Alternate Instruments to Manage the Capital Flow Conundrum: A Study of Selected Asian Economies

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Gross capital inflows and outflows to and from emerging market economies (EMEs) have witnessed a significant increase since early 2000s. This rapid increase in these flows accompanied by sharp rise in volatility has amplified the complexity of macroeconomic management in EMEs. While capital inflows provide additional financing for productive investment and offer avenues for risk diversification, unbridled flows could exacerbate financial and macroeconomic instability. In this paper, we focus on the experience of 6 large emerging Asian economies (EAEs) in dealing with capital flows. Using quarterly data, we identify the waves of capital flows experienced by these economies and the efficacy of the alternative policy measures taken by these economies in response to such flows. The policy measures encompass negotiating the trilemma, intervention in the foreign exchange market, and imposition of capital flow management measures. The efficacy of these responses have been varied across countries implying that a judicious mix of these measures, along with improvement in financial and institutional development is required to effectively counter the vagaries of capital flows.

Keywords: Capital flows, Trilemma, Asymmetric intervention, Capital controls, Exchange market pressure.

JEL Code: F32, F38 and F41

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June 30, 2018

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1 Introduction

Emerging economies witnessed a sharp increase in capital flows during the last two and a half decades. After fluctuating between 2.0% and 4.0% of GDP during 2000 to 2002, gross capital inflows started to pick up from 2003 and reached a peak of 11.5% of GDP in the third quarter of 2007. These inflows collapsed dramatically with the onset of the Global Financial Crisis (GFC) and fell to -5.4% of GDP in the fourth quarter of 2008 (Bluedorn et al., 2013).¹ The slew of measures introduced by a number of countries in the aftermath of GFC to bolster aggregate demand, including the unconventional monetary policies adopted by a number of advanced economies resulted in a resurgence of capital into the emerging markets. Gross capital inflows rose rapidly in the second half of 2009 and 2010, and by third quarter of 2010 these inflows to emerging markets exceeded the pre crisis peak and reached almost 15% of GDP of their cumulative GDP. The situation reversed again by end of 2011, with worsening of the global economic outlook driven by sovereign debt rating downgrade of the United States in August 2011 and exacerbation of the Eurozone crisis. This resulted in capital flows receding rapidly, with gross inflows falling below 3.0% of GDP in the last quarter of 2011, and eroding the recent exchange rate gains and reserve accumulation. While there was some recovery in the subsequent quarters, the signal by the Federal Reserve Bank in May 2013 that it would taper its bond-buying program, again precipitated a sharp drop in capital flows.

This heightened volatility in capital flows created a number of macroeconomic challenges and financial stability concerns for emerging economies, and forced them to undertake capital account management and macroprudential measures to stem the flow of capital. These measures were adopted to address multiple objectives such as preventing excessive appreciation of the domestic currencies in order to preserve the competitiveness of exports, guarding against asset bubbles, maintaining monetary policy autonomy in the face of volatile capital flows and pressure on the exchange rate, and reducing financial sector vulnerability to contagion.

The paper focuses on the trend of capital inflows and outflows in selected EAEs by analyzing the "waves" in capital flows. Subsequently, the response of the host countries to these waves of flows is analyzed, focusing both on the capital account management and macroprudential measures. These policy responses have involved (a) negotiating the trilemma or the impossible trinity in the face of rising and volatile capital flows; (b) intervening in

¹Bluedorn et al. (2013) define gross inflows in terms of sale and purchase of domestic assets by foreign residents. They are net sales of domestic assets to foreign residents. Gross outflows are net purchases of foreign assets by domestic residents. Net capital flows are basically net inflows, defined as gross inflows (change in domestic resident liabilities to foreigners) minus gross outflows (change in foreign assets owned by domestic residents).

the foreign exchange market by the central banks to stabilise the domestic currency; and (c) imposing capital controls to stem the inflow of particular types of foreign capital.² Finally, the paper attempts to evaluate the efficacy of these measures by analyzing if these measures achieved their desired goals.

The rest of the paper is organized as follows. Section 2 documents the broad trends in capital flows in selected EAEs. Section 3 discusses the various capital account management and macroprudential measures adopted by the EAEs to balance the complex and diverse objectives of macroeconomic management in the face of surges and stops of capital flows. In this section we also attempt to analyse the impact of capital controls implemented by some of the EAEs. Section 4 explores the evolution of exchange market pressure in the EAEs. Finally, Section 5 concludes by summarising the main take aways of the paper.

2 Identifying Surge and Stop Episodes

In this section, the broad trends in capital flows in selected EAEs is documented. The analysis focuses on six major emerging economies of the region viz. India, Indonesia, Republic of Korea (henceforth, Korea), Malaysia, Philippines and Thailand.³ The choice of these countries is driven by the availability of the data and their economic importance. According to IMF's World Economic Outlook, barring China, these 6 EAEs account for nearly 90% of GDP of emerging and developing Asia during the 2000s. At the same time, these economies also accounted for nearly 90% of capital flows into emerging and developing Asia. The paper covers the period 1995 Q1 to 2015 Q1.

Gross capital inflows have been extremely volatile in recent years in these Asian economies. For example, gross capital inflow on account of net purchase of Korean assets by foreigners through direct and portfolio investment, financial derivatives and other investment reversed from +\$25.7 billion in Q2 2007 to -\$22.6 billion (net sales) in Q3 2008. Similarly, even in India, an economy with limited capital account integration, net purchase of assets went down from +\$29.2 billion in Q4 2007 to -\$1.6 billion in Q4 2008.⁴

 $^{^{2}}$ The trilemma outlines that it is feasible for a country to choose at most two, and not all three, of the policy objectives

³We had also planned to include Vietnam in our sample but were constrained by the availability of data for many of the variables used in our analysis.

 $^{^{4}}$ The statistics are based on authors' calculations using data from Bluedorn et al. (2013). Their capital flows database contains panel data on international capital flows by country at annual and quarterly frequencies, covering years 1970 - 2015 and quarters 1970:Q1 - 2015:Q4.



Source: IMF's Balance of Payment Statistics & Authors' Estimates

Following Forbes (2014) the increase in volatility is assessed by calculating the standard deviation of quarterly gross capital inflows over the last eight quarters for our sample of countries. The results are shown in Figure 1. Given Korea's significantly higher degree of volatility, compared to the other economies, it has been measured on a different axis. It is evident that in all these economies, the period of the GFC was characterized by significantly higher volatility in capital flows, compared to earlier years. There was a steady increase in the volatility from early 2006, which peaked in the second half of 2008.

The volatility in the capital inflows have been driven by periods of "waves" of capital inflows. We use the methodology introduced in Forbes and Warnock (2012) to identify periods of sharp changes in inflows. According to this methodology C_t is the four-quarter moving sum of gross capital inflows (GINFLOW), and we compute annual year over year changes in C_t . Consequently,

$$C_t = \sum_{i=0}^{3} \text{GINFLOW}_{t-i} \tag{1}$$

and $\Delta C_t = C_t - C_{t-4}$. Next, we compute the rolling means and standard deviations of ΔC_t over the last 5 years or 20 quarters. Following Forbes and Warnock (2012), we identify surge as an episode, which starts in the month when ΔC_t increases more than one standard deviation above its rolling mean, provided it crosses two standard deviations above the rolling mean

during this period. The episode ends once ΔC_t falls below one standard deviation above its mean. Similarly, a "stop" episode covers the period when gross inflows decline one standard deviation below its mean. and again provided that it reaches two standard deviations below the rolling mean at some time during the period.

Sta	art	End	Ctant	
1000		Enu	Start	End
1996	6 Q2 1	997 Q1	1998 Q2	1998 Q3
2003	3 Q3 2	004 Q2	2008 Q3	2009 Q3
2004	4 Q4 2	005 Q3	2013 Q2	2013 Q3
India 2006	6 Q4 2	$008 \ Q1$		
2010	Q2 = 2	011 Q1		
2012	2 Q3 2	013 Q1		
1995	5 Q2 1	996 Q3	1997 Q3	1998 Q2
2005	5 Q4 2	$006 \ Q1$	2006 Q3	$2007 \ Q1$
Indonesia 2010) Q3 2	011 Q1	2008 Q4	$2009~\mathrm{Q2}$
2014	4 Q1 2	014 Q3	2012 Q1	$2012~\mathrm{Q2}$
			2015 Q3	$2015~\mathrm{Q4}$
Malaysia 2010	Q4 2	011 Q2	2005 Q4	2006 Q3
			2008 Q3	$2009~\mathrm{Q2}$
1995	5 Q1 1	995 Q4	1997 Q4	1999 Q1
Korea			$2008 \ Q1$	$2009~\mathrm{Q2}$
			$2015 \ Q1$	$2015~\mathrm{Q3}$
1996	6 Q1 1	997 Q1	1997 Q3	$1998 \ Q3$
Philippines 2005	5 Q2 = 2	005 Q4	2008 Q1	$2009 \ Q1$
2007	7 Q1 2	007 Q3	2013 Q3	$2014~\mathrm{Q1}$
1995	5 Q2 1	996 Q1	1996 Q3	$1998 \ Q1$
2005	5 Q1 2	006 Q3	2007 Q1	$2007~\mathrm{Q4}$
Thailand 2010	Q1 2	010 Q4	2008 Q3	$2009~\mathrm{Q3}$
			2011 Q4	$2012~\mathrm{Q2}$
			2015 Q3	$2015~\mathrm{Q4}$

Table 1: Surge and Stop Episodes in EmergingAsian Economies

Source: IMF's International Financial Statistics and Authors' Estimates.

Using this methodology we are able to identify numerous surge and stop episodes across the 6 EAEs. Overall, these 6 EAEs experienced 18 surge and 21 stop episodes. These episodes are listed in Table 1 while Figure 2 highlights the evolution of gross inflows, gross inflows and net inflows. Most of the surge episodes occurred in the years preceding the Asian financial crisis (AFC) and the GFC, and the post-GFC period when many of the advanced economies were practicing unconventional monetary policies. In contrast, majority of the stop episodes were confined to the AFC and the GFC periods, with several countries also being impacted with the US signalling a tapering of its quantitative easing in mid-2013.

There are significant differences at the individual country level. While, at six, India experienced the most number of surge episodes, Malaysia and Ko-

rea witnessed only one surge episode each.⁵ The stop episodes were more symmetrically distributed with Indonesia and Thailand experiencing five episodes each, followed by Philippines with 4 stop episodes, and India and Korea with three episodes. While Indonesia and Korea experienced the longest surge in capital inflows during the pre-AFC period (1994-1996), India and Thailand recorded the longest surge episodes during the pre-GFC period. Figure 2 shows that during the longest surge episode between 2006 Q4 and 2008 Q2, India experienced gross inflow in excess of \$150 billion or an average of 7.9% of GDP and net capital inflows of 6.7% of GDP. Similarly, though the surge episode between 2004 Q3 and 2006 Q1 in Thailand was much more modest in volume, resulting in gross capital inflow of only \$30 billion, these capital flows accounted for nearly 8.9% of GDP. Both Indonesia and Korea received net capital inflows of roughly 5% of GDP during their pre-AFC surge episodes. The stop episodes were equally diverse. The longest stop episode among these 6 EAEs took place in Thailand during the AFC (1996 Q3 - 1998 Q2), and led to sale of Thai assets by foreigners worth 4 billion or 2.4% of GDP. Korea experienced sale of assets worth 130 billion or 11.5% of GDP during the GFC.

As described above, overall we identify 39 surge and stop episodes across the 6 EAEs during the period 1995 Q1 to 2015 Q4 The average duration of a surge episode in these EAEs is 4 quarters, slightly longer than the average duration of stop episode, which is around 3.8 quarters. Table 2 outlines the effect of these episodes on key macroeconomic variables across the 6 EAEs. We compute the quarterly averages of month on month change in exchange rate, reserves, real effective exchange rate and stock market. We find that across all the 6 EAEs, surge episodes were associated with the strengthening of the local currency vis-a-vis the US Dollar, with the extent of appreciation ranging between 0.2% to 0.3%. In contrast, while the stop episodes were associated with the weakening of the local currency, the extent of impact differed widely. Indonesia experienced the highest depreciation, followed by Philippines, India and Korea. The magnitude of depreciations were relatively small in Malaysia and Thailand.

The surge episodes were universally associated with reserve accretion with the central bank in all the 6 EAEs intervening heavily in the foreign exchange market. In contrast, we do not find much evidence of depletion of reserves during the stop episodes, implying asymmetric intervention by the central bank.⁶ Only India and Malaysia witnessed a depletion of reserves during the stop episodes.

The nominal appreciation in all the economies during the surge episodes

⁵Data for Malaysia is available from 2005 Q1

 $^{^6\}mathrm{We}$ study the asymmetric intervention behaviour of the central banks empirically in Section 3.2



Figure 2: Gross and Net Flows to Selected Asian Economies along with Surge and Stop Episodes

Source: Forbes (2014), IMF's Balance of Payment Statistics and Authors' Estimates.

was accompanied by real appreciation, with the exception of Malaysia. In many cases the intervention in the foreign exchange market was associated with incomplete sterilization, which led to an increase in money supply and bolstered inflationary pressures, resulting in real appreciation. The stop episodes were typically associated with real depreciation across all the 6 EAEs, with the exception of India.

The episodes also had an effect in the stock market. During the surge episodes the stock gained across all the 6 EAEs with portfolio capital flows playing an important role in many of the episodes. Similarly, in all the economies the stop episodes were associated with a decline in the stock market as foreign investors withdrew capital out from these markets.

	In	dia	Indo	onesia	Ko	orea
	Surge	Stop	Surge	Stop	Surge	Stop
Episodes (Number of Quarters)	25	9	14	14	4	15
As Percent of Available Obs.	29.8%	10.7%	16.7%	16.7%	4.8%	17.9%
Average Duration (Quarters)	4.2	3.0	3.5	2.8	4.0	5.0
Change in Exchange Rate	0.28%	-1.27%	0.30%	-3.61%	0.23%	-1.25%
Change in Real Exchange Rate	0.38%	0.04%	0.92%	-2.33%	0.32%	-0.91%
Change in Reserves	1.95%	-0.54%	2.28%	0.11%	2.07%	1.40%
Change in Stock Market	2.38%	-1.01%	2.51%	-3.43%		-0.63%
	Mal	aysia	Phili	ppines	Tha	iland
	Surge	Stop	Surge	Stop	Surge	Stop
Episodes (Number of Quarters)	Surge 3	Stop 6	Surge 15	Stop 13	Surge 15	Stop 22
Episodes (Number of Quarters) As Percent of Available Obs.	Surge 3 4.4%	Stop 6 8.8%	Surge 15 17.9%	Stop 13 15.5%	Surge 15 17.9%	Stop 22 26.2%
Episodes (Number of Quarters) As Percent of Available Obs. Average Duration (Quarters)	Surge 3 4.4% 3.0	Stop 6 8.8% 3.0	Surge 15 17.9% 5.0	Stop 13 15.5% 3.3	Surge 15 17.9% 5.0	Stop 22 26.2% 4.4
Episodes (Number of Quarters) As Percent of Available Obs. Average Duration (Quarters) Change in Exchange Rate	Surge 3 4.4% 3.0 0.28%	Stop 6 8.8% 3.0 -0.32%	Surge 15 17.9% 5.0 0.34%	Stop 13 15.5% 3.3 -1.72%	Surge 15 17.9% 5.0 0.29%	Stop 22 26.2% 4.4 -0.65%
Episodes (Number of Quarters) As Percent of Available Obs. Average Duration (Quarters) Change in Exchange Rate Change in Real Exchange Rate	Surge 3 4.4% 3.0 0.28% -0.32%	Stop 6 8.8% 3.0 -0.32% -0.06%	Surge 15 17.9% 5.0 0.34% 0.61%	Stop 13 15.5% 3.3 -1.72% -0.88%	Surge 15 17.9% 5.0 0.29% 0.61%	Stop 22 26.2% 4.4 -0.65% -0.14%
Episodes (Number of Quarters) As Percent of Available Obs. Average Duration (Quarters) Change in Exchange Rate Change in Real Exchange Rate Change in Reserves	Surge 3 4.4% 3.0 0.28% -0.32% 3.33%	Stop 6 8.8% 3.0 -0.32% -0.06% -2.15%	Surge 15 17.9% 5.0 0.34% 0.61% 2.84%	Stop 13 15.5% 3.3 -1.72% -0.88% 0.28%	Surge 15 17.9% 5.0 0.29% 0.61% 1.56%	Stop 22 26.2% 4.4 -0.65% -0.14% 0.26%

Table 2: Impact of Surge and Stop Episodes

Source: IMF's International Financial Statistics and Authors' Estimates

3 Policy Response to Manage Capital Inflows

Policymakers' desire to prevent sharp surges in capital inflows stems from the myriad risks associated with these surges. These include macroeconomic risks, financial stability risks, and finally risks associated with capital flow reversal. Subramanian and Rajan (2005) and Prasad et al. (2007) show that excessive capital inflows result in rapid exchange rate appreciation, which can hurt exports of emerging markets. Thus capital flow surges can influence macroeconomic variables in a way that is inconsistent with policy objectives such as price stability, exchange rate stability and export promotion. Capital inflows can also push up asset prices, reduce the quality of assets and adversely affect maturity and currency composition of corporate balance sheets, contributing to enhanced financial fragility. Prasad and Rajan (2008) contend that in an underdeveloped financial system, foreign capital is channeled towards easily collateralized, non-tradable investments, leading to asset price booms, with subsequent busts severely disrupting the economy. Foreign portfolio investment into shallow equity markets also cause sharp valuation swings. Finally, capital inflows can reverse themselves leading to a costly balance of payments crisis. Schadler (2010) shows that about 15%of capital inflow episodes over the past two decades have resulted in a crisis.

In the case where capital flows are being driven largely by economic funda-

mentals, policymakers need to reconcile to the inevitability of allowing a real exchange rate appreciation as it would result in a fundamental revaluation of domestic assets relative to foreign assets. However, policymakers tend to be reluctant to allow the real exchange rate to appreciate for a variety of reasons. The most important concern tends to be loss of international price competitiveness resulting in adverse balance of payments situation.

In general, policymakers can resort to three broad macroeconomic measures to counter the surge in capital inflows. These involve (i) enhancing exchange rate flexibility to manage the trilemma in order to retain monetary autonomy, (ii) undertaking foreign exchange intervention to stabilise the domestic currency and maintain competitiveness of exports but sacrificing monetary policy independence, and (iii) imposing controls on capital inflows and/or relaxing controls on capital outflows. Below, we analyse the experience of 6 EAEs on these measures.

3.1 Enhancing Exchange Rate Flexibility

Enhancing exchange rate flexibility does not necessarily imply nominal exchange rate appreciation, something which the policymakers are reluctant to allow. It refers to introducing two-way risks, and thereby discourage speculative capital inflows. If a central bank responds to capital inflows over a period of time by continuing to intervene in the foreign exchange market it encourages more capital flows by introducing a one-way bet. It signals investors that the domestic currency will appreciate in the near future when the central bank cannot afford further intervention and allows freer movement of the currency. At the same time, large stockpile of reserves provides an assurance that large depreciation will not take place.

Introduction of two-way risks involve widening the band of fluctuation in the case of *de facto* peg or a tightly managed float. The need to allow greater freedom to the exchange rate in the face of enhanced capital inflows is driven by the desire to retain monetary autonomy to be able to stabilize the economy in the event of adverse shocks. This trade-off stems from the classic open economy trilemma, which argues that it is impossible to simultaneously attain monetary policy independence, exchange rate stability and capital market integration. Only two of the three objectives can be obtained at a particular point in time. We use empirical methods following Aizenman et al. (2010) to briefly describe the experience of the EAEs with the impossible trinity, using quarterly data from 2000 Q1 to 2015 Q4. Details of the calculations are given in Section A.1 in Appendix.

With three indices across 6 EAEs, it is difficult to identify events that would have resulted in a structural shift in these indices across all the economies.

Hence, to better understand the evolution of these indices, the entire sample is broken into four equal periods. While Period I lasts from 2000 Q1 to 2003 Q4, Period II covers 2004 Q1 to 2007 Q4, Period III encompasses 2008 Q1 to 2011 Q4 and Period IV covers 2012 Q1 to 2015 Q4. Figure 3 plots the means of the indices across these periods.





Next, we test the extent to which the trilemma was binding across these 6 EAEs. The relationship is estimated for the four sub-periods identified above. While the estimates for exchange rate stability and capital account openness are significant across all the specifications, it is not the case with monetary independence. To obtain the contribution of each trilemma policy orientation the coefficients are multiplied with the average for each phase. The results are outlined in Figure 4.



Figure 4: Policy Weights on the Trilemma Objectives

In case of both India and Malaysia, the importance of exchange rate stability has decreased over time while the weight attached to monetary policy independence has gone up. In India capital account openness witnessed an

increase in Period II, boosted by abundant global liquidity and strong domestic macroeconomic fundamentals. However, the GFC, followed by the sovereign debt crisis in Europe, and concomitant deterioration in domestic macroeconomic indicators resulted in a slump in capital flows in Period III. The weight on monetary independence increased from 22.4% in Period I to over 70% in Period III as monetary policy was calibrated to manage rising domestic inflationary pressures. In Malaysia, it increased from 1% to 38% during this period. Both these economies significantly reduced the weight on exchange rate stability to manage the trilemma. In Malaysia, the weight declined from 92.6% in Period I, when the Ringgit was pegged to the US Dollar, the weight on exchange rate stability declined to below 60% in Period III, while in India it dropped from 76.3% to 20.3%. Finally, in Period IV, both Malaysia and India came close to adopting corner solutions, focusing only on monetary independence and capital account openness and allowing the exchange rate to remain completely adjustable.

In Thailand also, there has been a decline in the weight given to stabilizing the exchange rate across the periods, barring Period III when there was a slight uptick in ERS index. The decline in ERS index was associated with rising focus on monetary independence. In fact, in Period IV, Thailand, like, India and Malaysia, came close to adopting a corner solution comprising monetary independence and capital account openness, with a very small weight on stabilizing exchange rate.

In contrast, in Indonesia policymakers imparted greater weight to exchange rate in the first three periods with a view to retain competitiveness, despite BI committing to an inflation targeting framework in 2005. The dichotomy between monetary and exchange rate management was achieved through BI's intervention in the foreign exchange market to keep its exchange rate near what the central bank perceived to be equilibrium. This is evidenced from the ΔRes index, which is highest for Indonesia among the 6 EAEs. This was associated with a declining weight on monetary independence across the period. However, this policy configuration changed in the fourth period when Indonesia significantly increased the weight on monetary independence and capital account openness and allowed the exchange rate to fluctuate.

In Philippines the weights accorded to the three policy objectives have remained fairly steady over the period 2000 to 2015. Philippines accorded the highest weight to monetary independence to ensure macroeconomic stability, and this has increased steadily during this period. Stabilizing the exchange rate has also been a fairly important consideration and the weight on exchange rate stabilization has remained between 35% and 40%.

Finally, Korea has also consistently put a strong weight on monetary independence, followed by exchange rate stability. There was some decline in the emphasis given to monetary independence in Period II and IV, when the economy experienced a rush of capital inflows, resulting in an increase in capital account openness. The emphasis on exchange rate stability has been fairly consistent across the periods.

Thus, the 6 EAEs negotiated the trilemma in diverse manner as they were confronted with volatile capital flows. During the first three periods, instead of adopting corner solutions, all the 6 EAEs adopted intermediate approach in negotiating the conflicting approaches of the trilemma. While India, Malaysia and Thailand chose to sacrifice exchange rate stability in more recent years to have greater freedom to exercise monetary policy in the face of rising capital account openness, Philippines and Korea have continued to put emphasis on curbing exchange rate variability. While in Korea, this was accompanied by a reduction in the weight on monetary independence, in Philippines, it was complemented with lower degree of capital account openness.

3.2 Intervention in the Foreign Exchange Market

One of the policy tools that is most commonly used to counter surge and stop in capital flows is foreign exchange intervention. This involves the central bank intervening in the foreign exchange market to resist an appreciation or depreciation of the domestic currency. The central banks of the 6 EAEs also resorted to intervention in the face of volatile capital inflows. The surge episodes identified in Figure 2 were associated with significant accumulation of reserves. Focusing on the episodes since 2000, Table 3 indicates the extent of reserve accumulation during the surge episodes since 2000.⁷ All the surge episodes were associated with accumulation of reserves.

	<u>~</u> ;	~
	Surge	Stop
	(Billion \$)	(Billion \$)
India	217.3	-45.62
Indonesia	52.1	6.77
Korea		-25.97
Malaysia	14.7	-34.68
Philippines	9.9	3.7
Thailand	45.5	37.37

Table 3: Reserve Accumulation During Surge and Stop Episodes (Since 2000)

Source: IMF's International Financial Statistics and Authors' Estimates.

Table 3 shows that the stop episodes were not universally associated with

⁷Data on actual intervention by the central bank would be a better indicator to exclude valuation change. However, such data is not available for all the economies in our sample. Hence we use the change in reserves as a proxy for intervention.

depletion of reserves. In the post 2000 period, in only 8 out of the 14 stop episodes these EAEs used reserves to counter the stop of capital inflow. This raises a question as to whether the central banks in these EAEs have been intervening in an asymmetric manner in the foreign exchange market i.e. accumulating reserves during surges of capital flows to stem appreciation of the domestic currency but adopting a hands-off approach during stops of capital flows, and allowing the currency to depreciate. The plausible reasons as to why central banks would pursue such an asymmetric intervention policy could either be adherence to a mercantilist approach of keeping exchange rates depreciated in order to promote exports or the fear of losing international reserves that are now considered a crucial indicator of the overall macroeconomic stability of a country.

Following Pontines and Rajan (2011) and Sen Gupta and Sengupta (2014), we model the behaviour of a central bank who seeks to minimize a loss function comprising deviation of reserves as well as the exchange rate from their respective target. Using monthly data on reserves and exchange rate we emperically test the optimality condition employing GMM methodology.⁸ The parameter θ indicates the degree of asymmetric intervention, with a positive value indicating fear of appreciation. We cover the period 2000 to 2016, excluding 2008 due to erratic movement in exchange rate and reserves with the onset of GFC. We divide the entire sample in to pre-GFC (2000 to 2007) and post-GFC (2009-2016) periods.

During the pre-GFC period India, Indonesia, Malaysia and Thailand significantly intervened in an asymmetric manner in the foreign exchange market to prevent their currency from appreciating. The extent of asymmetric intervention was highest in the case of India, followed by Malaysia and Indonesia. These results are consistent with Section 3.1 where India, Indonesia and Malaysia exhibit high degree of exchange rate stability during Period I (2000 Q1 to 2003 Q4) and Period II (2004 Q1 to 2007 Q4). Philippines does not exhibit asymmetric intervention, again supported by low values of exchange rate stability compared to other countries. Korea is the only country in our sample to exhibit fear of depreciation, and used reserves to stem depreciation, although the result is significant only at the 10% level.

In the post-GFC period there were clear differences across the countries. India, Malaysia and Philippines abandoned the policy of asymmetric intervention. The currencies in these economies appreciated as global capital flows resumed in the post-GFC period with advanced economies undertaking unconventional monetary policies. These currencies were also allowed to depreciate in the aftermath of the taper tantrum. The limited volume of reserve accumulation or decumulation during the surge and stop episodes as

⁸Details of the model, estimation strategy and results are described in Section A.3 in Appendix.

well as low values of exchange rate stability in these economies also support the limited degree of asymmetric intervention. Indonesia continued with the policy of asymmetric intervention by accumulating reserves during the surge episodes but not intervening much during the stop episodes to prevent exchange rate depreciation while Korea continued its practice of intervening asymmetrically in the market to prevent depreciation, Thailand switched from exhibiting a fear of appreciation to a fear of depreciation as it used its reserves to stem depreciation in the post-GFC period.

		Pi	re-GFC Perio	od: 2000 to 2	007	
	India	Indonesia	Korea	Malaysia	Thailand	Philippines
β_0	2.823***	0.978^{***}	0.858^{***}	1.264^{***}	1.064^{***}	0.933^{***}
	[18.19]	[11.78]	[10.54]	[16]	[14.12]	[6.88]
β_1	1.827***	0.302^{***}	0.385^{***}	0.961^{***}	0.500^{***}	0.345^{***}
	[5.46]	[12.01]	[3.67]	[10.32]	[11.32]	[5.14]
β_2	-0.689***	-0.019***	0.050^{*}	-0.268***	-0.017	-0.009
	[-5.20]	[-9.95]	[1.94]	[-6.75]	[-0.64]	[-0.88]
θ	0.754***	0.123^{***}	-0.261*	0.558^{***}	0.067**	0.051
Number of Observations	89	89	89	89	89	89
		Po	st-GFC Peri	od: 2009 to 2	2016	
	India	Indonesia	Korea	Malaysia	Thailand	Philippines
β_0	0.403***	1.442^{***}	0.222^{***}	0.615^{***}	0.039	0.731^{***}
	[4.27]	[10.11]	[3.12]	[9.49]	[0.53]	[5.31]
β_1	0.383***	1.020^{***}	0.330^{***}	0.634^{***}	0.954^{***}	0.309^{***}
	[7.40]	[9.15]	[15.09]	[12.07]	[15.11]	[5.14]
β_2	0.011	-0.051**	0.061^{***}	-0.102***	0.235^{***}	0.005
	[0.86]	[-2.01]	[2.83]	[-5.57]	[7.10]	[0.18]
θ	-0.057	0.099**	-0.368***	0.321	-0.494**	-0.033
Number of Observations	89	89	89	89	89	89

Table 4: Extent of Asymmetric Intervention in EAEs:2000-2007

Notes: Robust z-statistics in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1% respectively Source: Authors' Estimates.

The asymmetric intervention resulted in the central banks acquiring significant volume of foreign assets, which threatened to disrupt the monetary base. Central banks sought to limit the impact on the monetary base by sterilizing these interventions albeit with varying results.

3.3 Capital Controls and Impact

One of the most common macroeconomic policy tools to deal with surges in capital inflows is imposing capital controls i.e. residency-based restrictions on the cross- border movement of capital. In recent times emerging economies have begun using controls-both on inflows and outflows, to manage volatile and potentially disruptive capital flows. The GFC has been a turning point in the world-view on capital controls, just as a similar reassessment was done in the aftermath of the AFC of 1997-98. The issue of regulation of capital flows has slowly but steadily moved to the centerstage from earlier being confined to the periphery of mainstream policy discourse. Ex-ante management of capital flows is now accepted as a legitimate instrument in a country's macroeconomic policy toolkit.

The IMF, a one-time proponent of complete liberalization of the capital account, has also shifted in favor of the idea that capital controls can be useful as a last resort when a country faces a net capital inflow surge and after other macroeconomic policy options have been exhausted (Ostry et al., 2011). The IMF position articulated in Ostry et al. (2010) goes further in suggesting that capital controls be used in the pursuit of macroeconomic management. The impact of controls on the magnitude and composition of capital flows, on transactional frictions, monetary policy, rates in different financial markets, asset prices etc., have been a subject of enormous debate with very little consensus on the issue. Effectiveness of capital controls varies with initial conditions as well as across countries and time periods. To the extent that there are country specific characteristics that make capital controls effective, understanding individual country experiences with capital controls gains significance (Patnaik and Shah, 2012).

Numerous studies have used the information available in IMF's AREAER to create indices of de jure capital account restrictions. Fernndez et al. (2016) constructs annual capital control indices for capital inflows and outflow across different asset categories like direct investment, portfolio equity, portfolio debt and other flows. Figure 5 plots the evolution of capital controls in these 6 EAEs during 2000 to 2015. Evidently, there is substantial heterogeneity among the 6 EAEs. India has maintained high degree of capital account restrictions with very limited degree of liberalization during the entire period, with restrictive regulations across different assets. On the other hand, Korea has shown substantial reduction in these restrictions from 2005, mainly driven by liberalisation of regulations governing capital flows in bond and equity markets. Indonesia, Malaysia, Philippines and Thailand witnessed some tightening of restrictions in recent years, mainly due to more restrictive regulations in the equity market. In contrast, bond markets witnessed some liberalization during this period. FDI restrictions are also quite diverse across the 6 EAEs and also vary significantly between inflows and outflows.

While these indices are useful in gauging the extent and direction of capital account openness in an economy they are less likely to capture the impact of use of sporadic capital controls that are often implemented by the authorities to deal with surge or stop episodes. During a surge or stop episode controls are often adopted and adjusted at higher frequency than can be captured by annual data. Consequently, analyzing the efficacy of capital account management restrictions, requires evaluation at a higher frequency.

Below, we evaluate the impact of selected capital account management measures by using daily data. Frequently, capital account management measures



Source: Authors' Estimates based on Fernndez et al. (2016). Note: IND - India; IDN - Indonesia; KOR - Republic of Korea; MYS - Malaysia; PHL - Philippines; and THA - Thailand. The intensity of controls are based on information provided in IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The narrative description in the AREAER is used to determine whether or not there are restrictions on international transactions, with a 1 representing the presence of a restriction and a 0 representing no restriction.

are introduced to prevent rapid changes in exchange rate and asset prices. Hence, we evaluate the impact of these measures on exchange rate and equity market returns. We evaluate the impact at weekly, fortnightly and monthly interval. We use the means equality test to differentiate between averages of the treated and untreated group, with the observations after the introduction of the capital account management measures being considered as the treated group. A measure is considered effective if it is successful in directing the exchange rate and stock market movement in the desired direction.

We focus on instances where policymakers introduced a broad set of measures to influence the capital flows. For India and Indonesia, we evaluate the efficacy of the measures introduced in mid-2013 in the aftermath of 'taper tantrum' to encourage inflows and stem outflows. In mid-August 2013, India restricted the import of gold to improve its external balances, imposed restrictions on capital outflows and eased regulations on foreign commercial borrowings to bolster capital inflows and restrict outflows. In Indonesia, policymakers hiked the policy rates considerably and introduced a policy package to rein in current account deficit, contain inflation, and boost investment and employment. In Indonesia regulations related to purchase of foreign exchange by exporters and short-term borrowing by banks were also relaxed. In response to its currency experiencing sharp volatility during the crisis in Eurozone, on 13 June 2010 Korea announced a wide range of measures involving restrictions on currency derivatives trades, including non-deliverable currency forwards, cross-currency swaps and forwards, restricted the use of bank loans denominated in foreign currency. and tightening the regulations on foreign currency liquidity ratio of domestic banks.

While the above measures aimed to stem outflows and incentivize inflows, some of the EAEs have also introduced measures to discourage foreign capital inflow. On 18 December 2006, Thailand required financial institutions to withhold 30% of all foreign currency purchased or exchanged against baht exceeding a limit. The amount withheld was refunded after an year on proof that the funds had been kept in Thailand for at least one year.

Malaysia introduced stringent capital flow management in the aftermath of the Asian Crisis, which allowed it to fix its exchange rate and pursue monetary and fiscal expansion to fight recession. These controls were gradually relaxed over the next few years and in 2005 the ringgit peg to the dollar was abandoned in favor of a managed floating system. Since then Malaysia, has not imposed any broad set of measures in response to capital flow volatility. During the GFC, Malaysia experienced a decline in asset prices, weakening of currency and dip in reserves, these shocks were well absorbed as the financial sector reforms and capacity building undertaken following the AFC increased the resilience of the sector to financial turmoil.

				(analysis)	20102 10	mat do o		22				
						Exchang	se Rate					
		One We	ek		15 Days			One Mon	th	L	Three Mon	iths
	Before	After	Difference	Before	After	Difference	Before	After	Difference	Before	After	Difference
India	-0.078	0.096	-0.174^{**}	-0.241	0.102	-0.343	-0.209	-0.189	-0.020	0.559	-0.509	1.068
(Restrict Outflows)			[-2.08]			[-0.79]			[-0.03]			[1.61]
Indonesia	-0.136	-0.102	-0.034	0.019	-0.118	0.137	0.142	-0.901	1.042	0.124	-1.369	1.493^{*}
(Restrict Outflows)			[-0.12]			[0.27]			[1.04]			[1.71]
Korea	-0.048	0.120	-0.168	-0.054	0.209	-0.264	0.376	0.046	0.329	0.134	0.471	-0.337
(Restrict Outflows)			[-0.81]			[-0.80]			[0.95]			[-0.58]
Thailand	0.075	-0.147	0.222	0.020	-0.575	0.595	0.006	-0.980	0.986	-0.208	-0.954	0.746
(Restrict Inflows)			[0.67]			[0.57]			[0.63]			[0.25]
						Stock Mar	ket Index					
		One We	ek		15 Days			One Mon	th	L	Three Mo	iths
	Before	After	Difference	Before	After	Difference	Before	After	Difference	Before	After	Difference
India	-0.148	0.114	-0.262**	0.048	-0.019	0.067	-0.011	0.087	-0.098	0.251	0.029	0.221
(Restrict Outflows)			[-2.36]			[0.30]			[-0.29]			[0.43]
Indonesia	-0.039	-0.029	-0.011	0.079	-0.037	0.116	0.065	-0.058	0.123	0.167	-0.081	0.248
(Restrict Outflows)			[-0.16]			[0.76]			[1.11]			[1.21]
Korea	0.200	0.117	0.083	0.152	0.369	-0.217	-0.247	0.642	-0.889**	-0.405	0.155	-0.560
(Restrict Outflows)			[0.342]			[-0.55]			[-2.30]			[-1.12]
Thailand	0.000	0.076	-0.076	-0.025*	-0.024	-0.001	-0.072	-0.017	-0.055	-0.046	-0.025	-0.021
(Restrict Inflows)			[-1.94]			[0.07]			[-1.16]			[-0.24]
Notes: Robust t-statisti	cs in parent	heses. *, **	', and *** indica	te significanc	te at 10%, 5	%, and 1% resp	ectively.					

Table 5: Efficacy of Selected Capital Flow Measures

Source: Authors' calculations.

In contrast, the central bank in Philippines views that imposition of strict capital controls poses more costs than benefits. Bangko Sentral ng Pilipinas (2018) points out that imposition of controls result in substantial administrative difficulties, Furthermore, unless the capital controls are broadbased and universally implemented, they create arbitrage opportunities and distort efficient allocation of capital across sectors. Financial innovation also makes circumvention of capital controls. Finally, sporadic introduction of capital controls could send negative signals to international investors and hinder Philippines' access to international capital markets.



Figure 6: Composition of External Liabilities

Consequently, we focus on the capital controls introduced in the remaining 4 EAEs. Table 5 highlights the efficacy of the capital flow management

Source: Authors' Estimates.

measure in influencing the exchange rate and stock price index movement in the desired direction. We focus on the average daily change in the exchange rate (value of domestic currency in terms of foreign currency) and stock market index and employs means-comparison test, which tests the equality of the means before and after the introduction of the measure. To evaluate the the short-term and longer term effect of these measures we undertake the tests at differing periods of time – a week, a fortnight, one month and three months.

In the short-term there is some evidence of the capital flow management measures introduced in India in mid-2013 was associated with a reversal of the earlier trend of exchange rate depreciation and drop in stock market index. However, the reversal was short lived with the exchange rate resuming its depreciating trend after one week. A similar trend was observed in the case of stock market index where gains made during the first week after the imposition of the measure faded away in the longer term. In Indonesia, the introduction of the capital flow management measure did not significantly influence the exchange rate or stock market movements either in the short or in the longer-term. In Korea, the restrictions on the capital outflows introduced in December 2006 was not associated with any significant change in the exchange rate movement.

However, a comparison of the stock market index movement over one month before and after the introduction of the measure, shows that trend of stock market index rising prior to the introduction of the measure reversed after the measure was introduced. However, the difference dissipates as we evaluate a longer term. Finally, again in the case of Thailand we find no significant difference in the exchange rate movement before and after the introduction of the measure across different type periods. It is only during the one week period before and after the introduction of the period, there is a significant difference in the stock market index movement.

Thus, by and large for these 4 EAEs, there is very limited evidence of implementation of capital flow management measures yielding changes in the movement of exchange rate and stock price. Furthermore, even in the cases where the imposition of these measures had an impact, the effect lasted only for a short-term and dissipated over a longer horizon.

The limited success of capital controls is in line with other studies such as Forbes and Warnock (2012), who conclude that controls on inflows do not significantly affect surges of gross capital inflows. Other studies such as Forbes et al. (2016) and Zhang and Zoli (2016) also find limited impact of capital flow management measures such as exchange rate and equity returns, but find that capital flow management measures to stem inflows have dampened domestic credit growth. In contrast, studies including Ahmed and Zlate (2014) and Bruno et al. (2017) have found that imposition of capital inflow management measures have reduced the volume of inflows.

Klein (2012)) argues that episodic capital controls (gates) have limited impact in reducing financial vulnerabilities and moderating exchange rate appreciations, while long-standing capital controls (walls) may have some effect. Figure 5 shows that liberalization of capital flows since the mid-1990s involved dismantling of the "walls" in a manner that is consistent with the "pecking order" of capital flows.⁹ Across most of the 6 EAEs, "walls" on FDI inflows were liberalized the most, followed by equities. Debt flows continued to be restricted across most of these EAEs, and in some instances there was an increase in restrictions on debt flows in recent years. This hierarchical nature of liberalization has significantly altered in the composition of foreign liabilities held by these countries over the period 2001 to 2015, with the share of debt liabilities declining across all the 6 EAEs. Less restrictive regulations on FDI inflows have resulted in the share of FDI liabilities increasing in India, Indonesia, Philippines and Thailand. The share of portfolio equity liabilities also increased across all the 6 EAEs, with Philippines experiencing the largest increase, followed by India, Indonesia and Thailand.

4 Conclusion

Gross capital flows to and from emerging market economies have witnessed a significant increase since early 2000s. This rapid increase in the volume of flows was accompanied by sharp swings in volatility, and has amplified the complexity of macroeconomic management in these economies. Capital flows provide a wide range benefits to economies including additional financing for productive investment, new technology and management practices through FDI, avenues for risk diversification and consumption smoothing, and disciplining macroeconomic policy. However, unbridled and volatile capital flows pose a myriad of challenges for macroeconomic and financial stability. These challenges can take the form of asset price bubbles, exchange rate overshooting, and exacerbation of financial fragilities.

This paper focuses on 6 major emerging economies in Asia, and analyses the experiencing of these economies in managing volatile capital flows. We find that these economies witnessed numerous episodes of waves of capital flows. Between 1995 and 2015, these 6 EAEs experienced 18 surge episodes and 21 stop episodes resulting in challenges for macroeconomic management. Policy response to such volatile flows have been diverse across these 6 EAEs. During

⁹Ostry et al. (2010) prescribes a pecking order of capital flows in decreasing order of riskiness, with short-term instruments being more risky than long-term instruments. According to this approach, FDI inflows are the least risky flows, followed by portfolio equity investment inflows, local currency debt inflows, consumer price indexed debt inflows. Foreign currency debt inflows are categorized as the most risky class of assets.

the period 2000 Q1 to 2011 Q4, all the 6 EAEs tried to adopt an intermediate regime and manage the conflicting policy options. In the most recent period, 2012 Q1 to 2015 Q4, we find that there is a discernible shift towards exchange rate flexibility in India, Indonesia, Malaysia and Thailand. This has not only allowed the exchange rate to be the primary shock absorber but also enabled these economies to have greater monetary policy independence and be able to modify interest rates to respond to inflationary pressures or external financing pressures.

Intervention in the foreign exchange market remained an important tool during the pre-GFC period of 2000 to 2007 with countries like India, Indonesia, Korea, Malaysia and Thailand intervening asymmetrically in the foreign exchange market. Among these Korea was the only country to intervene in an asymmetric manner to stem depreciation pressures, while the other economies resorted to intervening mostly to stem depreciation. The proclivity to intervene in an asymmetric fashion dampened down significantly in the post-GFC period in India and Malaysia, reflecting adoption of a more flexible exchange rate policy in these economies. Indonesia continued to intervene in an asymmetric manner to stem appreciation but the intensity of asymmetric intervention dampened down considerably. Korea continued with the pre-GFC practice of intervening to stem depreciation in the post-GFC period, again in line with relatively high weight on exchange rate stability during the entire period. Thailand switched from exhibiting a fear of appreciation to displaying fear of depreciation. Thus international reserve management was an important tool to counteract the vagaries of capital flows.

Finally, we review the efficacy of selected capital flow management measures introduced in 4 of these EAEs. We focus on the impact of introduction of these measures on exchange rate and equity return. In a few instances, these measures have been effective and managed to reverse the direction of movement in exchange rate and equity markets. However, these effects have been short lived and have dissipated in the longer term. Thus imposition of sporadic controls ex-post has limited impact on reversing the movement in exchange rate and stock market. On the other hand when controls are imposed ex-ante in a more systematic manner in order to restrict certain kinds of flows irrespective of surge episodes, they succeed in altering the composition of capital flows.

While the limited success of capital flow management measures does not rule out their imposition in the future, countries must build other lines of defence to guard themselves against vagaries of capital flows. This would include achieving a threshold level of financial and institutional development, implementing prudent macroeconomic policies, building an adequate international reserve cover and imparting greater flexibility to the exchange rate to act as a shock absorber.

A Appendix

A.1 Computing Trilemma Indices

Monetary Independence: The extent of monetary independence is measured as the inverse of the quarterly correlation of the interest rates between EAEs and their base country. Here, the base country is defined as the country that a home country's monetary policy is most closely linked with. Aizenman et al. (2010) indicate that the base country for all these 6 EAEs is the United States. The quarterly indices are calculated using weekly 3-month Treasury Bill yields for the home country and the US. The index of Monetary Independence is given by

$$MI = 1 - \frac{corr(i_j, i^{US}) - (-1)}{1 - (-1)}$$
(2)

where i_j refers to the interest rate prevailing in the EAEs, i^{US} refers to the US interest rates and $corr(i_j, i^*)$, refers to the correlation of these interest rates over a quarter, and provides evidence on co-movement of domestic and foreign interest rates. By definition, $corr(i_j, i^{US})$, can take a maximum value of +1 and a minimum value of -1. Thus the monetary independence index can theoretically take a value between 0 and 1 with a higher value indicating greater degree of monetary independence.

Exchange Rate Stability: We make use of the methodology introduced by Frankel and Wei (1994) to create an index of exchange rate stability. The degree of influence that major global currencies have on the domestic currency can be estimated using the following estimation model.

$$\Delta log\epsilon_{j,t}^{SDR} = \alpha_0 + \beta_{j,USD} \Delta log\epsilon_{USD,t}^{SDR} + \beta_{j,EUR} \Delta log\epsilon_{EUR,t}^{SDR} + \beta_{j,JPY} \Delta log\epsilon_{JPY,t}^{SDR} + \nu_t$$
(3)

Where $\epsilon_{j,t}^{SDR}$ is the value of the 6 EAEs' currency j against the numeraire currency, which in this case is the IMF's Special Drawing Rights. The three major global currencies, US Dollar, Japanese Yen and the Euro, can be viewed as making up the implicit currency basket, which the different EAEs are targeting to a different degree. Here $\hat{\beta}_{j,k}$ where k = USD, EUR and JPY, which is the estimated coefficient on the rate of change in the exchange rate for major global currency, represents the weight of currency k in the implicit basket. In the case where the EAE currency is pegged to a particular currency or a basket of currency, either $\hat{\beta}_{j,k} = 1$ or $\sum_{k=1}^{K} \hat{\beta}_{j,k} = 1$ for K currencies that are a part of the basket. Moreover, pegging to an

individual or a basket of currencies implies a higher goodness of fit. The estimation is applied over a quarter and the goodness of fit, or the adjusted R^2 is taken as the measure of exchange rate stability (ERS). A higher R^2 indicates greater pegging to an individual or a basket of currencies.

Capital Account Openness: A *de facto* measure of capital account openness is employed as it is the actual volume of flows that creates a conflict between monetary independence and exchange rate stability as opposed to controls governing the movement of capital. A country with high *de jure* openness can have low capital flows and hence can simultaneously stabilize exchange rate and retain monetary autonomy. Alternatively, a country with low *de jure* openness can experience large flows due to low enforcement of controls, and face a trade-off between ensuring monetary independence and exchange rate stability. Hence, the index is based on net capital flows. The index is constructed as the ratio of absolute value of net capital flows to GDP. ¹⁰ The index is normalized to lie between 0 and 1.

$$CapOpen = \frac{|NKF|}{GDP} \tag{4}$$

Finally, policymakers can garner greater flexibility vis-a-vis monetary and exchange rate management in the short run by accumulating or depleting reserves. Consequently, ΔRes , the absolute change in reserves (as a share of GDP) is also computed, and normalized to lie between 0 and 1

A.2 Testing Validity of Trilemma Framework

The validity of the trilemma framework is examined by testing whether the weighted sum of the three trilemma policy variables adds up to a constant, here set to be 2. If the Trilemma is indeed binding then a country, which chooses to implement any 2 of the 3 policy objectives perfectly will have to completely forego the third objective. Hence in the analysis where all the trilemma objectives are normalized to lie between 0 and 1, the maximum combined value of the Trilemma indices can be 2.

$$2 = \alpha M I_t + \beta E R S_t + \gamma Cap Open_t + \mu_t \tag{5}$$

 $^{^{10}\}mathrm{We}$ obtain similar results when we use gross flows in this KO measure.

	2000 Q1	2004 Q1	2008 Q1	2012 Q1
	to	to	to	to
	2003 Q4	$2007 \mathrm{Q4}$	$2011 \mathrm{Q4}$	2015 Q4
		Ine	dia	
Monetary Independence	1.055^{*}	0.115^{*}	2.159^{***}	2.965***
	[1.774]	[1.661]	[3.645]	[8.652]
Exchange Rate Stability	1.880***	2.250^{***}	1.662	0.023^{**}
	[12.002]	[6.458]	[0.892]	[2.038]
Capital Account Openness	0.145**	1.844^{***}	0.484	1.139
	[1.993]	[3.472]	[0.545]	[2.084]
Observations	16	16	16	16
R-squared	0.983	0.943	0.891	0.881
		Indo	nesia	
Monetary Independence	0.957**	1.321^{***}	0.703^{*}	0.765^{**}
	[2.302]	[5.106]	[1.785]	[2.009]
Exchange Rate Stability	2.372***	2.685^{***}	1.909^{***}	2.144^{***}
	[6.803]	[4.885]	[4.204]	[7.111]
Capital Account Openness	1.073*	1.250^{**}	0.642^{*}	1.533^{***}
	[2.088]	[2.518]	[1.887]	[3.076]
Observations	16	16	16	16
R-squared	0.883	0.914	0.887	0.938
		Ko	rea	
Monetary Independence	1.983***	1.239^{*}	1.514^{***}	1.812***
	[5.536]	[1.699]	[3.669]	[4.836]
Exchange Rate Stability	1.349**	1.422^{*}	3.058^{**}	1.314**
	[2.896]	[1.775]	[2.446]	[2.944]
Capital Account Openness	3.459^{**}	5.631^{**}	1.641^{***}	3.525^{***}
	[2.770]	[2.242]	[6.942]	[3.854]
Observations	16	16	16	16
R-squared	0.892	0.859	0.884	0.865
		Mala	aysia	
Monetary Independence	0.047*	0.638^{*}	1.362^{***}	0.792^{*}
	[1.677]	[1.764]	[9.250]	[1.830]
Exchange Rate Stability	1.885***	1.679^{***}	4.012^{***}	1.909***
	[20.586]	[4.766]	[6.859]	[6.627]
Capital Account Openness	0.807*	1.705**	0.134^{*}	1.044**
	[1.743]	[1.987]	[1.738]	[1.755]
Observations	16	16	16	16
R-squared	0.996	0.852	0.946	0.912
		Philip	ppines	
Monetary Independence	1.592^{**}	1.803^{***}	1.933***	1.964^{***}
	[2.270]	[3.144]	[4.714]	[3.757]
Exchange Rate Stability	1.444**	1.170**	1.383***	1.300
	[2.029]	[2.521]	[3.896]	[5.034]
Capital Account Openness	0.797	0.969**	0.882	0.697
	[1.193	[2.545]	[2.476]	[0.865]
Observations	16	16	16	16
R-squared	0.854	0.75	0.962	0.944
	0 5055	'I'ha	land	0.00(****
Monetary Independence	0.765*	1.812***	0.792*	2.334***
	[1.709]	[4.836]	[1.795]	[4.189]
Exchange Rate Stability	1.644***	1.314**	1.909***	0.662
	[7.111]	[2.944]	[6.627]	[0.318]
Capital Account Openness	1.533***	2.525***	1.044	1.860*
	[3.076]	[3.854]	[1.755]	[1.927]
()bservations	1 10	16	16	16
Descrivations	10	10	10	10

Table 6: Testing the Validity of the Trilemma Framework

Notes: Standard errors in parentheses. *, **, and *** indicate correlations significant at 10%, 5%, and 1% respectively Source: Authors' calculations.

A.3 Estimating Asymmetric Intervention by Central Banks

A representative central bank's loss function is given as follows:

$$L_t = \frac{1}{2} \left(R_t - R^* \right)^2 + \frac{\phi}{2} \left(\left(\tilde{\varepsilon}_t - \varepsilon^* \right)^2 + \frac{\theta}{3} \left(\tilde{\varepsilon}_t - \varepsilon^* \right)^3 \right)$$
(6)

Here $\tilde{\varepsilon}_t$ is the percent change in exchange rate with the exchange rate being defined as the foreign currency price of the domestic currency while R_t is the reserves level. The central bank aims to minimize the deviation of reserves as well as the exchange rate from their respective target values ε^* and R^* . Moreover, ϕ is the relative weight on stabilizing exchange rate visa-vis reserves. The right most term introduces the asymmetry in the loss function. With $\theta > 0$, an appreciation ($\tilde{\varepsilon} > 0$) increases the loss of the central bank while depreciation ($\tilde{\varepsilon} < 0$) reduces the extent of loss. Thus a positive θ implies asymmetric intervention to prevent appreciation while a negative θ implies asymmetric intervention to prevent depreciation

There is a trade-off between stabilizing reserves and exchange rate as interventions can reduce the extent of exchange rate deviation.

$$\tilde{\varepsilon}_t - \varepsilon^* = \alpha_0 + \alpha_1 R_t + \eta_t \tag{7}$$

where $\alpha_1 > 0$. Minimizing equation (6) by choosing R_t , subject to the constraint given in equation (7) yields the optimality condition

$$R_t = R^* - (\phi \alpha_1) \,\tilde{\varepsilon}_t - \frac{\phi \theta}{2} \alpha_1 \tilde{\varepsilon}_t^2 \tag{8}$$

This can be reduced to an empirically testable formulation

$$R_t = \beta_0 + \beta_1 \tilde{\varepsilon}_t + \beta_2 \tilde{\varepsilon}_t^2 + \upsilon_t \tag{9}$$

where $\beta_1 = -\phi \alpha_1$ and $\beta_2 = -\frac{\phi \theta}{2} \alpha_1$. These parameters provide information on the degree of asymmetry in exchange rate stabilization with $\theta = -\frac{2\beta_2}{\beta_1}$.

Equation (9) is empirically estimated by using monthly data on nominal exchange rate and reserves (minus gold) over the period 2000 to 2011. The Generalized Method of Moments (GMM) methodology is employed to estimate Equation (9). Here 1 to 12 and 15 lags of R_t and $\tilde{\varepsilon}_t$, as well as the current value of federal funds rate and its four lags are used as nstruments. The estimates of the intervention reaction function and the asymmetric preference parameter are reported in Table 4.

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