserve accumulation and high reserve accumulation episodes being associated with a higher probability of occurrence of a systemic banking crisis. On the contrary, we find that higher reserve accumulation and a episode of high reserve accumulation is associated with a statistically significantly lower probability of occurrence of a systemic banking crises within 1 year as is evident in Columns (1)–(3) of Table 12.

The change in signs in the significant coefficients between the first, second, and fifth lag of reserves in Table 11 suggest that there may be some non-linearities in the relationship between reserve accumulation and the occurrence of currency crises. On the other hand, it appears that foreign exchange reserves provide a stabilizing influence as far as systemic banking crises are concerned. It is not immediately clear why we see these contrasting effects of foreign exchange intervention on currency crises and systemic banking crises; further exploration is required in order to understand these differential impacts, which are beyond the scope of this paper.

Table 12: Logistic Regression results for Systemic Banking Crises

	(1) Reserves	(2) $Z_{Reserves}$	(3) High Reserve episodes	(4) Reserves in High Reserve episodes
l1	-9.500*	-20.185*	-5.403**	5.267**
	(5.158)	(11.801)	(2.709)	(2.581)
l2	2.256	19.857	1.118	-3.187
	(3.863)	(13.048)	(3.022)	(2.453)
l3	-5.801	-38.004**	-4.289	-1.880
	(4.434)	(18.712)	(3.685)	(2.103)
l4	-2.271	22.861	0.029	1.506
	(4.278)	(16.473)	(2.806)	(2.452)
l5	4.753	1.154	3.761	-5.121**
	(4.549)	(15.073)	(3.760)	(2.504)
volatility	0.047**	0.038**	0.031**	0.021**
	(0.022)	(0.018)	(0.015)	(0.010)
Per-capita Income	41.108*	25.221*	11.276	4.484
	(23.119)	(14.106)	(10.186)	(3.609)
GDP growth	26.939	30.410	10.863	0.982
	(21.858)	(20.520)	(17.074)	(9.163)
Current account	-196.415	-144.787	-92.735	-71.538**
	(135.392)	(94.241)	(76.348)	(31.276)
Interest rate	-0.476	-0.242	-0.106	0.236
	(0.435)	(0.529)	(0.355)	(0.226)
Chinn-Ito index	0.325	-8.553	-9.124	-4.349
	(12.739)	(11.175)	(7.846)	(3.643)
N	506	506	506	720

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficients and standard errors for the control variables *commodity index* and *ER Regime* are not shown in the interest of space, and are available on request.

7 Implications and Conclusions

The results in this paper pose a challenge to the assumptions about the impacts of accumulation of foreign exchange reserves on financial stability. Even though the literature suggests that the accumulation of reserves allows central banks to protect against the impacts of volatile capital flows. However, our results show that the impact of foreign exchange intervention is not so straightforward. In particular, we show that very high levels of reserve accumulation are qualitatively different from lower levels of reserve accumulation, and have impacts that are distinct from scaled up levels of lower reserve accumulations. In particular, the direction of the relationship between reserve accumulation in the preceding first, second, and fifth year changes at 60th and 80th percentiles of reserve accumulation. This warrants a closer look at the highest levels of reserve accumulation resulting from foreign exchange intervention.

When we analyze the episodes of reserve accumulation in the top 30th percentile in reserve accumulation, we find that higher reserve accumulation and episodes of high reserve accumulation are associated with a higher probability of occurrence of a surge in gross capital inflows within one year and five years. However, a similar relationship is not observed between foreign exchange reserve accumulation and net capital inflows. We also observe that while higher reserve accumulation is associated with a lower probability of crisis within one year, our results also show that higher reserve accumulation and episodes of high reserve accumulation are also associated with a heightened probability of a currency crisis within five years. On the other hand, higher foreign exchange reserve accumulation is associated with a lower probability of the occurrence of a systemic banking crisis.

Therefore, this paper finds some evidence of two opposing and contradictory impacts on foreign exchange intervention on gross capital inflows, net capital inflows, and occurrence of currency crises. Further analysis is needed to identify the conditions under which the stabilizing effect dominates the destabilizing effects of foreign exchange intervention. Specifically, the role of mitigating factors and effectiveness of other policy factors like capital controls would be of interest. This is not to suggest that the policy of accumulating foreign exchange reserves is irrational, and that they should not conduct foreign exchange intervention to accumulate foreign exchange reserves. In the context of an average lower level of capital controls, it is perfectly rational for Central Bankers to continue to intervene in the foreign exchange market and accumulate foreign exchange reserves. Reserves clearly play an important role in fostering global financial stability in the absence of other more effective measures of protecting against the destabilizing effects of volatile capital flows. However, this paper shows that they can also have a destabilizing effect, and their use and effectiveness need to be evaluated taking this potential destabilizing effect into account.

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8 Appendices

8.1 Appendix A

Table 13: Full List of Variables Used and their Sources

Variable	**Source**	**Notes**
Gross Capital Inflows as a share of GDP	IMF International Financial Statistics and Lane and Milesi-Ferreti (2017)	Dependent Variable; Change in Total Liabilities
Gross Capital Outflows as a share of GDP	IMF International Financial Statistics and Lane and Milesi-Ferreti (2017)	Dependent Variable; Change in Total Assets
Net Capital Inflows as a share of GDP	IMF International Financial Statistics and Lane and Milesi-Ferreti (2017)	Dependent Variable; Gross Capital Inflows − Gross Capital Outflows
External Debt as a share of GDP	IMF International Financial Statistics and Lane and Milesi-Ferreti (2017)	Dependent Variable
Short-term External Debt as a share of GDP	IMF International Financial Statistics and Lane and Milesi-Ferreti (2017)	Dependent Variable
Currency Crisis	Laeven and Valencia (2018)	Dependent variable; 1 if first year of currency crisis; 0 otherwise
Systemic Banking Crisis	Laeven and Valencia (2018)	Dependent variable; 1 if first year of systemic banking crisis; 0 otherwise
Sovereign Debt Crisis	Laeven and Valencia (2018)	Dependent variable; 1 if year of sovereign default; 0 otherwise
Reserves as a share of GDP	IMF International Financial Statistics and Lane and Milesi-Ferreti (2017)	Independent Variable; Foreign exchange reserves excluding gold reserves
Volatility	Website of Chicago Board Options Exchange	Control Variable; calculated as rolling standard deviation of closing values of the daily S&P 500 Index for each year
Commodity Index	IMF International Financial Statistics	Control Variable; Global Primary Commodity Price index
Real GDP per capita	World Bank World Development Indicators	Control Variable; constant 2010 US dollars
Real GDP	World Bank World Development Indicators	Control Variable; constant 2010 US Dollars
Real GDP growth	World Bank World Development Indicators	Control Variable; rate of growth of Real GDP
Chinn-Ito Index	Chinn and Ito (2006)	Normalized de-jure index of Capital account openness; $0 <$ Chinn-Ito Index < 1, where 1 indicates fully free capital mobility
Interest Rate	IMF Monetary and Financial Statistics	Short-to-medium term Government bond yields per annum

Exchange Rate Regime	Ilzetzki et al. (2017)	Categorical variable varying from 1 (fixed exchange rate) to 6 (freely falling exchange rate)

8.2 Appendix B

Table 14: Country Classification based on Per-capita Income

Low Income Countries			
Benin	Burkina Faso	Ethiopia	Mali
Nepal	Niger	Senegal	Togo
Lower-Middle Income Countries			
Angola	Bangladesh	Cote d'Ivoire	Ghana
India	Kyrgyz Republic	Moldova	Mongolia
Morocco	Myanmar	Pakistan	Papua New Guinea
Philippines	Solomon Islands	Sri Lanka	
Upper-Middle Income Countries			
Armenia	Botswana	Bulgaria	Fiji
Malaysia	Maldives	Mauritius	Mexico
Romania	Russia	South Africa	Thailand
Venezuela			
High Income Countries			
Australia	Austria	Belgium	Canada
Cyprus	Czech Republic	Denmark	Finland
France	Germany	Greece	Hungary
Iceland	Ireland	Italy	Japan
Republic of Korea	Lithuania	Luxembourg	Malta
Netherlands	New Zealand	Poland	Portugal
Seychelles	Singapore	Slovak Republic	Slovenia
Spain	Sweden	Switzerland	United Kingdom
United States			

Table 15: Country Classification based on World-Bank Lending Category

IDA			
Bangladesh	Benin	Burkina Faso	Cote D'Ivoire
Ethiopia	Ghana	Kyrgyz Republic	Maldives
Mali	Myanmar	Nepal	Niger
Senegal	Solomon Islands	Togo	
Blend			
Fiji	Moldova	Mongolia	Pakistan
Papua New Guinea			
IBRD			
Angola	Armenia	Botswana	Bulgaria
India	Malaysia	Mauritius	Mexico
Morocco	Philippines	Poland	Romania
Russia	Seychelles	South Africa	Sri Lanka
Thailand	Venezuela		
No Classification			
Australia	Austria	Belgium	Canada
Cyprus	Czech Republic	Denmark	Finland
France	Germany	Greece	Hungary
Iceland	Ireland	Italy	Japan
Republic of Korea	Lithuania	Luxembourg	Malta

Netherlands	New Zealand	Portugal	Singapore
Slovak Republic	Slovenia	Spain	Sweden
Switzerland	United Kingdom	United States	

8.3 Appendix C

Table 16: Impact of Relative Reserve Accumulation on Net Capital Inflow

	(1) Fixed Effects	(2) Difference GMM	(3) System GMM	(4) System GMM w/ IV
l1.$Z_{reserves}$	0.0358	0.0476***	-0.0648	0.1182*
	(0.0267)	(0.0126)	(0.0671)	(0.0658)
l2.$Z_{reserves}$	-0.0228	-0.0314*	-0.0155	-0.0537
	(0.0238)	(0.0167)	(0.0254)	(0.0372)
l3.$Z_{reserves}$	-0.0105	-0.0109	-0.0159	-0.0073
	(0.0184)	(0.0170)	(0.0191)	(0.0193)
l4.$Z_{reserves}$	0.0082	0.0021	0.0067	-0.0136
	(0.0312)	(0.0172)	(0.0252)	(0.0315)
l5.$Z_{reserves}$	0.0098	0.0130	-0.0076	-0.0028
	(0.0210)	(0.0134)	(0.0208)	(0.0282)
l1.consistent	0.0018	0.0027	-0.0030	0.0073
	(0.0046)	(0.0060)	(0.0071)	(0.0069)
Volatility	0.0001	-0.0000	-0.0000	-0.0001
	(0.0014)	(0.0000)	(0.0000)	(0.0000)
Commodity Index	0.0002	0.0002***	0.0001	0.0002**
	(0.0009)	(0.0000)	(0.0001)	(0.0001)
Per-capita Income	-0.0537	-0.0147	-0.0111	-0.1407***
	(0.0405)	(0.0162)	(0.0583)	(0.0358)
GDP growth	0.0688	0.0061	0.0471	-0.0335
	(0.0559)	(0.0302)	(0.0456)	(0.0692)
Chinn-Ito Index	0.0307	0.0512***	-0.0573	0.1649*
	(0.0221)	(0.0130)	(0.0590)	(0.0965)
Interest Rate	-0.0009	-0.0002	0.0006	-0.0014
	(0.0009)	(0.0007)	(0.0018)	(0.0017)
ER Regime	0.0024	0.0029	0.0051	0.0142
	(0.0043)	(0.0031)	(0.0121)	(0.0205)
Constant	-0.7748	-0.7718***	-1.7830***	-0.3656
	(0.5583)	(0.2210)	(0.6807)	(0.3230)
N	980	902	1040	820

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the Fixed Effects model, five lags of the dependent variable are also used as controls

Table 17: Impact of Relative Reserve Accumulation on Relative Net Capital Inflow

	(1) Fixed Effects	(2) Difference GMM	(3) System GMM	(4) System GMM w/ IV
l1.$Z_{reserves}$	0.117	0.171**	-0.332	0.482
	(0.105)	(0.068)	(0.305)	(0.373)
l2.$Z_{reserves}$	-0.016	-0.057	0.027	-0.147
	(0.091)	(0.090)	(0.082)	(0.148)
l3.$Z_{reserves}$	-0.056	-0.039	-0.069	-0.034
	(0.078)	(0.092)	(0.104)	(0.111)
l4.$Z_{reserves}$	-0.066	-0.100	-0.065	-0.160
	(0.104)	(0.093)	(0.102)	(0.152)
l5.$Z_{reserves}$	0.098	0.172**	-0.003	-0.010
	(0.103)	(0.073)	(0.093)	(0.109)
l1.consistent	-0.005	0.014	-0.095**	-0.054
	(0.028)	(0.033)	(0.040)	(0.042)
Volatility	-0.012	0.000**	0.000	-0.000
	(0.009)	(0.000)	(0.000)	(0.000)
Commodity Index	0.008	0.001**	0.000	0.000
	(0.006)	(0.000)	(0.000)	(0.001)
Per-capita Income	-0.189	0.022	0.115	-0.629***
	(0.203)	(0.089)	(0.262)	(0.131)
GDP growth	0.494*	0.410**	0.453*	-0.055
	(0.258)	(0.165)	(0.274)	(0.326)
Chinn-Ito Index	0.074	0.279***	-0.332	0.614
	(0.084)	(0.069)	(0.239)	(0.412)
Interest Rate	-0.000	0.008**	0.017*	0.003
	(0.005)	(0.004)	(0.009)	(0.009)
ER regime	-0.005	0.017	-0.060	-0.147*
	(0.017)	(0.017)	(0.091)	(0.089)
Constant	3.901	-2.430**	-3.070	5.824***
	(2.626)	(1.074)	(3.266)	(1.679)
N	980	902	1040	820

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the Fixed Effects model, five lags of net capital inflows are also used as controls

Table 18: Quantile Regression results for Net Capital Inflows: Five Lags

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Quantile	10th	20th	30th	40th	50th	60th	70th	80th	90th
l1.logreserves	-0.0019***	-0.0009***	-0.0002***	-0.0001***	-0.0000	-0.0003***	-0.0010***	-0.0021***	0.0026***
	(0.0003)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0002)	(0.0005)	(0.0003)
l2.logreserves	0.0021***	0.0011***	0.0003***	0.0001***	0.0000	0.0008***	0.0020***	0.0031***	-0.0003
	(0.0005)	(0.0003)	(0.0000)	(0.0000)	(0.0000)	(0.0002)	(0.0003)	(0.0004)	(0.0004)
l3.logreserves	-0.0008**	-0.0003	-0.0002***	0.0000	0.0000	-0.0006***	-0.0019***	-0.0025***	-0.0012*
	(0.0003)	(0.0004)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0002)	(0.0004)	(0.0006)
l4.logreserves	0.0012***	0.0003	0.0004***	-0.0000	0.0000	0.0001	0.0004	0.0007*	-0.0012
	(0.0003)	(0.0003)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0002)	(0.0004)	(0.0008)
l5.logreserves	-0.0006***	0.0001	-0.0002***	0.0000***	-0.0000	-0.0000	0.0007***	0.0013***	0.0006*
	(0.0002)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0002)	(0.0002)	(0.0003)
Consistent	0.0014***	0.0007***	0.0002***	0.0001**	-0.0000	-0.0001	0.0004*	0.0032***	-0.0009
	(0.0003)	(0.0002)	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0002)	(0.0011)	(0.0006)
Volatility	0.0000	0.0000	0.0000	-0.0000	0.0000	0.0000**	0.0000***	0.0000***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Per-capita GDP	-0.0012***	-0.0003***	-0.0002***	-0.0000***	0.0000	-0.0000	-0.0002***	-0.0008***	-0.0050***
	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0002)	(0.0001)
GDP growth	-0.0014	0.0013	-0.0006	-0.0004**	-0.0000	-0.0016***	-0.0045**	-0.0050**	0.0125***
	(0.0018)	(0.0008)	(0.0004)	(0.0002)	(0.0000)	(0.0004)	(0.0021)	(0.0026)	(0.0037)
Interest Rate	0.0003***	0.0000	0.0000***	0.0000***	0.0000	-0.0000***	-0.0000	-0.0001	-0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)
Chinn-Ito Index	-0.0001	-0.0013***	-0.0003***	0.0000**	0.0000	0.0006***	0.0021***	0.0042***	0.0060***
	(0.0004)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0002)	(0.0003)	(0.0006)	(0.0006)
ER Regime	0.0010***	-0.0001	0.0000	-0.0001***	0.0000	-0.0001***	-0.0007***	-0.0015***	-0.0023***
	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
N	1175	1175	1175	1175	1175	1175	1175	1175	1175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$