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JUSTIFIED?

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IS *FEAR OF APPRECIATION* JUSTIFIED?**

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Abstract

The objective of our paper is to provide an empirical platform to the debate on the macroeconomic consequences of large currency appreciations. Observing the experiences of six major Asian economies (the ASEAN-5 (Indonesia, Malaysia, Philippines, Thailand and Singapore) and Korea) during the past two decades, the primary aim of this study is to ascertain the consequences of strong currencies, on the one hand, and reserves accumulation, on the other, for a set of vital macroeconomic indicators, namely, exports, growth and price. We then deal squarely, in retrospect, with the question of whether there is any justification to the so-called fear of appreciation phenomenon among the policy makers of these Asian economies.

Key Words: Fear of Appreciation; Episodes of Large Appreciation; Reserve Accumulation; Export; Growth and Inflation

JEL Classification: F4, F31, F32

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1. Introduction

The potential real-economy consequences of exchange rate appreciations remain one of the perennial and contentious macroeconomic policy issues. While the recent sub-prime financial crisis momentarily put the discussion to rest in view of the downward pressures experienced by most currencies during this period, the return since mid-2010 of massive capital flows to emerging markets, most especially, the countries in the East and Southeast Asian region has amplified complexities in the management of monetary and exchange rate policies, in particular, and macroeconomic policies, in general, for these countries. While the effects of the attendant currency appreciations from these substantial and volatile inflows are typically seen as lamentable for exporters, scholars have yet to reach consensus on the definitive impact of exchange rate changes on the macro-economy, especially so on how effective can currency appreciations alter trade balances as well as on economic growth. This is all the more important as this issue is intimately related to the problem of global imbalances. Central to this problem is the large trade imbalances between China and the United States in which as some politicians and economists argue only a major currency adjustment on the part of the US and the Chinese renminbi and other Asian currencies – basically in the form of depreciation in the former and an appreciation in the latter currencies – can resolve or reduce these imbalances.

In this regard, one of the two key objectives of our paper is to provide an empirical platform to the debate on the macroeconomic consequences of large currency appreciations. Observing the experiences of six major Asian economies (the South East Asian-5 (Indonesia, Malaysia, Philippines, Thailand and Singapore) and Korea) during the past two decades, the primary aim of our study is to ascertain the consequences of strong currencies on a set of vital macroeconomic indicators, namely, exports, growth and price. While the former assesses the consequences of actually allowing the domestic currency to appreciate, we also at the same time ascertain the macroeconomic outcomes on the same set of macroeconomic variables of those instances wherein the monetary authorities of these same economies repel supposed appreciation pressures. This study will demonstrate that in order to render a complete diagnosis of what can be considered as the costs and benefits of currency appreciations, it is imperative to assess the macroeconomic outcomes not only of actual appreciations, but as well as of appreciation pressures that did not transpire due to heavy reserve purchases by the monetary authorities. This

is also of great relevance to the economies examined in this paper as all of them in recent times have engaged in heavy reserves accumulation. The results emanating from these two separate objectives should shed some lights on the question of whether the supposed fear of appreciation phenomenon among the policy makers of these Asian economies can be justified.

In an attempt to contribute further to what has been done in the past, we employ a more structured set of sequential steps to address the aforementioned policy issues. The structure of the paper is as follows: a brief literature survey on the debates will be presented in Section 2. In Section 3, we employ a regime-switching model to first take account of the possible existence of an asymmetry in exchange rate behavior and policy stances in these countries. Monetary authorities can asymmetrically manage their exchange rates wherein they can allow for some currency depreciation while substantially limiting the extent of currency appreciation. For lack of better alternatives, this exchange rate intervention behavior has been coined by Levy Yeyati and Sturzenegger (2007) as ‘fear of floating in reverse’ or ‘fear of appreciation’.

In Section 4, we will identify the periods or episodes of significant exchange rate appreciations experienced by these six economies. Note here that we do not focus on just any periods in which appreciation did take place. Rather, we will focus on the periods of significantly large actual appreciations as well as of significantly large appreciation pressures that were smoothed-out or moderated via foreign exchange market intervention. As emphasized above, since monetary authorities of these economies have been known to actively intervene and manage the movements of their currencies, we will carefully observe the rates of reserve accumulation as a proxy for foreign exchange market intervention. Also in this section, a concrete method to define and identify large and ‘extreme’ actual appreciations and intervention episodes will be discussed.

Having identified and isolated dates of large currency appreciations and intervention episodes, the next sequential step is to assign dummy variables to them and estimate their impacts on the macroeconomic indicators of exports, growth and price. Based on the estimation results of a simple autoregressive distributed lag model and the subsequent impulse response functions, careful analyses on the impacts of strong currencies as well as of large reserves purchases on these key domestic macroeconomic indicators will be drawn in Section 5 of the paper. A brief concluding section ends the paper.

2. Literature Review

This paper touches on a broad range of relevant and topical issues that have pre-occupied the interests of policymakers and academics alike. For one, by examining the effect of large currency appreciations on exports, we deal, in an alternative fashion, with the heated and ongoing debate on whether large exchange rate movements affect trade and current account balances. For instance, a number of studies have verified this issue according to the validity of the so-called “elasticity pessimism” and studies such as Hooper et al. (2000), Chinn (2004) and Chinn and Lee (2009) have found export and import elasticities that are relatively low.² Likewise, evidence emanating from new open economy models found limited short-run responsiveness of the current account to exchange rate changes (Goldberg and Knetter, 1997; Devereux and Engel, 2003).

This contentious topic of the supposed impact of exchange rate changes on trade balances is all the more relevant as it is directly linked with the global rebalancing issue, in particular, the question of the materialisation of a possible Chinese renminbi appreciation in reducing the large Chinese current account surplus. The evidence in this emerging strand of literature has so far been mixed. For example, Kwack et al. (2007), Marquez and Schindler (2007), Cheung et al (2010) and Thorbecke and Smith (2010) have found Chinese trade elasticities that are quite small, whereas Ahmed (2009) and Cline (2010) have found opposite results.

Our paper also ascertains the impact of *large currency appreciations* on economic growth and as such, follows the considerable literature that investigates the growth effects of exchange rate changes. However, a distinctive feature of our line of inquiry is that previous literature on this area has only mainly focused on two fronts. One large body of literature dealt with the reverse question to ours on the growth effects of *depreciation* episodes³ while a second related literature has focused on the growth ramifications of any departures of the real exchange rate from a certain equilibrium rate. This so-called “misalignment view” of the nexus between the

² In other words, the so-called Marshall-Lerner condition is not fulfilled, and should be interpreted as changes in real exchange rates does not immediately affect the current account. A contrasting view, however, is put forward by Obstfeld (2002).

³ On this strand of literature, see for instance, Hong and Tornell (2005), Gupta et al (2007), Cerra and Saxena (2008), Bussiere et al (2010) and IMF (2010).

real exchange rate and economic growth hinges on the idea that the promotion of an undervalued currency brings forth several manifestations of positive externalities to the domestic economy in terms of technology transfers and learning-by-doing (Eichengreen, 2008; Aizenman and Lee, 2008) as well as improvement in welfare that comes from investments in the tradable sector (Korinek and Serven, 2010). The latter implication of an undervalued currency is closely intertwined with the export-promotion cum growth strategy that is alleged to underpin the development strategies in most parts of Asia in recent times.

Finally, the paper also investigates the inflation consequences of large exchange rate appreciations and this is in line with the already theoretically established existence of a relationship between the real exchange rate and the inflation rate.⁴ Widely referred to in the empirical literature as the “the pass-through” of exchange rate changes to inflation, the bulk of the literature has determined the extent of the responsiveness of inflation to the real exchange rate and the evidences suggest the clear role of the real exchange rate along with some other macroeconomic variables in the inflation process.⁵ On the other hand, a separate strand of literature has also lately taken notice of the decline in exchange rate pass-through in the last two decades, both for developed and developing countries.⁶

3. Fear of Appreciation

A current understated nuance of the seeming move to allowing some greater flexibility in exchange rates is that under various reasons it is possible that the degree of flexibility is significantly higher on one side of the market.⁷ In other words, the monetary authorities in the six Asian economies examined in this paper can asymmetrically manage their exchange rates wherein they can allow for some currency depreciation while substantially limiting the extent of currency appreciation. This exchange rate intervention behavior has been coined by Levy Yeyati and Sturzenegger (2007) as ‘fear of floating in reverse’ or ‘fear of appreciation’. In accordance, the first important task of the paper is to verify evidences of asymmetrical exchange rate behaviour, that is, the presence, if any, of fear of appreciation on the part of the six monetary authorities.

⁴ See, for instance, Montiel and Ostry (1991) and Calvo et al (1995) as examples of these theoretical studies.

⁵ See, for instance, Kamin and Klau (2003).

⁶ See, for instance, Ihrig et al (2006) and Frankel et al (2004).

⁷ See, for instance, Stigler et al (2009) for this various set of plausible reasons.

We conduct our estimation using weekly data and divide the estimation into three distinct periods: pre-global financial crisis (GFC) period (January 2000-December 2006), GFC crisis period (January 2007-July 2009) and post-GFC period (August 2009-March 2011). All nominal exchange rate (domestic currency per US\$) data for these countries are obtained from the Pacific Exchange Rate Service (<http://fx.sauder.ubc.ca>). The rationale for the choice of the three distinct periods are based on the view that the bulk of reserves accumulation occurred during the pre-GFC period as evidenced from official reserves data and numerous academic studies; the period of the GFC crisis captures the massive volatilities experienced by the countries examined that consequently led to the drawdown of reserves by these countries. The post-GFC period corresponds to the several months after the collapse of Lehman Brothers and is in agreement with official announcements and publications by international multilateral institutions of a return of global financial market stability. As volatility and uncertainty in the global market returned in the second half of 2011, the post-GFC period included observations only up to first quarter of 2011.

In order for this paper to capture asymmetry in exchange rate behavior, we employ a class of a regime-switching model known as the smooth transition autoregressive model (STAR) and in particular a certain type of regime switching model known as the LSTR2 model. This model allows one to explicitly measure the thresholds on both sides of the market, i.e., appreciation and depreciation thresholds. This is nothing but a logical method to capture this form of exchange rate behavior. A brief discussion on the underlying mechanics of the LSTR2 model as well as how the appreciation and depreciation thresholds are derived from this LSTR2 model is provided in Appendix A.⁸ Appendix B presents the estimation results of the LSTR2 models for the three respective periods as well as the diagnostic results for these estimated LSTR2 models. Overall, the estimation results suggest the suitability of fitting a LSTR2 model for the weekly exchange rate data on the five Asian currencies. More importantly, the diagnostic results on the residuals from the fitted LSTR2 models all indicate the absence of autocorrelation.

As emphasized above, from these fitted LSTR2 models we can then obtain our main focus of interest, the lower or appreciation threshold (c_L) and upper or depreciation thresholds

⁸ In general, the construction of STAR models follows the same steps as in the ARIMA-Box-Jenkins modeling approach, wherein the modeling cycle consists of model specification, parameter estimation, and diagnostic evaluation.

(c_H). Both thresholds from these fitted LSTR2 models are then presented in Table 1.⁹ This table is divided into three panels -- the upper panel contains the estimated lower and upper thresholds for the pre-GFC period, the middle panel reports the lower and upper thresholds for the GFC period, while the lower panel contains the lower and upper thresholds for the post-GFC period. Turning first to the estimated lower and upper thresholds for the pre-GFC period, these are at 1.34% and 3.83%, respectively, for the Indonesian rupiah; 1.49% and 2.12% for the Korean won; -1.80% and 3.88% for the Philippine peso; -0.39 and 0.71 for the Singapore dollar, and -0.07% and 1.90% for the Thailand baht. This shows that in all of the five East Asian currencies, the upper threshold, c_H is larger than the (absolute value of the) lower threshold, c_L , indicating a lower threshold tolerance or aversion of the monetary authorities in these countries to currency appreciations against the US\$.

However, according to our findings, this phenomenon of fear of appreciation all but disappeared during the height of our chosen period for the recent GFC. Understandably, the preference of the monetary authorities of the said countries is to avoid a freefall in the value of their currencies and as such, would adopt the typical strategy during a financial turmoil of resisting or leaning against the significant selling pressures that are brought on to bear on these currencies by the international financial markets. In light of the proposed testing strategy laid out in this paper, this is either interpreted as significantly negative lower and upper thresholds or a significantly negative lower threshold but with an insignificant upper threshold.¹⁰ As reported in the middle panel of Table 1, the former applies to the cases of the Philippine peso, Singapore dollar and the Thailand baht vis-à-vis the US dollar. Whereas, the latter applies to the cases of the Indonesian rupiah and Korean won vis-à-vis the US dollar.

More interestingly, once this tumultuous period of the GFC subsided, can we find a re-appearance of the behaviour akin to the pre-GFC period of fear or aversion to currency

⁹ It should be noted at this point that since the nominal exchange rate is defined in this paper as the local currency with respect to the USD, the lower (c_L) threshold parameter corresponds to the central bank's tolerance for allowing appreciation (appreciation threshold), whereas the upper (c_H) threshold parameter corresponds to the central bank's tolerance for allowing a depreciation (depreciation threshold) of its local currency with respect to the USD.

¹⁰ Both cases are the expected results and this is reasonably logical since in any crisis situation, the preference of a monetary authority is to mitigate or alleviate the pressure of its currency depreciating or sliding in a freefall such that both threshold parameters (c_L and c_H) must either be significantly negative (indicating its preference for its currency to strengthen) or, to a lesser extent, significantly negative lower threshold but with an insignificant upper threshold (again to indicate that it is willing to accept a much stronger currency in a crisis situation, while averting the possibility of a free-fall in the value of its own currency).

appreciations? There are indications that the global financial crisis had only briefly and temporarily interrupted this behaviour and as such, this phenomenon may have again reasserted itself on the part of the monetary authorities in these countries. To varying degrees, all five countries show a revealed preference for limiting the extent of strengthening of their currencies against the US dollar (0.44% and 1.31%, respectively, for the Indonesian rupiah; -1.60% and 3.09% for the Korean won; 0.22% and 2.12% for the Philippine peso; 0.10% and 0.24% for the Singapore dollar, and -0.70% and 0.87% for the Thailand baht).

In other words, after experiencing a tumultuous period that was punctuated by sharp and volatile movements in their exchange rates, these countries slowed the pace of the depreciations of their currencies vis-à-vis the US dollar, while at the same time, retained their preference to restrain the strengthening of their currencies against the US dollar. When compared to their respective pre-GFC behavior, we observed that this analysis applies in the cases of the Indonesian rupiah, Singapore dollar and the Thailand baht. In the case of the Korean won, however, which can be depicted as being the most affected amongst the five Asian currencies in the group during the outbreak of the global financial crisis, we can observe some loosening in their restraint to the appreciation of their currency against the US dollar after the GFC, which is in marked contrast to the outcome found during the pre-GFC period.

4. Identifying Large Appreciation and Intervention Episodes

4.1 Large Appreciation Episodes

In identifying large appreciation episodes, we work with monthly real effective exchange rates data obtained from the Bank for International Statistics (BIS) website (<http://www.bis.org/statistics/eer/index.htm>) for the period of January 1994 to January 2011 for the six Asian countries. The question that arises at the onset is how to establish a threshold that will define the “largeness” of the appreciation episode. In typical studies of currency crises episodes, a large value of a certain index of exchange market pressure (EMP) is indicative of a currency crisis episode. A large value is usually defined once values of this index exceed its mean by 1.5 or 3 standard deviations. For instance, Eichengreen et al (1996) set a threshold of 1.5 standard deviations above the mean of the entire panel index, and thus a crisis is deemed to

occur once the value of this full panel index exceeds this cutoff point. Kaminsky and Reinhart (2000), on the other hand, set a threshold of 3 standard deviations above the mean of the respective country's index. In terms of our foregoing objective of defining instead the "largeness" of an appreciation episode, one can also adopt a recent definition of a large appreciation event by Kappler et al (2011) as comprising a 10% (or larger) appreciation of the nominal effective exchange rate over a two a two-year window (or less) which leads to sustained real effective appreciation.

The main problem, however, with the above designations of "largeness" is that they are arbitrary and lack the theoretical justification of setting a cutoff point or threshold either for a large EMP index or a large appreciation event. This paper dispenses with this problem by deviating from the conventional yet arbitrary approach of defining a large appreciation episode by employing an alternative and objective approach. This paper uses instead the extreme value theory (EVT) to identify large appreciation episodes.¹¹ The main rationale for its use here is that the tail of the distribution of changes in the exchange rate, in particular, the right-tail observations of the changes in exchange rate represent the outliers or, simply, the extreme or large exchange rate appreciations. To be more specific, the EVT works by exploiting the information in the tails of the distribution by locating the threshold that separates the normal values of the changes in exchange rates (corresponding to the normal periods) from that of the extreme or large values (corresponding to the large or extreme appreciation episodes) but without the need to set an arbitrary cutoff or threshold value for the changes in exchange rates. A brief discussion on the underlying mechanics of the EVT is provided in Appendix C.

Figure 1 shows the logarithmic changes in the real effective exchange rate data of the six Asian countries. We have drawn vertical lines for those dates wherein large appreciation episodes were identified using the EVT. From these graphs, once we omit those large appreciation episodes that coincide with the Asian financial crisis years of 1997-98 as well as the recent global financial crisis years of 2008-2009 in order to avoid large appreciations that are preceded by large devaluations, it appears that while these episodes were felt at various times, a consistent pattern emerges (Figure 1). One can arguably claim that there are three "great" and

¹¹ The EVT has also found its application and use in the identification of currency crisis episodes via the papers of Pozo and Dorantes (2003), Pontines and Siregar (2007, 2008), Lestano and Jacobs (2007).

“major” events of large exchange rate appreciations in the past two decades for these countries, viz., the period between the early 1990s and prior to the abrupt interruption by the 1997-98 Asian financial crisis; the period between the early 2000s and prior to the 2008-2009 global financial crisis; and, intermittently, for some of these countries until early 2011.

4.2 Large Intervention Episodes

Given the lack of official intervention data on these six Asian countries, we work with movements in central bank reserves to capture as closely as possible interventions in the exchange markets. In essence, the identification of large intervention episodes undertaken in this section is the mirror-image of the large appreciation episodes conducted in the previous section. That is, in order to moderate or repel supposedly large appreciation pressures on the local currency, the central bank, under a “leaning against the wind” strategy, is often resorted to the absorption of the foreign currencies in the market. Thus, we associate positive movements in international reserves as a natural consequence of foreign exchange reserves accumulation episodes. In employing the extreme value theory (EVT) to identify the large reserves purchases, we also work with the right-tail observations of the changes in reserves as this would constitute the outliers that represent the extreme or large reserves purchases to ward off actual appreciation pressures on the local currency.

Figure 2 shows the logarithmic changes in international reserves data of the six Asian countries. Just as we did for the previous figure, we have also drawn vertical lines for those episodes where large reserves purchases were identified using the EVT. By also omitting those large reserve purchase episodes that coincide with the Asian financial crisis years of 1997-98 as well as the recent global financial crisis years of 2008-2009 to avoid large reserve purchases that are preceded by large reserves draw-downs, these graphs depict a particularly striking consistency that contrast with Figure 1. On the one hand, on a mirror-image perspective with respect to the one readily observed in Figure 1, three “great” waves of large reserves purchases in the past two decades are accounted for these countries that correspond to the ones emphasised in Figure 1, viz., the early 1990s; the early 2000s; and, the most recent months post-GFC. In contrast however to episodes in which large appreciation episodes are allowed, large reserves

purchases are more frequent and persistent for this group of countries except perhaps with the lesser exception of Thailand.

5. Empirics

5.1 Methodology

To formally test the impact of large appreciation episodes that we have identified in the previous section on certain macroeconomic indicators, namely, exports, growth and price, we employ a simple test that was originally introduced by Romer and Romer (1989) to determine the statistical relationship in a time-series context between monetary shocks that they have identified for the case of the United States and movements in real output. A more recent application of their simple time-series based test, also undertaken by Romer and Romer (2010), examines the macroeconomic effects of tax changes in the United States. This simple test was extended and applied in a panel context recently by Cerra and Saxena (2008) and Bussiere et al (2010) to study the macroeconomic effects of large devaluations. A more recent paper closer to ours in terms of the research questions posed but follows the testing undertaken by the two latter papers in a panel context is by Kappler et al (2011).

For this paper we determine how large appreciation episodes as well as large intervention episodes in the form of reserves purchases affect exports, growth and prices of six Asian countries by following the methodology pioneered by Romer and Romer (1989, 2010) in a time-series context. Having identified separately the large appreciation and intervention episodes, we create dummy variables that are equal to one in each of the months for which we identified such large episodes for both appreciations and intervention and zero in all other months. We then include current and lagged values of either the dummy variable for large appreciations or the dummy variable for large reserves purchases episodes in the following actual equation that is estimated as:

$$y_t = \beta_0 + \sum_{j=1}^{24} \beta_j y_{t-j} + \sum_{k=0}^{24} \beta_k D_{t-k} \quad (1)$$

where y is either the monthly change in log of exports, monthly change in log of output (output is measured by industrial production) or the monthly change in log price. D is either the dummy

variable for large appreciation episodes or for large reserves purchases episodes. The regressions are run over the period of January 1994 to January 2011.

5.2 Empirical Results

A simple but natural way to summarize the response of our chosen macroeconomic indicators to either large appreciations or large reserves purchases episodes is to examine the impulse response function implied by our estimating equation as this should provide some horizon to an estimate of the total effect of such large episodes. The graphs that then follow depict the respective effects of a unit shock to the dummy variable (D) on large exchange rate appreciations (left-panel diagrams) as well as the effect of a unit shock to the dummy variable on large reserves purchases (right-panel diagrams) to each of our chosen macroeconomic indicators.

5.2.1 Exports

The 24-months impulse response functions for the change in log of exports are given in Figure 3. As earlier noted, the effect on exports of a unit shock to the dummy variable (D) on large exchange rate appreciations are presented in the left-hand panel of each diagram while the effect on exports of a unit shock to the dummy variable on large reserves purchases are presented in the right-hand panel. Each figure also shows the two standard error bands for the impulse response functions.

After a unit-shock to the dummy variable on large exchange rate appreciations, the subsequent movements in exports are often small and irregular in the cases of Indonesia, Korea, and Thailand. The impulse response functions for Malaysia and Singapore show little effect on exports of a unit shock to the dummy variable on large exchange rate appreciations for the first several months. However, exports show an increasing (decreasing) response in Malaysia (Singapore) at the end of the first year and reach a plateau (trough) sometime after 19 months. The impulse response function for the Philippines show a negative effect on exports of a unit shock to this same dummy variable, however, and the wide confidence bands suggest that these effects are insignificant in statistical terms.

On the other hand, the responses of exports after a unit-shock to the dummy variable on large reserves purchases are consistently positive in the cases of Indonesia, Korea, and

Singapore. Furthermore, the maximum effect of a rise in exports of around 10 percent, 6 percent and 15 percent are estimated for Indonesia, Korea and Singapore, in that respective order, and these maximum effects are felt after 20 months ($t = 2.02$), 18 months ($t = 1.90$) and 12 months ($t = 3.22$) also in that same respective order for these three countries. Meanwhile, the subsequent movements in response of exports after a unit shock to the dummy variable on large reserves purchases are irregular in the cases of Malaysia and the Philippines. However, for almost the entirety of the 24-months the impulse responses are positively signed. The maximum effect are estimated to be at around 5 percent and occurs after 19 months ($t = 2.78$) in the case of Malaysia, whereas it is estimated at around 10 percent in the case of the Philippines and this is felt after 8 months ($t = 1.80$). The maximum response of exports to a unit-shock in the dummy variable on large reserves purchases in the case of Thailand is felt quite immediately (only after 2 months) and this peak response (at round 7 percent) is also significant ($t = 1.89$).

In summary, large exchange rate appreciations seem to have rather limited impact on the export performance of these six major Asian economies, which are in line with some of the results obtained in the previous literature. The interesting contrast is the results that show that the management of large currency appreciations through large reserve purchases has had positive and significant impacts on the export performance of these six East Asian economies.

5.2.2 Growth

Does the response of exports to a one-unit shock in our respective dummies for large appreciations and large reserves purchases episodes bear some resemblance to the subsequent responses of output growth to similar unit-shocks in these dummies? As with the previous case of the response of exports, the results for the responses of output growth underscore once again the importance of ascertaining the issue of the macroeconomic consequences of currency appreciations from the supposed mirror-images of large currency appreciation, on one hand, and large reserves accumulation, on the other. For a start, the impulse responses of growth to a unit-shock in the dummy variable for large appreciations in the case of Indonesia are quite irregular but for the most part the impulse responses are significantly negative. A more telling picture of the depressing effect of large appreciations on growth is provided by the results for Singapore as well as for the Philippines wherein the large appreciations tend to have a sizeable, sustained and negative impact. These results are in contrast, however, to those obtained for Korea, Malaysia

and more so with Thailand wherein the statistical results are either weakly significant or insignificant.

With regards to the response of growth to large reserves purchases, the impulse responses obtained for Indonesia, Korea, Singapore and Philippines are modest and insignificant. In contrast, the impulse responses obtained in the cases of Malaysia and Thailand, however, reveal a positive and significant impact of reserves accumulation on growth. In summary, except for Korea, large currency appreciations have negative growth effects in the case of Indonesia, Singapore and the Philippines, though, interestingly, for these same three countries efforts to manage large currency appreciation through large reserve purchases did not have the intended growth effects. A stark contrast are the experiences of Malaysia and Thailand in which large currency appreciations have limited growth effects, while containing the extent of the appreciation via large reserve purchases were effective in fostering economic growths in these two major Southeast Asian economies.

5.2.3 Price

The reaction of the logarithmic changes in price to a unit-shock in the dummy for large appreciations is either a case of a negative reaction as in the cases of Indonesia, Korea, and Malaysia or impulse responses that reveal few dynamics or incremental changes (Philippines and Thailand). However, the wide confidence intervals imply that these noted reactions are insignificant in statistical terms. The only exception is the case of Singapore where there is a clear sustained rise in inflation. This effect is significant and the total impact of large appreciations after 24 months is that inflation in Singapore is about 2.1 percentage points higher than it otherwise would have been.

The response of the logarithmic changes in price to a unit-shock in the dummy for large reserves purchases is a study in contrast for the six Asian countries. While the impulse responses for Malaysia, Philippines and Thailand are statistically insignificant in view of the wide confidence intervals, there is a noted significant decline in inflation in the case of Korea throughout the 24 months while Indonesia also experienced a significant drop in inflation for the first sixteen months but rose thereafter. On the other hand, in the case of Singapore dollar, the

total impact of large reserves accumulation after 24 months on inflation is also positive, albeit about 1 percentage lower than that of allowing the Singapore dollar to actually rise.

6. Brief Concluding Analyses

From the evidences that large appreciation of domestic currencies had only limited undesirable consequences on exports of all six economies, on growth rates of only three (Indonesia, Philippines and Singapore) out of six economies, and limited pass-through benefits on the domestic price, one may be tempted to immediately presume that the “fear of appreciation” policy stance pursued by selected Asian economies during the past decades cannot be warranted. However our study demonstrates that the justification for fear of appreciation phenomena cannot and should not be assessed only from the perspectives of episodes of large appreciations. Rather, one should arguably consider the benefit (or the cost) of pursuing extensive foreign exchange interventions to smooth the appreciation of the domestic currency. In fact, hardly any study that we are aware of, has systematically ascertained the consequences of strong currencies from both positions of realized large appreciations against those of smoothed appreciations via foreign exchange rate intervention.

With intervention via reserves accumulation to smooth the strengthening of domestic currencies, export performances have improved across the economies under consideration, particularly for Indonesia, Korea and Singapore. The benefits of intervention measures on growth, however, were less significant and limited only to two economies (Malaysia and Thailand). Furthermore, reserves intervention has also significantly contained domestic inflation only in two (Korea and Indonesia) out of the six economies.

In summary, we find generally weak evidences of adverse consequences of large exchange rate appreciation on exports, growth and price variables on this group of major Asian economies. Moreover, the test results demonstrate that the benefits of foreign exchange intervention via reserves accumulation vary for the six economies. In the cases of Indonesia and Korea, intervention strategy had desirable consequences on exports and price indicators. As for the other economies, only exports benefited from such large interventions. Hence, we can conclude that the benefit of the fear of appreciation cannot be completely dismissed. Yet, the

gain may arguably be too limited, via the trade channel only, to warrant or justify the cost of an asymmetrical exchange rate policy stance, such as in the form of quasi-fiscal costs and other possible distortions to the economy. This may then signify that the fear of appreciation manifested in the form of large reserves purchases fulfill more than just mercantilist considerations for these economies, but as previously recognized by the extant literature that account for what drives the recent large reserves accumulation in this part of the world, the desire for self-protection in times of crisis and illiquidity may justify such behavior.

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Table 1
Threshold Values (in percent)

Pre-GFC period, January 2000 – December 2006		
	Lower threshold (c_L)	Upper Threshold (c_H)
Indonesia rupiah	1.34 (0.01)***	3.83 (0.28)***
Korea won	1.49 (0.04)***	2.12 (0.08)***
Philippine peso	-1.80 (0.18)***	3.88 (0.03)***
Singapore dollar	-0.39 (0.11)***	0.71 (0.13)***
Thailand baht	-0.07 (0.01)***	1.90 (0.08)***
GFC period, January 2007 – July 2009		
	Lower threshold (c_L)	Upper Threshold (c_H)
Indonesia rupiah	-0.78 (0.02)***	0.88 (6.9)
Korea won	-0.37 (0.02)***	1.61 (1.20)
Philippine peso	-2.57 (0.06)***	-1.58 (0.05)***
Singapore dollar	-2.07 (0.17)***	-1.11 (4.15)
Thailand baht	-3.02 (0.23)***	-1.25 (0.16)***
Post-GFC period, August 2009-March 2011		
	Lower threshold (c_L)	Upper Threshold (c_H)
Indonesia rupiah	0.44 (0.06)***	1.31 (0.23)***
Korea won	-1.60 (0.09)***	3.09 (0.07)***
Philippine peso	0.22 (0.05)**	2.12 (0.13)***
Singapore dollar	0.10 (0.01)***	0.24 (0.01)***
Thailand baht	-0.69 (0.10)***	0.87 (0.02)***

Numbers in parentheses are standard errors. Significance levels: *10%, **5%, ***1%.

Figure 1
Logarithmic Changes in Real Effective Exchange Rate (REER) in six Asian Countries, January 1994 – January 2011

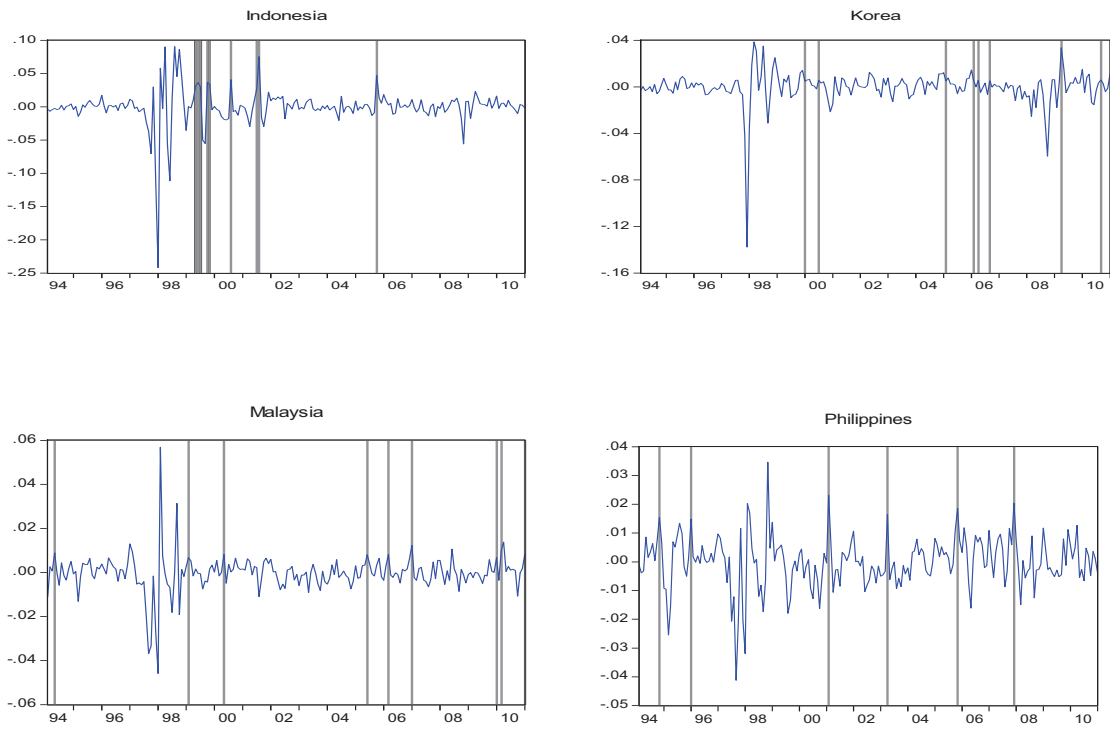


Figure 1
Logarithmic Changes in Real Effective Exchange Rate (REER) in six Asian Countries, January 1994 – January 2011

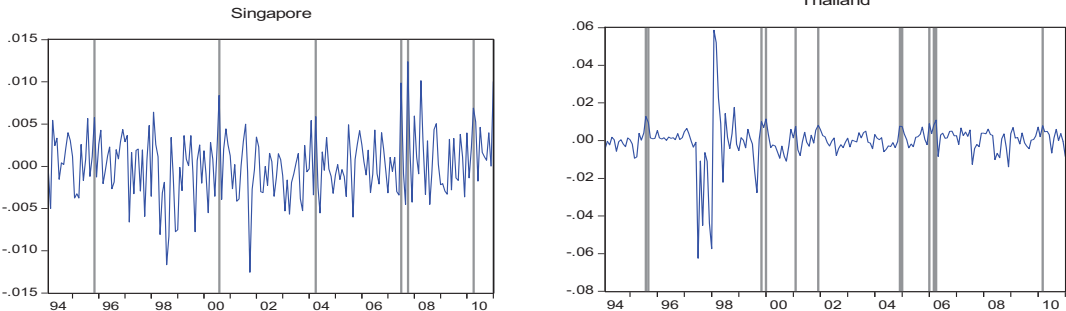


Figure 2
Logarithmic Changes in Reserves in six Asian Countries, January 1994 – January 2011

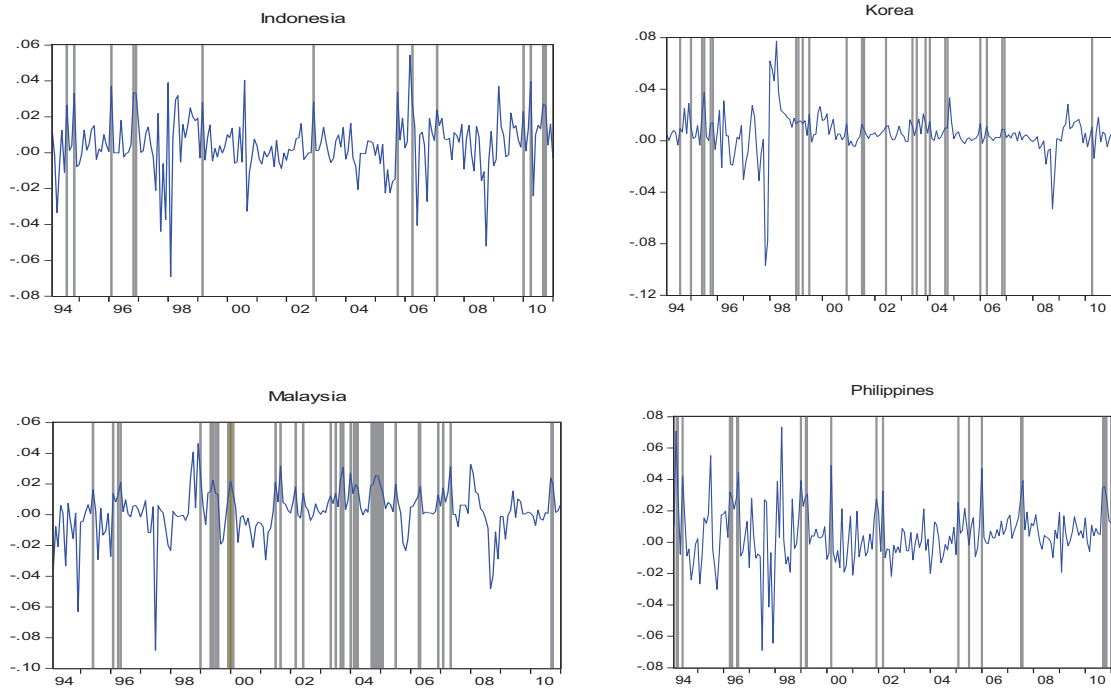


Figure 2
Logarithmic Changes in Reserves in six Asian Countries, January 1994 – January 2011

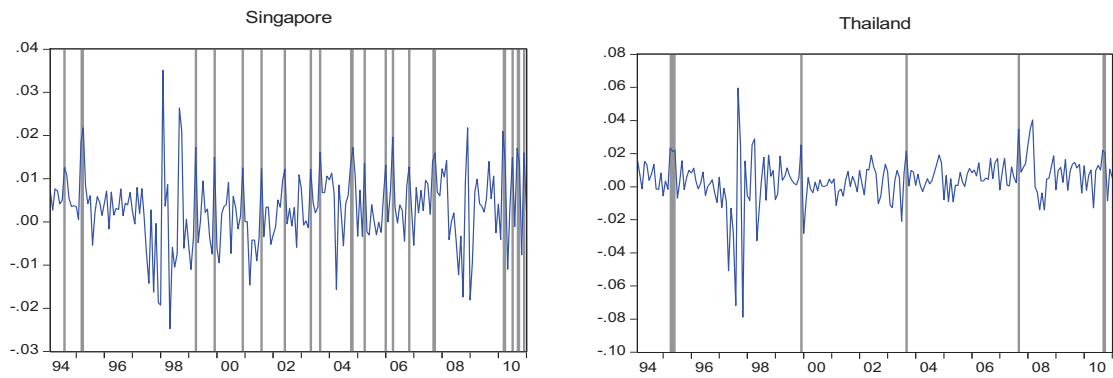
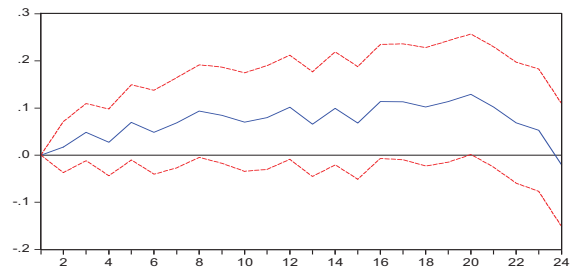
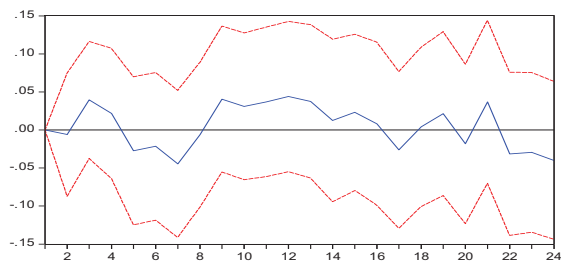
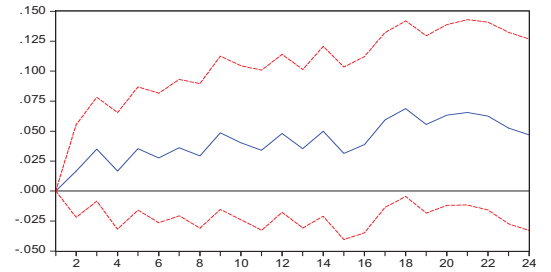
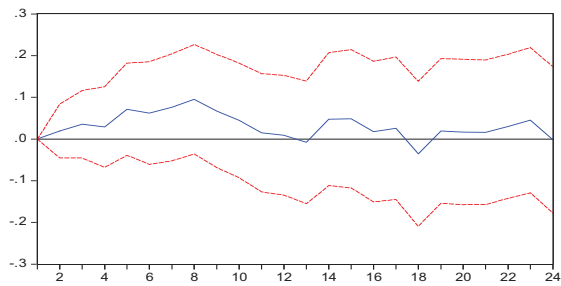


Figure 3
Impulse Response Function for Exports

Indonesia



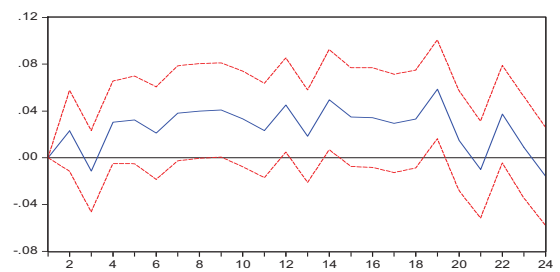
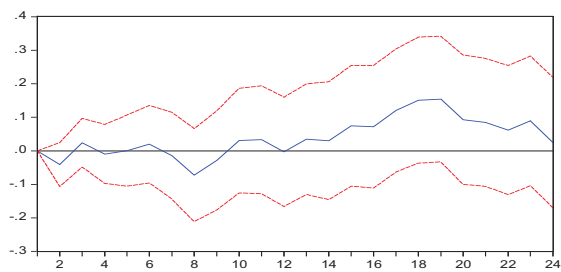
Korea



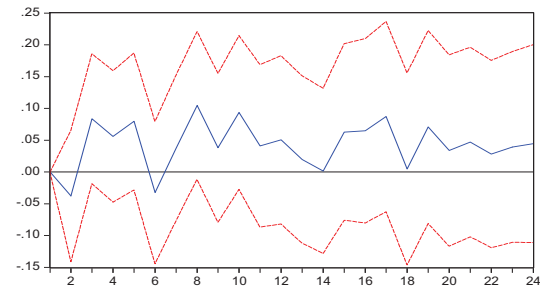
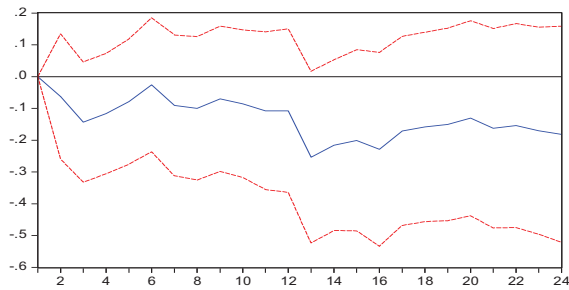
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 3
Impulse Response Function for Exports

Malaysia



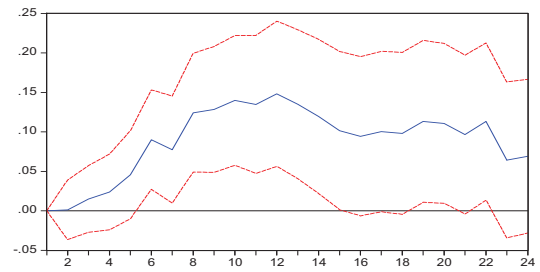
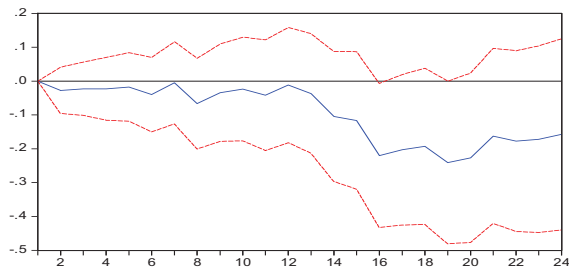
Philippines



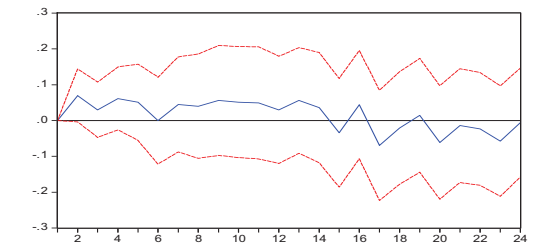
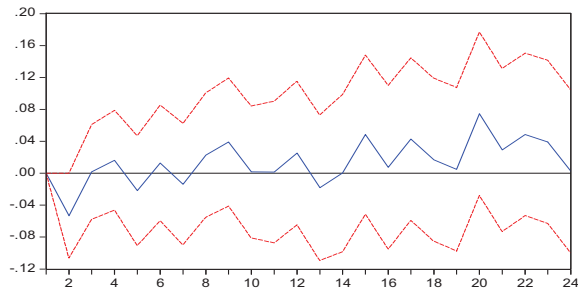
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 3
Impulse Response Function for Exports

Singapore



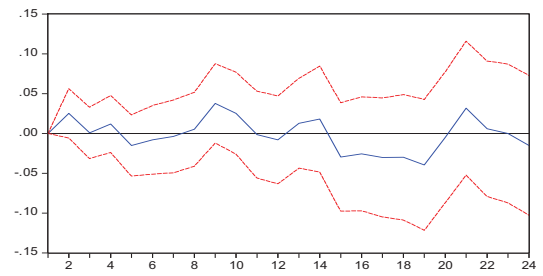
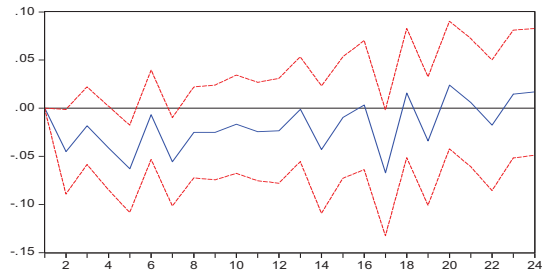
Thailand



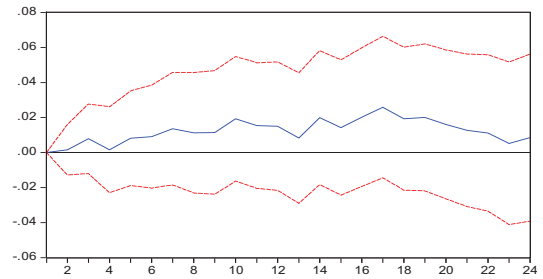
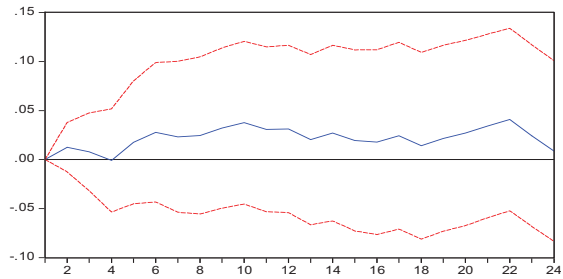
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 3
Impulse Response Function for Growth

Indonesia



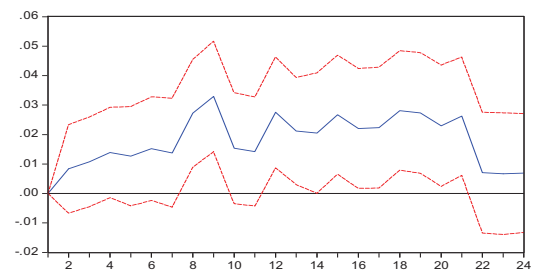
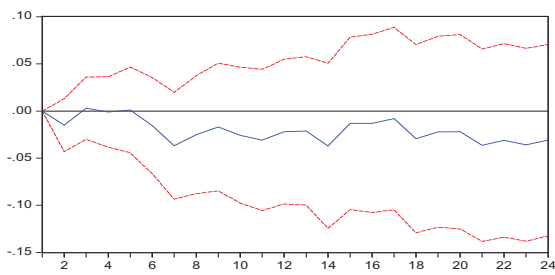
Korea



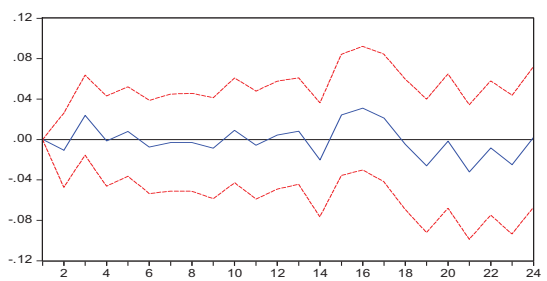
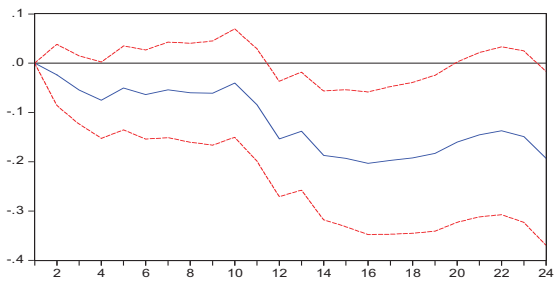
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 3
Impulse Response Function for Growth

Malaysia



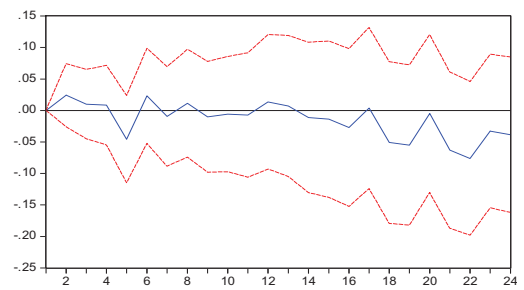
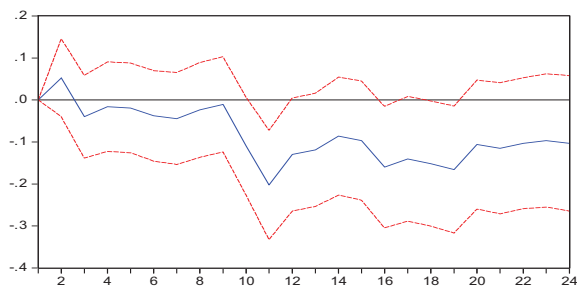
Philippines



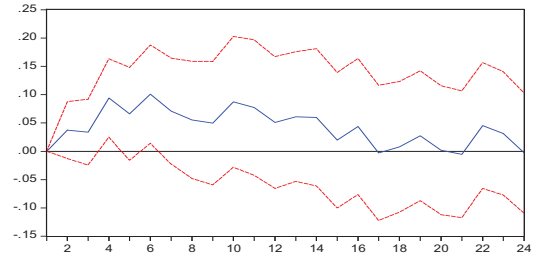
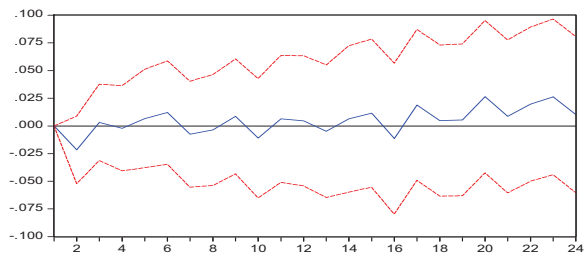
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 3
Impulse Response Function for Growth

Singapore



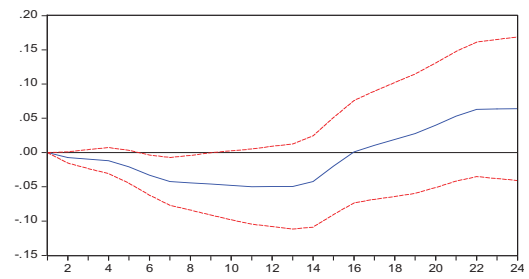
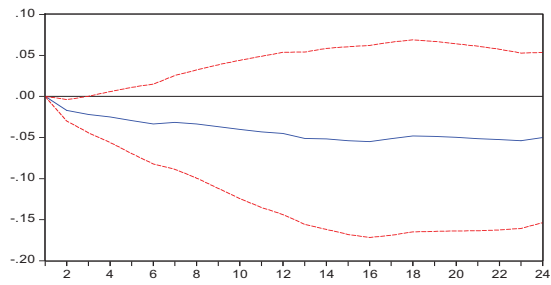
Thailand



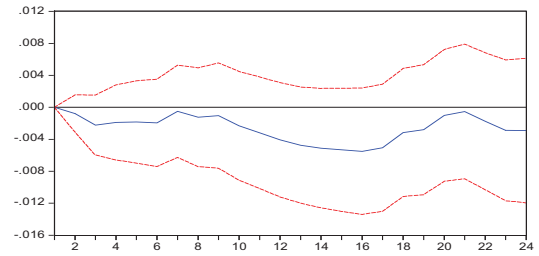
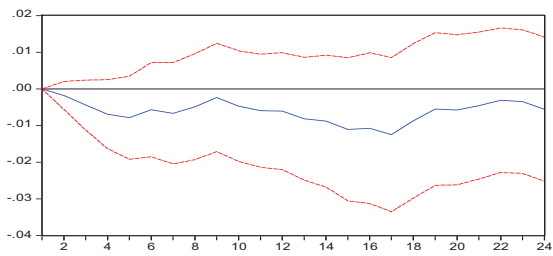
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 4
Impulse Response Function for Price

Indonesia



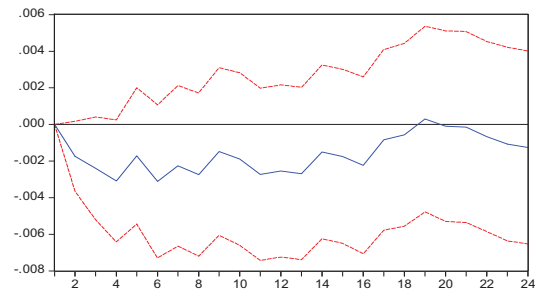
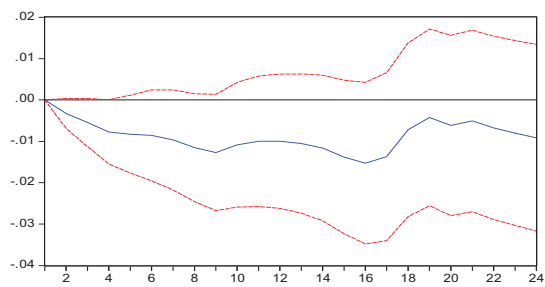
Korea



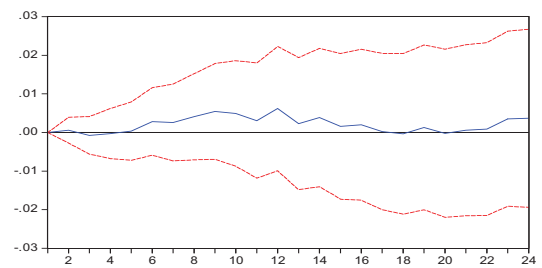
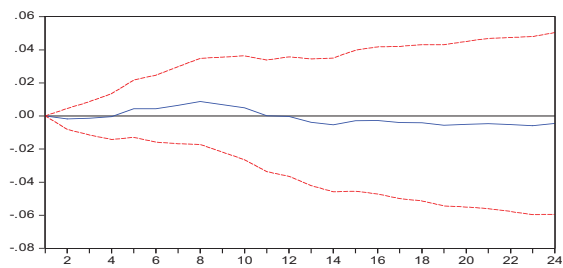
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 4
Impulse Response Function for Price

Malaysia



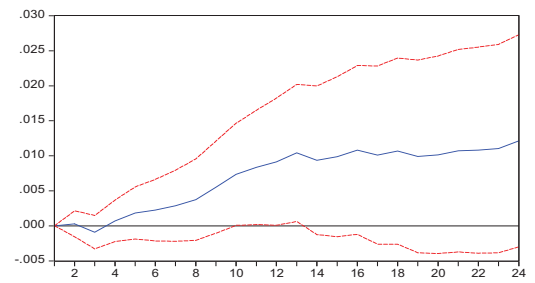
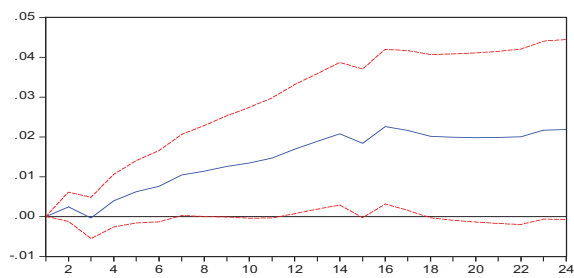
Philippines



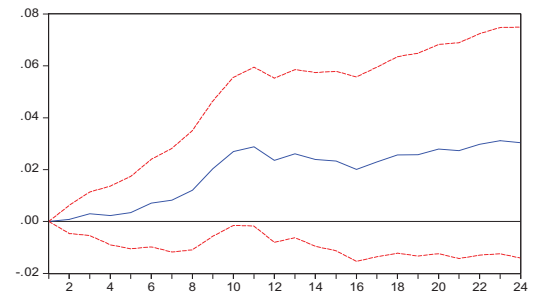
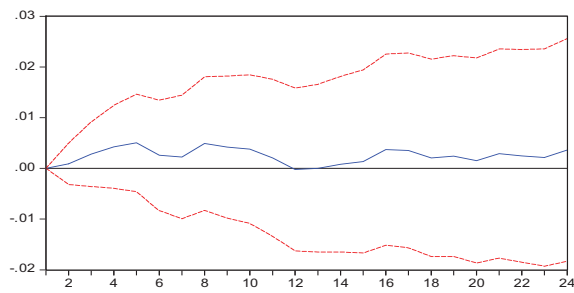
Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Figure 4
Impulse Response Function for Price

Singapore



Thailand



Notes: The impulse responses shown at the left-hand panel is for a one-unit shock on the dummy variable for large appreciations while the one shown at the right-hand panel is for a one-unit shock on the dummy variable for large intervention episodes.

Applying a Regime Switching Method to Test for the Presence of Fear of Appreciation

The STAR model is a non-linear time series model that allows the variable under investigation, which in the present case denoted as $\Delta \ln exr$, the first difference of the log of the nominal exchange rate (local currency per US dollar) to adjust smoothly every moment within different regimes. This model may be written as:

$$\Delta \ln exr = \alpha_0 + \sum_{i=1}^p \alpha_i (\Delta \ln exr_{t-i}) + \left[\beta_0^* + \sum_{i=1}^p \beta_i^* (\Delta \ln exr_{t-i}) \right] F(\Delta \ln exr_{t-d}) + \varepsilon_t \quad (A1)$$

where α_0 is the linear intercept term; α_i ($i = 1, \dots, p$) stand for the linear autoregressive parameters; β_0^* is the nonlinear intercept term, β_i^* ($i = 1, \dots, p$) stand for the nonlinear autoregressive parameters, $F(\Delta \ln exr_{t-d})$ is the transition function which characterized the smooth transition in between 2 regimes that depend on the lagged term of the first difference of the log of the nominal exchange rate, $\Delta \ln exr_{t-d}$ where d is the delay lag length, and ε_t is a white noise with zero mean and constant variance.

The theoretical and empirical aspects of this model are rather involved and extensively discussed in a number of studies. Interested readers should refer to Terasvirta and Anderson (1992) and Dijk et al. (2002) for a thorough discussion of STAR models. Nonetheless, depending on the specification of the transition function, the natural starting point in describing the STAR model is the two-regime LSTR1 model with the following general logistic transition function, which takes values in the interval between zero and one:

$$F(\gamma, c; y_{t-d}) = \frac{1}{1 + \exp(-\gamma(y_{t-d} - c))}, \quad \gamma > 0 \quad (A2)$$

where γ is the slope parameter (the magnitude of which measures the speed of transition between the two regimes), c is the threshold parameter (the value of which indicates the location of the transition) and y_{t-d} is the transition variable with the associated delay parameter d .

It turns out that a variant of the LSTR1 model is well-suited to testing whether East Asian currencies exhibit aversion to appreciations. In particular, one can resort to the LSTR2 model

suggested in Terasvirta (1998).¹² The transition function of the LSTR2 model is the second-order logistic function:

$$F(\gamma, c_L, c_H; y_{t-d}) = \frac{1}{1 + \exp(-\gamma(y_{t-d} - c_L)(y_{t-d} - c_H))}, \quad \gamma > 0 \quad (\text{A3})$$

Notice that the LSTR2 transition function resembles the transition function of the LSTR1 model but the LSTR2 transition function involves two threshold parameters c_L (the lower or appreciation threshold) and c_H (the upper or depreciation threshold). These lower (c_L) and upper (c_H) threshold parameters can be utilized to test for asymmetrical exchange rate behavior as these thresholds reflect to measure the relative tolerance of monetary authorities to exchange rate variations. To be more specific, if the upper threshold, c_H is larger than the (absolute value of the) lower threshold, c_L , this suggests an aversion of monetary authorities to currency appreciations.

¹² The other possible choice of the transition function is given by the exponential transition function: $F(\gamma; c; y_{t-d}) = 1 - \exp(-\gamma(y_{t-d} - c)^2)$. One limiting behavior though of the ESTAR model is that for large values of γ , this model becomes practically indistinguishable from a linear model.

Appendix Table B1-A
Estimation Results of LSTR2 Models for East Asian Currencies vis-à-vis US Dollar
Pre-Global Financial Crisis (GFC) Sample Period,
Weekly Data, January 2000-December 2006

	Indonesian Rupiah	Korean Won	Philippine Peso	Singapore Dollar	Thailand Baht
<i>p</i>	5	1	3	8	1
<i>d</i>	2	3	1	5	9
linear part					
intercept	0.037 (0.01)***	0.004 (0.00)	0.001 (0.00)	-0.000 (0.00)	-0.000 (0.00)
$\Delta \ln exr_{t-1}$	-0.478 (0.15)***	-0.708 (0.26)**	0.369 (0.06)***	0.365 (0.08)***	0.471 (0.07)***
$\Delta \ln exr_{t-2}$	-0.889 (0.38)**		0.170 (0.04)***	-0.005 (0.10)	
$\Delta \ln exr_{t-3}$	-0.579 (0.16)***		0.062 (0.05)	0.038 (0.09)	
$\Delta \ln exr_{t-4}$	0.123 (0.12)			-0.182 (0.10)*	
$\Delta \ln exr_{t-5}$	-0.271 (0.10)***			0.248 (0.15)*	
$\Delta \ln exr_{t-6}$				-0.027 (0.10)	
$\Delta \ln exr_{t-7}$				-0.091 (0.14)	
$\Delta \ln exr_{t-8}$				-0.222 (0.13)*	
non-linear part					
intercept	-0.037 (0.01)***	-0.005 (0.00)	-0.096 (0.01)***	-0.000 (0.00)	0.001 (0.00)
$\Delta \ln exr_{t-1}$	0.893 (0.15)***	1.023 (0.27)***	-2.311 (0.23)***	-0.056 (0.18)	-0.319 (0.10)***
$\Delta \ln exr_{t-2}$	0.823 (0.39)**		-1.791 (0.29)***	-0.181 (0.17)	

$\Delta \ln exr_{t-3}$	0.827 (0.17)***		3.870 (0.76)***	-0.101 (0.16)	
$\Delta \ln exr_{t-4}$	-0.189 (0.13)			0.229 (0.19)	
$\Delta \ln exr_{t-5}$	0.187 (0.12)			-0.197 (0.19)	
$\Delta \ln exr_{t-6}$				-0.229 (0.17)	
$\Delta \ln exr_{t-7}$				0.425 (0.19)**	
$\Delta \ln exr_{t-8}$				0.412 (0.22)*	
LB-Q test	0.20	0.72	0.67	0.74	0.33

p is the number of lags of the linear autoregressive model; d is the optimal delay parameter;
Numbers in parentheses are standard errors, whereas numbers in the LB-Q test are p -values.
Significance levels: *10%, **5%, ***1%.

Appendix Table B1-B
Estimation Results of LSTR2 Models for East Asian Currencies vis-à-vis US Dollar
Global Financial Crisis (GFC) Sample Period, Weekly Data, January 2007-July 2009

	Indonesian Rupiah	Korean Won	Philippine Peso	Singapore Dollar	Thailand Baht
<i>p</i>	2	1	2	1	1
<i>d</i>	4	12	1	2	5
linear part					
intercept	0.000 (0.01)	0.002 (0.00)	-0.142 (0.08)*	-0.010 (0.00)**	0.007 (0.00)
$\Delta \ln exr_{t-1}$	0.206 (0.13)	-0.216 (0.12)*	-6.567 (3.74)*	-0.974 (0.50)**	1.704 (0.91)*
$\Delta \ln exr_{t-2}$	0.242 (0.13)**		-1.971 (0.86)**		
non-linear part					
intercept	0.001 (0.00)	-0.002 (0.00)	0.143 (0.075)*	0.010 (0.00)**	-0.007 (0.00)
$\Delta \ln exr_{t-1}$	-0.358 (0.29)	0.911 (0.18)***	6.735 (3.73)*	1.310 (0.50)***	-1.679 (0.92)*
$\Delta \ln exr_{t-2}$	-0.839 (0.36)**		2.047 (0.87)**		
LB- <i>Q</i> test	0.57	0.58	0.62	0.13	0.16

p is the number of lags of the linear autoregressive model; *d* is the optimal delay parameter;
Numbers in parentheses are standard errors, whereas numbers in the LB-*Q* test are *p*-values.
Significance levels: *10%, **5%, ***1%.

Appendix Table B1-C
Estimation Results of LSTR2 Models for East Asian Currencies vis-à-vis US Dollar
Post-Global Financial Crisis (GFC) Sample Period,
Weekly Data, August 2009-March 2011

	Indonesian Rupiah	Korean Won	Philippine Peso	Singapore Dollar	Thailand Baht
<i>p</i>	1	1	1	1	1
<i>d</i>	2	2	1	7	11
linear part					
intercept	-0.002 (0.00)	-0.001 (0.00)	-0.010 (0.00)***	-0.014 (0.01)**	-0.001 (0.00)
$\Delta \ln exr_{t-1}$	-0.840 (0.35)**	0.607 (0.13)***	1.237 (0.37)***	-1.259 (0.86)	0.577 (0.12)***
non-linear part					
intercept	0.001 (0.00)	0.006 (0.00)	0.009 (0.004)**	0.013 (0.00)***	0.003 (0.00)*
$\Delta \ln exr_{t-1}$	1.077 (0.37)***	-1.364 (0.26)***	-1.242 (0.42)***	1.398 (0.88)	-0.837 (0.28)***
LB- <i>Q</i> test	0.75	0.97	0.16	0.98	0.40

p is the number of lags of the linear autoregressive model; *d* is the optimal delay parameter;
Numbers in parentheses are standard errors, whereas numbers in the LB-*Q* test are *p*-values.
Significance levels: *10%, **5%, ***1%.

Applying Extreme Value Theory to Identify Large Appreciations and Intervention Episodes

In order to locate the threshold that separates the normal values of the changes in exchange rates (corresponding to the normal periods) from that of the extreme or large values (corresponding to the large or extreme appreciation episodes), for instance, but without the need to set an arbitrary cutoff or threshold value for the changes in exchange rates, the estimation of the parameter (α), the tail index of the distribution of the changes in exchange rates, is crucial as it determines the degree of tail fatness the distribution exhibits. The tail index measures the speed at which the distribution's tail approaches zero—the higher (α), the faster the speed and the less fat-tailed the distribution. In addition, the tail index (α) has the attractive feature that it is equal to the maximum number of existing finite moments in the distribution. Unfortunately, the estimation of the tail index is not a simple task, although there are a few available estimators in the literature. The most common of these is the Hill (1975) estimator, which is given as:

$$\gamma(k) = \frac{1}{k} \sum_{j=1}^k \ln(x(n-j+1) - \ln(x(n-k))) \quad (C1)$$

We assume that there is a sample of n positive independent observations drawn from some unknown fat-tailed distribution. Letting the parameter (γ) be the inverse of the tail index (α), and $x(i)$ be the i th-order statistic such that $x(i-1) \leq x(i)$ for $i = 2, \dots, n$. k is the pre-specified number of tail observations. The choice of k is crucial to obtain an unbiased estimate of the tail index. The intuition behind this critical choice of k is that there is an uncomfortable variance and bias trade-off. If we employ a k that is too low, we are not using all of the tail observations, and would thus obtain an estimate of the tail index with a large variance. In contrast, if we employ a k that is large, we bias the estimate of the tail index by including observations in the sample from the centre of the distribution.

In an important paper, Huisman et al. (2001) introduces an estimator that overcomes the need to select a 'single' optimal k in small samples, by accounting for the bias in the Hill estimator. They

showed that for values of k smaller than some threshold κ , the bias of the Hill estimate of γ increases almost linearly in k and can be approximated by:

$$\gamma(k) = \beta_0 + \beta_1 k + \varepsilon(k), \quad k = 1, 2, \dots, \kappa \quad (\text{C2})$$

The above equation has to be estimated by weighted least squares (WLS) to deal with the heteroscedasticity in the error term $\varepsilon(k)$. The weight has $(\sqrt{1}, \sqrt{2}, \dots, \sqrt{k})$ as diagonal elements and zeros elsewhere. The bias corrected estimate of γ is the intercept β_0 and the estimate of the optimal tail index α would be given by $\hat{\alpha} = 1/\beta_0$.

The essence is to identify separately the ‘extreme right-tail’ observations from the ordered distribution of the changes in the exchange rate and the ordered distribution of the changes in reserves since the incidence of large appreciations and large reserves purchases are determined and located in the right-tail of the distribution. Accordingly, Diebold, Schuermann and Stroughair (2000) suggested, (also similarly employed by Pozo and Dorantes (2003), Pontines and Siregar (2007, 2008) and Lestano and Jacobs (2007)), that recursive residuals be derived from the above discussed weighted least squares regression to diagnose structural changes, which will then guide us ultimately in the selection of the optimal k .