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Explaining the Real Exchange Rate During Sudden Stops Period: Evidence from Asia and Latin America

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ABSTRACT

This paper tries to untangle the causes behind the recent real exchange rate overshooting events with particular attention paid to the Sudden Stop of capital flows, and also to the comparison across the two emerging markets, Asian and Latin America. We examine whether the sudden stop of capital inflows leads to asymmetric behavior in real exchange rate movements as suggested by Calvo (1999) among others.

By utilizing cumulative impulse response function and variance decomposition analysis, we argue that there is the asymmetric response across Sudden Stop and tranquil times. Further comparison across Asia and Latin America, however, reveals that the sudden stop disturbance has significantly larger explanatory power in Asia than in Latin America. The estimation result also reveals that the real exchange rate in Asia is subject more to the external shocks while it is due more to the domestic policy developments in Latin America.

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Explaining the Real Exchange Rate During Sudden Stops Period: Evidence from Asia and Latin America

Akiko Terada-Hagiwara

I. Introduction

The violent Sudden Stop of the capital inflows during the Asian crisis and the macroeconomic turmoil following the events has once again focused our attention on learning about the causes behind these extreme fluctuations. Sudden Stops are typically accompanied by large contractions in international reserves and declines in the relative price of non-tradables with respect to tradables, i.e. real currency depreciation. This relationship between international payments and the real exchange rate has been extensively discussed[1].

Figure 1 plots the development of capital flow[2] of our sample countries. All of the countries in our sample experienced large reversals of capital flow. The reversals have been particularly severe during the Asian crisis starting in 1997, and in Latin American in during the debt (early 1980) crisis as well as Mexican crisis (1994)[3]. In the case of Thailand, for example, this most affected country was forced by the reversal of capital flows to go from a deficit of some 3% of GDP in 1996 to a surplus of 11% in 1998. These swings in current account have been achieved partly through massive real depreciation, and partly through severe recession that produces a compression of imports.

Figure 2 plots the development of real exchange rates and our definition of Sudden Stop period, which we will discuss later in the paper. We can find that the real exchange rate

[1] See Calvo (1998, 2000) and Agénor (1998), for example, for the discussion.

[2] Capital flow is defined as a net sum of Net Errors and Omissions, Capital account, and Financial account.

[3] The period 1973 – 81 witnessed massive capital flows to countries in many parts of the developing world, largely in a form of private syndicated bank loans directed to the public sector. Such lending effectively dried up for many (but not all) developing countries during the period of the debt crisis, 1982 – 89.

depreciates significantly at the time of the large reversals in some countries. Table 1 shows that, except for the Philippines, 7 out of 8 countries in our sample experienced their most severe depreciation events during our definition of Sudden Stop periods. In the Philippines, the most severe depreciation, which was captured by the Sudden Stop period, took place during the debt crisis. The Philippines was one of the few countries in Asia, which was affected severely by the debt crisis. During the Asian crisis, on the other hand, the country was forced to depreciate its currency in 1997q3 by 23% after Thailand collapsed while large capital flow reversal started only later in 1999.

Despite the apparent importance of the real exchange rate depreciation at the sudden stops, its empirical investigation is rather scarce, and yet to be examined. Perhaps most of the attention has been paid to the behaviour of investors rather than the real economy per se. The objective of the paper, therefore, is to untangle the causes behind the recent real exchange rate depreciation events with particular attention paid to the reversals of capital inflows. We also pay attention to any distinctions in factors affecting the real exchange rate across two emerging markets; Asia and Latin America. The countries in the two regions similarly experienced the Sudden Stop crises, and sharp real depreciation of the currencies during the sample period, however, against different economic background. Therefore, we compare across the two regions seeking any differences during the sudden stop period.

We interpret the fluctuations in the real exchange rate as due to six types of shocks. They are the external and internal disturbances that arise from 1) world interest rate, 2) terms of trade, 3) monetary, 4) productivity, 5) demand, and 6) current account. We define the Sudden Stop shock as a shock arising from current account, which is not associated with the interest rate differential but is associated with market sentiments. We pay particular attention to the dynamic response of the real exchange rate at the time of Sudden Stop shocks to examine whether the responses are different between Sudden Stop times and inflow times as Calvo (1998) and others suggest.

Our sample includes 8 emerging markets from Latin America and Asia. They are Argentina, Brazil, Chile, Mexico, Indonesia, Korea, Philippines, and Thailand[4]. To the extent that the Sudden Stop events contain a large unexpected component associated with investors' sentiment and risk premium of the country, such events are more relevant to emerging markets. Therefore, we focus our attention on emerging markets[5]. We then estimate a structural VAR model using the Blanchard and Quah decomposition. The analyses of variance decomposition as well as impulse response functions are performed. The results are compared across our definition of Sudden Stop or "no access to capital market" times versus tranquil times, and also debt crisis ('82-'87) versus two well-known Sudden Stop crises in Latin America ('94-'95) and Asia ('97-'98) to see if they reveal any significant difference in responses.

By utilizing impulse response function and variance decomposition analysis, our results suggest the following. For the first comparison across "No Access to Capital market" and tranquil time, the cumulative impulse response functions reveal that the most significant impact comes from Sudden Stop shock during the "no access" period accounting for nearly 40% of the real exchange rate variance while it is only around 5% during the tranquil time. Terms of trade shock affects the real exchange rate in the short run for 2 quarters during the "no access" period accounting for about 7% of the variance, while it has long run impact during the tranquil time albeit its smaller explanatory power of about 4%. Monetary policy shock has impact in short run during the both periods, accounting for around 8-10% of the variance. Both supply and foreign rate shocks have minimal impacts on real exchange rate during both periods. Demand shock accounts for about 40% of the real exchange rate variance during the "no access" time while it doubles to around 80% during the tranquil period.

[4] For Latin America, Colombia, Peru and Venezuela are not used due to their short sample periods. In Asia, the capital flow series is not available for Malaysia in IFS.

[5] See also Arellano and Mendoza (2002) for why Sudden Stop phenomena are unique to emerging markets.

The second comparison across Asia and Latin America during the "no access" period allows us to examine different factors affecting the real exchange rate during the two regions. We find, by looking at the cumulative impulse response functions, that the Sudden Stop shock affects the real exchange rate for the first 3 quarters in Asia while it is not so obvious in Latin America. The variance decomposition supports the observation that the Sudden Stop shock accounts for about 48% of the real exchange rate variance in Asia while it becomes significantly smaller about 2% in Latin America. Terms of trade shock has significant impacts only in Asia having a long run impacts on the real exchange rate while it is only in the short-run that is significantly different from zero in Latin. Another distinction appears to exist with monetary policy shock. Monetary policy shock accounts for more than 37% of the real exchange rate variance in Latin America while it explains almost none in Asia during the "no access" period. The cumulative impulse response functions reveals that the expansionary monetary policy disturbance leads to real depreciation for 3 quarters in Latin America while the response is not significantly different from zero in Asia.

Section II provides a brief theoretical and empirical literature review, and empirical prediction. Section III presents the analytical framework that provides a guideline for the VAR specification. Section IV describes our data set and empirical methodology. Section V reports results of the VAR estimation. Section VI concludes.

II. A Review of Theoretical and Empirical Literature

A. Why Sudden Stop causes real exchange rate devaluation?

"Large and unexpected" are the two defining characteristics of what the literature calls Sudden Stop (see Calvo, 2000). The majority of the recent capital market crises studies incorporate a factor arising from imperfect capital markets in order to explain the severity of the aftermath of Sudden Stops. Such theoretical developments include the work of Calvo (1998),

Caballero and Krishnamurthy (2000), Mendoza (2001), among others. They focus on characteristics of the imperfect capital markets, such as higher risk premium and/or higher collateral requirements at the onset of the Sudden Stop of capital inflows. Details differ, but most of the papers seem to agree on the mechanism of the real exchange rate depreciation following Sudden Stop.

Caballero and Krishnamurthy (2000), for example, argue that to the extent that the reversals of capital flows require additional guarantee per unit of credit raised, the country becomes more credit constrained and runs out of dollar denominated assets. Under this scenario, agents are forced to sell domestic assets leading to a lower demand and the fire sales of domestic assets, which lead to a lower price of the domestic assets. This reaction causes the real exchange rate to depreciate, and possibly depreciate more in countries with external liabilities. This temporary reaction of the real exchange rate could lead to financial collapse as suggested by Edison, Luangaram, and Miller (1998)[6].

We can therefore expect to find that the effects on the real exchange rate are different between Sudden Stop period and period without, one would lead to larger depreciation in the real exchange rate than the other in the short run.

B. Review of Empirical Literature

Empirical literature linking capital flows and real exchange rates comes in two ways. Some focus on explaining the real appreciation episode associated with capital inflows using time series analysis, and others analyze Sudden Stop episodes and their impact on economies by looking at episode by episode. While the former examines the long-run relationship between the flows and the real exchange rates, the latter looks at temporary components of the real exchange rates or the short-run relationship between the two.

[6] See Calvo and Reinhart (1999).

Debós and Ramón (2000) examine the case of Mexico and find the long run real appreciation of the peso with capital inflows using an error correction model. Lin (2000) looks at Thailand and finds that the real appreciation of the Thai baht is associated with the current account deficit or capital inflows using an error correction model.

On how capital flows affect real exchange rates in short-run, Agénor and Hoffmaister (1996) examine the relationship between capital flows and the real exchange rates using near-VAR[7] methodology for four emerging markets. Their system includes 5 variables: temporary components of real exchange rates, capital inflows / GDP, money-base velocity, government expenditure / GDP, and interest rate differential. They show that the temporary components of the real exchange rate movements are associated only weakly with shocks to capital flows[8]. This study, however, does not specifically investigate the effects of Sudden Stop – large negative flows.

Calvo and Reinhart (2000) conduct a cross-country analysis of Sudden Stops. They document 15 recent episodes of large reversals in net private capital inflows into 12 emerging countries. 12 out of the 15 episodes took place in 1990s[9]. The reversals are defined to be Sudden Stops if it exceeds at least 4 % of GDP. They show that the impact effects of the reversals are much larger than those corresponding to average crises data for the period of 1970-1994. As for the real exchange rate, they show that Sudden Stops produce larger adjustments in real exchange rates than those produced by previous BOP crises[10]. Calvo, Izquierdo, and Talvi (2002) also provide some evidence of large real depreciation associated with Sudden Stops for 5 Latin American countries. They compute the required real depreciation at Sudden Stops in order to bring down its current account to a value of zero. Their computation reveals that Argentina

[7] A "Near-VAR" model allows to have different sets of variables in each equation.
[8] See also Agénor, Hoffmaister, and Medeiros (1997).
[9] The remaining 3 episodes are in Argentina, Chile, and Mexico during the period of debt crisis in early 1980s.
[10] Hutchison and Noy (2002) conduct an analysis of Sudden Stops, but they only look at their impacts on output, and not on real exchange rate.

would have needed to depreciate about 43% to close the current account gap. Despite the dramatic nature of Sudden Stops, empirical studies are rather scarce. Most of the existing studies remain to provide not more than a summary statistics of the Sudden Stop events.

Lee and Chinn (1998) perform a structural VAR analysis of the current account and real exchange rate for seven major industrialized countries. Though the analysis does not pay particular attention to Sudden Stop events, it utilizes Blanchard and Quah decomposition so as to minimize assumptions for identification. They find that permanent shock to productivity have large long run effects on the real exchange rate, and money shock have large effects but only in the short run. We use similar approach taken by Lee and Chinn as for the analytical methodology.

The objective of the paper is to examine the factors affecting the real exchange rate paying particular attention to asymmetric nature of responses to the current account disturbance. We analyze the real exchange rate fluctuations associated with the current account movements using time series data, and decompose to different factors contributing to the fluctuations. The specific econometric technique we adopt is the Blanchard and Quah (1989) decomposition. This strategy relies on long-run economic restrictions and allows us to avoid the contemporaneous ordering restrictions of standard VAR analysis. Next section presents an analytical framework identifying the long run structure.

III. Analytical Framework

We use production function as in Hoffmaister and Roldos (1997) to discuss the factors affecting business fluctuations, particularly on the real exchange rate. This allows us to discuss the role of exogenous world interest rate, as well as other shocks, namely terms of trade, supply, fiscal, and nominal shocks, which are jointly identified and quantified. The description of the model, that follows, focuses on the long-run effects of these shocks on real exchange rate while the short-run dynamics are left to be determined by the data. This economic model

motivates the long-run identifying restrictions that, together with the usual assumption of orthogonality of structural innovations, identify the structural innovations and helps to interpret the empirical results.

We consider a small open economy that produces a tradable and a nontradable good. The supply side of the tradable good can be expressed by ways of a real value added function as follows.

1. $$Y_{xt} = [\mu(1-\mu)^{(1-\mu)/\mu}]A_{xt}^{1/\mu}P_{mt}^{(\mu-1)/\mu}V_{xt},\ where\ V_{xt} = K_t^{1-\alpha}L_{xt}^{\alpha}$$ [11]

A_{xt} is the level of the technology and P_{mt} is the domestic price of intermediate inputs in terms of the exportable good. The tradable sector uses capital (K) and labor (L_x). To complete the supply side of the model, the production of the nontradable good is assumed to use only labor (L_n) as an input,

2. $$Y_{nt} = A_{nt}L_{nt}^{\beta}$$

Total GDP is expressed $Y_t = Y_x + Q\ Y_{n,}$ where Q is the real exchange rate. By using lower-case letters to denote the logs of upper-case variables, the long-run response of the (log) real exchange rate, q, i.e. relative price, to the different shocks is expressed as follows:

3. $$q_t = \phi + (1/\mu)a_{xt} - a_{nt} - (\frac{1-\mu}{\mu})p_{mt} - (1-\beta)(\frac{1-\lambda_n}{\lambda_n})\log K_t - [(1-\alpha) + (1-\beta)(\frac{1-\lambda_n}{\lambda_n})]\log l_{xt}$$

where λ_n is the share of nontraded sector labor in total labor, $l_x = L_x / K$ is the inverse of the capital/labor ratio in the tradable sector, and an increase is an appreciation. Equation 3 is useful to illustrate the factors that determine the long-run (log) level of real exchange rate. Ignoring the constant, there are five factors affecting the real exchange rate. The equation says that a

[11] The equation is derived by subtracting intermediate inputs from gross output,

positive supply shock, due either to technological progress in the tradable sector as well as a terms of trade improvement, leads to real exchange rate appreciation. This is due to the fact that positive wealth effects of theses shocks lead to a higher demand for nontradables that is met by a reallocation of labor to the nontraded goods sector induced by the increase in the relative price of the nontradable good. Meanwhile positive supply shock in the nontradable sector leads to depreciation. This may be because an increase in wage associated with the productivity growth leads to lose competitiveness.

The fourth term is interpreted as an impact arising from government spending. Hoffmaister and Roldos (1997) argue that the fiscal expansion leads to a decline in the capital stock K, that has an effect on the real exchange rate. An increase in government spending leads to a real exchange rate appreciation since the government spending is biased towards nontradable goods requires an increase in the relative price of the nontraded good to reach a new equilibrium despite having a negative wealth effect from the appreciation. Finally, the fifth term in equation 3 captures the effect of world interest rate shocks because in the long run the marginal productivity of capital equals the world interest rate. Therefore, an increase in the world interest rate leads to depreciation of real exchange rate.

We now turn to specify the long-run relationship between current account and real exchange rate by looking at the trade balance linking the two as discussed in Lane and Milesi-Ferretti (2002).

4. $ca_t = i_t^* b_t^* + tb_t$ [12]

$Q_{xt} = A_{xt}[K_t^{1-\alpha} L_{xt}^{\alpha}]^{\mu} M_t^{1-\mu}$. M is an imported intermediate input.

[12] Lane and Milesi-Ferretti (2002) assume that a country can run a steady-state trade deficit equal to the net investment income on its net foreign asset position in the long run, $ca_t = 0$, however we assume that the long term current account is non zero value since all of the countries in our sample are net debtors during the whole sample period and the magnitude of indebtedness is increasing.

The current account (ca_t) is a sum of the interest earning (payment) on its holding of foreign asset (debt) (b_t^*) and the trade balance (tb_t). i_t^* represents foreign interest rate. As the trade balance is a function of real exchange rate, the current account equation 4 can be rewritten as follows.

4'. $ca_t = i_t^* b_t^* - \varphi q_t$, where q_t is given by equation 3. [13]

Equation 4' says that the real exchange rate will be more depreciated, the bigger the current account surplus, and also that the current account is more endogenous than the real exchange rate.

For nominal variable, following the common practice in the literature on the sources of business fluctuations, we assume long-run neutrality of money and/or the nominal exchange rate. To capture the role of nominal variables in the short-run, the model includes M2 in the VAR estimation. We further assume that this temporary shock arising from the current account has no long-run impacts on real variables, such as real exchange rate and output[14].

The long run level of output is given at $y_t^l = y_t^s$. We apply small open economy assumption. It implies that domestic innovations do not affect external variables, i.e. foreign interest rates and terms of trade.

IV. Empirical Methodology and Data

A. The identification of the shocks

The structural VAR model that is used to obtain the main empirical results of this paper summarizes both the extrinsic dynamics of the exogenous variables as well as the intrinsic

[13] We interpret the impact arising from the holding of net foreign asset is constant, since all the countries in our sample are net debtors and variation in the magnitudes across countries is small.
[14] See Lee and Chinn (1998), for the similar treatment.

dynamics – or propagation mechanisms – of the model. The analytical framework in the previous section implies estimating the following system.

5. $$AX_t = A(L)X_{t-1} + C\varepsilon_t, \quad V(\varepsilon_t) = \Sigma,$$

where X is a vector of variables [i_t*, tot_t, m_t, y_t, q_t, ca_t], where i_t*, tot_t, m_t, y_t, q_t, ca_t are the world interest rate, the terms of trade, monetary policy, productivity, demand, and current account (or Sudden Stop shock). The variables are assumed to have an MA representation. ε_t is the vector of the structural shocks, [ε_{i*}, ε_{tot}, ε_m, ε_y, ε_d, ε_{ca}]. We pay particular attention to $\varepsilon_{ca,t}$, which represents a current account shock. We interpret it as being a shock arising from market sentiments, and this disturbance is meant to capture the "unexpected" nature of the Sudden Stops.

In matrix, they are:

6. $$\begin{bmatrix} i* \\ tot \\ m \\ y \\ q \\ ca \end{bmatrix} = A(L)* \begin{bmatrix} \varepsilon_{i*} \\ \varepsilon_{tot} \\ \varepsilon_m \\ \varepsilon_y \\ \varepsilon_d \\ \varepsilon_{ca} \end{bmatrix}$$

The reduced form VAR representation can be obtained by multiplying both sides of equation 5 by A^{-1}:

7. $$X_t = B(L)X_{t-1} + \mu_t,$$

where μ_t is the vector of reduced-form innovations, [μ_{i^*}, μ_{tot}, μ_m, μ_y, μ_d, μ_{ca}]. The left hand side of equation 7 contains the endogenous variables and B(L) is a square matrix of lag polynomials. The typical element of A(L), a_{ij} (L) denotes the response of the ith endogenous variable to the jth structural innovation lagged L periods.

The estimation strategy used in this study to recover the structural innovations is an extension of Blanchard-Quah (1989)[15]. This strategy relies on long run economic restrictions and this avoids the contemporaneous ordering restrictions of standard VAR analysis. Blanchard and Quah show that the structural innovations are a linear transformation of the reduced-form innovations and this linear transformation requires the matrix of contemporaneous effects of the structural innovations, A(0). We apply this approach not only because we can avoid the ordering problem, but also we can avoid assuming a particular macroeconomic paradigm so that the empirical methodology allows the data to determine the short run dynamics implied by A(L). The short run movements of the endogenous variables can then depend both on the dynamics of the exogenous variables and the unspecified intrinsic dynamics of the model.

The analytical framework of section III provides guidelines for imposing zero restrictions on the elements of A(1) – sum of the coefficients. We use it to discuss the justification of this interpretation. The small open economy assumption for the foreign interest rate and terms of trade implies to impose $A_{ik}(L) = 0$ for i=1, 2 and k=3, 4, 5, 6 for L=0, 1, 2, …, ∞, for example. The identification restrictions, as implied by the analysis of the previous section, can be summarized as follows.

[15] See Enders (1995) for detailed explanation of the decomposition.

8. $$A(1)=\begin{bmatrix} A_{11}(L) & 0 & 0 & 0 & 0 & 0 \\ 0 & A_{22}(L) & 0 & 0 & 0 & 0 \\ 0 & 0 & A_{33}(L) & 0 & 0 & 0 \\ 0 & 0 & 0 & A_{44}(L) & 0 & 0 \\ A_{54}(L) & A_{54}(L) & 0 & A_{54}(L) & A_{55}(L) & 0 \\ A_{61}(L) & A_{62}(L) & 0 & A_{64}(L) & A_{65}(L) & A_{66}(L) \end{bmatrix}$$ [16]

where $A_{ij}(L)=\sum_{k=0}^{\infty} a_{ij}(k)\varepsilon_{it-k}$ and $A_{ij}(L)$ are polynomials in the lag operator L such that the individual coefficients of $A_{ij}(L)$ are denoted by $a_{ij}(k)$.

B. Define Sudden Stop Period

Sudden Stop of capital inflows is defined as "unexpected severe stops in capital flows of a persistent nature" by Calvo (2002) and others. We interpret this as a period of loss of access to international capital market. In other words, the Sudden Stop is a period of no capital inflows or a period of capital outflows. There are several ways of defining the Sudden Stop period. Calvo et al (2002), for example, looks at Emerging Market Sovereign Bond Spread (EMBI). The EMBI would capture the uncertainty in international markets[17] and cost of sovereign bond issuance, which can be a proxy for a loss of access to the international capital market[18][19]. Milesi-Ferretti and Razin (1997) focuses on current account imbalances net of official transfers. They set two requirements to be satisfied; 1) the average reduction in the current account deficit of at least 3 (5) % of GDP over a period of three years before the event, and 2) the maximum

[16] We thus have an over-identified model.
[17] See also "Global Financial Stability Report" IMF (2003).
[18] To be more precise, developments of new bond issuance is a better proxy for the accessibility of fund.
[19] We do not use this variable for two reasons. Firstly, capital flow consists of different components including financial flows as well as bank flows, for example, and thus the EMBI would only capture a part of the Sudden Stop story, namely the financial flow, but not the bank flows, which was the major part of the Sudden Stop during the Asian financial crisis. Secondly, the EMBI is available only after 1995 from DataStream while our sample includes the events during 1980s. The variable, therefore, does not allow us to identify the Sudden Stop period consistently throughout our sample.

current account deficit after the reversal must be no larger than the minimum deficit in the three years preceding the reversal. Hutchison and Noy (2002), on the other hand, define a sudden stop crisis as one in which there is the contemporaneous occurrence of a currency crisis, and a capital account reversal while Calvo and Reinhart (1999) select events with reversals in net private capital flows of more than 4% of GDP.

While Sudden Stop crisis in 1990s tend to be identified solely by looking at capital flows or current account movements as we discussed, and each event usually lasts relatively short period for 1 or 2 years, the events of 1980s can be seen as prolonged period of loss of access to international capital market because of the long restructuring process. Table 2 compares several papers identifying the Sudden Stop and crises events both in 80s and 90s that we like to examine. By setting a set of criteria, we try to capture these events of prolonged debt crisis as well as sharp reversal of capital flows such as Tequila and Asia financial crises. The criteria are 1) a change in net capital flow as % of GDP is less than the sample mean, and also it continues for the following two years, and 2) a change in net capital flow is larger than the sample's one standard deviation, 1.6% (See Table 3)[20]. The first definition ensures that the episode is of a sustained duration of capital outflows, while the second definition ensures to include one time sharp reversal. The defined Sudden Stop episodes are shown in Figure 2 along with the real exchange rate development. They include a period of Mexican debt and tequila crises (1982 and 1994), hyperinflation episodes in Argentina (1990) and in Brazil (1990 and 1994) and Asian Crisis (1997 and 1998)[21] among others, some with large real depreciation. This can be seen as a period without access to international capital market or "no access" period. We use these criteria to compare across the "no access" versus tranquil times[22].

[20] Milesi-Ferretti and Razin (1997) used 3% or 5% (y-o-y) as a threshold, while our criterion was to use 1.6% (q-o-q) or more than 6% at annualized rate.

[21] Note that there was an episode in Chile with current account reversals in early 1980s. The current account deficit declined from 15 percent of GDP in 1981 to 5 percent of GDP in 1983, however, the event is not captured by our data since there are no quarterly current account data available during episode.

[22] The period where the dummy variables tales zero

C. Data

The variables in the empirical analysis are quarterly data spanning from 1980Q1 to 2000Q4 where data is available[23]. Our sample includes 8 emerging countries form Asia and Latin America. They are Argentina, Brazil, Chile, Mexico, Indonesia, Korea, Philippines, and Thailand. The six variables of our interests are US interest rate[24], terms of trade, M2, industrial production (See Table 4 for the data statistics.)[25], current account as percent of GDP[26], and real exchange rate[27].

Apart from the capital flow development in Figure 1 that we looked at, there are two external macroeconomic developments, which seem to be important in explaining the real exchange rate movements. Figure 3 plots the development of US money market rate showing drastic change in early 1980s. After the "Volcker Shock[28]" of rising US short-term rate by 6.5 percent, the US treasury bills again dropped below 12 percent by 1982. The consequent sharp rise in real interest rates paid by oil-importing developing countries raised the cost of servicing external debts. The US rate, on the other hand, has been relatively stable in 1990s except for the expansionary development in early 1990s.

The second external factor is the decline in commodity prices. The widespread recession in industrial countries in 1981-82 severely weakened the markets for developing country exports. Figure 4 plots terms of trade developments in 8 countries in our sample. The

[23] The data starts in 1984 in Brazil, 1991 in Chile, and 1981 in Philippines and Indonesia.

[24] As a robustness test, we examine another definition of the world interest rate created by taking average of the US, Japan, and German interest rates. The impulse response is not significantly different from the one of the regional foreign interest rate that we present in the paper. The explanatory power of the regional foreign rate, however, is slightly higher by about 5 %.

[25] Annual GDP data is interpolated to create quarterly GDP for Thailand from 1980 to 1992, where the quarterly industrial production is not available.

[26] Instead of using the aggregate measure of capital flow, estimations with financial flows and current account (the other side of account) are also performed. The results are not significantly different from the estimation with the aggregate capital flows.

[27] Terms of trade, M2, production, and real exchange rate are used in natural logs.

[28] The Federal Reserve Chairman, who set out to reverse the inflationary excesses of the preceding years

terms of trade deteriorated dramatically in most of the countries during the first half of 80s, except for perhaps in Korea, which did not experience the decline in the terms of trade during the debt crisis, it, however, deteriorated sharply preceding the Asian financial crisis.

As a preparation for the estimation we first transfer the variables to a zero mean one standard deviation series to correct for the scale effects, i.e. any one country does not dominate the estimation results. We then perform unit root tests on the time series variables using the Dickey-Fuller test. In order to use the Blanchard and Quah technique, the variables must be in a stationary form[29]. Appendix 2 shows the test results for all the series and the countries. The Dickey-Fuller tests failed to reject the unit root hypothesis for the most of the variables except for the current account series in a couple of countries. As suggested by Enders (1995), we take the first difference of those series to make them stationary.

Secondly we perform lag-length test. Akaike information criterion (AIC) and Schwartz Bayesian criterion (SBC) are calculated to find a reasonable approximation to the infinite-order VAR. The results suggest including 1 lag by AIC and including 2 lags by SBC. We use 1 lag for each estimation, and did not use long lags suggested by AIC given the limited number of observation as AIC is biased toward selecting an over parameterized model[30].

V. Estimation Results

This section presents the main empirical evidence of the macroeconomic disturbances (world interest rate, terms of trade, monetary, supply, demand, and current account) on the real exchange rate by discussing the relative importance of each disturbance and of the negative and positive capital flow shock in particular. The results are summarized by variance decompositions

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after his appointment in 1979

[29] See Enders (1995) for a detailed discussion on the decomposition technique.

[30] See Enders (1995) for details.

and impulse response functions. The estimation result with the pooled sample refers to a typical economy as described by the pooled time series data in the previous section.

A. "No Access to Capital market" and tranquil time

Figure 5 and Table 5 presents the estimation results comparing the "no access" and "tranquil" times, and report impulse response functions and variance decomposition. The cumulative impulse response functions of real exchange rate to different shocks are presented in a way that an increase (decrease) is real appreciation (depreciation).

By looking at the impulse response functions, we can see that the most significant impact comes from Sudden Stop shock during the "no access" period accounting for nearly 40% of the real exchange rate variance while it is only around 5% during the tranquil time. The impulse response is particularly different across two periods during the first 2 quarters, and the real exchange rate depreciates more in responding to the capital outflows during the "no access" than tranquil time, suggesting its rather temporary impact. This result validates our earlier argument that this unexpected Sudden Stop shock could lead to asymmetric responses of real exchange rate in the short-run as discussed in Calvo et al (2002) and others.

As for other factors affecting the real exchange rate, positive disturbance in the terms of trade leads to the real exchange rate appreciation, but only in the short run for 2 quarters during the "no access" period accounting for about 7% of the real exchange rate variance, while it has long run impact during the tranquil time albeit its smaller explanatory power of about 4%. As our identification framework suggests, the terms of trade does have a long run impact on the real exchange rate in general, this result, however, suggests that is true during the tranquil time, and is not obvious during "no access" period.

A positive shock in monetary policy (expansionary) has a negative impact or real depreciation in the short run during both of the periods validating nominal shocks to have only

short run impacts. It accounts for around 8 to 10% of the real exchange rate variance explaining slightly more during "no access" period.

Our results suggest that both supply and foreign rate shocks have minimal impacts on the real exchange rate during both periods. While both shocks are expected to have long run impacts on the real exchange rate, the impulse response functions are not significantly different from zero both in the short run and long run in our sample countries and periods[31]. Finally the demand shock accounts for about 40% of the real exchange rate variance during the "no access" time while it doubles to around 80% during the tranquil period suggesting that the demand disturbance is the main factor driving the real exchange rate development during the tranquil time[32]. Hoffmaister and Roldós (1997) also find that the real exchange rate to be mostly determined by demand shock particularly in Latin America explaining that the demand factor to be fiscal policy driven; and a positive shock in the fiscal policy would lead to real appreciation since the fiscal policy mostly falls on non-tradable sector leading to real appreciation.

B. Comparing Asia and Latin America during "No Access" period

We now turn our attention to compare across Asian and Latin American regions to examine if there are differences in factors explaining the real exchange rate across the two regions. Figure 6 and Table 6 present the estimation results comparing the two regions and again report the cumulative impulse response functions to show the long run impact of the disturbances and also the variance decomposition analysis.

We find, by looking at the cumulative impulse response functions, that the Sudden Stop shock affects the real exchange rate for the first 3 quarters in Asia while it is not so obvious in

[31] Hausman and Gavin (1995) also find a small correlation between external shocks and real exchange rate volatility for Latin America. In contrast, Calvo, Leiderman, and Reinhart (1993) find a large impact of external factors on the real exchange rate. This contrasting result may due to the sample period used, and that domestic policy and supply shocks are not explicitly accounted for.

[32] Our result is consistent with what Hoffmaister and Roldós (1997) find. Their VAR analysis concludes

Latin America. The variance decomposition supports the observation that the Sudden Stop shock accounts for about 48% of the real exchange rate variance in Asia while it becomes significantly smaller about 2% in Latin America suggesting that this unexpected capital flow disturbance has been more severe in Asia than in Latin America despite the well know Tequila crisis, which has been documented as sudden stop type of crisis. The result may be due to the fact that the "no access" period in Latin America has more weights on the 1980s crisis than that of 1990s.

Two other external shocks, terms of trade and foreign interest rate, appear to show distinctions across Latin America and Asia. The impulse response functions reveal that the real exchange rate responses are significantly larger in Asia responding to the two external shocks. A positive terms of trade shock, for example, has significant impacts only in Asia leading to real appreciation and having a long run impacts while it is only in the short-run that is significantly different from zero in Latin America. The variance decomposition reveals that about 6% of the real exchange rate variance is due to the terms of trade disturbance in Latin America while it is only about 1.5% in Asia. Foreign interest rate exhibits similar trend as terms of trade; a positive interest rate shock leads to real depreciation for the first 2 quarters in Asia, but it has almost no effects in Latin America[33]. It is interesting to find out that the relatively similar developments of the two external shocks lead to different real exchange rate responses in the two regions. The difference may be due to the fact that Asian countries are more open or export driven economies than relatively closed Latin American economies such as Argentina and Brazil, where domestic factors play more important role.

We now turn to examine two domestic shocks, namely supply and monetary shocks. In addition to the sudden stop shock, there is another distinction across the two regions appears to exist with monetary policy shock. Monetary policy shock accounts for more than 37% of the real exchange rate variance in Latin America while it explains almost none in Asia during the "no

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that the real exchange rate is mainly driven by its own past history with more than 90%.

[33] Hoffmaister and Roldós (1997) also find that the real exchange rate in Asian countries respond more to

access" period. The cumulative impulse response functions reveals that the expansionary monetary policy shock leads to real depreciation for the first 3 quarters in Latin America while the response is not significantly different from zero in Asia. The real depreciation is rather significant with the largest response in the first quarter, and then gradually comes back to zero after 3rd quarter.

As for the supply shock, the comparison of cumulative impulse response function reveals that a positive supply shock leads to real appreciation in the short-run as well as in the long-run in Latin America, it, however, leads to real appreciation only in the short-run in Asia. While the variance decomposition suggests slightly smaller explanatory power by the supply shock in Latin America, the domestic shocks seem to lead larger real exchange rate responses in Latin America than in Asia, contrasting those of the external shocks. Finally the demand shock accounts for about 50% of the real exchange rate variance in both of the. This result concludes that the monetary policy shock and the demand (or fiscal according to Hoffmaister and Roldós (1997) interpretation) shock account for more than 80% of the real exchange rate disturbance in Latin America suggesting that domestic policies are the key factors determining the real exchange rate movement in the region. Meanwhile, Asian region is subject more to external disturbances, particularly to capital flow shock.

VI. Conclusion

This paper tries to untangle the causes behind the recent real exchange rate overshooting events with particular attention paid to the Sudden Stop of capital flows, and also to the comparison across the two emerging markets, Asian and Latin America. We examine whether the sudden stop of capital inflows leads to asymmetric behaviour in real exchange rate movements as suggested by Calvo (1999) among others.

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the external shocks than those of Latin America.

By utilizing cumulative impulse response function and variance decomposition analysis, we argue that there is the asymmetric response across Sudden Stop and tranquil times. This appears to be true when we compare across "no access" and tranquil times. Further comparison across Asia and Latin America, however, reveals that the sudden stop disturbance has significantly larger explanatory power in Asia than in Latin America. The estimation result also reveals that the real exchange rate in Asia is subject more to the external shocks while it is due more to the domestic policy development in Latin America.

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Appendix 1: Data Source

a) World interest rate: US, Japanese, and German money market rates are taken from International Financial Statistics (line 60B)

b) Terms of trade: International Financial Statistics (line 74 and 75) and various sources[34]. The missing terms of trade are calculated using the countries main exports price divided by the OECD's import price index.

c) M2: International Financial Statistics (line 34 and 35)

d) Industrial production index is taken from International Financial Statistics (line 66) except for three countries listed below.

Argentina: "Indicadores De Coyuntura," Fundacion de Investigaciones Economicas Latinoamericanas, various issues.

Brazil: "Boletim Do Banco Central Do Brazil," Central Bank of Brazil, various issues.

e) Current account is taken from International Financial Statistics. We look at the aggregate capital flow, which consists of the net errors and omissions, capital account, and financial account. See below for details of each component.

Capital Flows: CA + RES = -(EO + KA + FINA)

Where the left hand side is CA: Current account (line 78ald), and RES: Reserves and Related items (line 79dad, Reserve assets + Exceptional financing + Fund credit and loans). The right hand side is EO: Net Errors and Omissions (line 78cad, unrecorded capital flows / trade transactions), KA: Capital account (line 78bcd, Capital transfers associated with migrants, debt forgiveness, or other government transfers), and FINA: Financial account (line 78bjd, Direct I + Portfolio I + other I)

f) Real exchange rate is taken from International Financial Statistics (line AE) for nominal exchange rate, and multiplied by CPI US / CPI domestic for real exchange rate.

[34] I benefited from Graciela Kaminsky's database for some countries.

Appendix 2: Dickey-Fuller test for unit roots on variables

	Argentina	Brazil	Chile	Mexico	Indonesia	Korea	Philippines	Thailand
	Test Statistics							
TOT	-2.67	-2.48	-2.89	-1.16	-1.39	-0.29	-2.12	-1.90
D.TOT	-8.16**	-13.80**	-8.19**	-6.73**	-9.51**	-8.25**	-6.95**	-6.95**
M2	-2.79	-0.14	-3.55**	-1.70	0.07	-0.58	-0.26	-2.50
D.M2	-4.45**	-3.19*	--	-6.38**	-8.95**	-9.91**	-11.15**	-7.32**
Production	-3.98**	-3.96**	-0.88	0.04	-0.95	-0.52	-1.08	-1.55
D.Production	--	--	-13.32**	-10.00**	-9.56**	-9.49**	-10.22**	-7.08**
REX	-2.06	-1.78	-1.55	-1.78	-1.50	-2.24	-1.92	-2.26
D.REX	-13.00**	-8.60**	-8.93***	-9.81**	-7.92**	-12.04**	-10.37**	-9.41**
Capital Flow	-5.00 ***	-3.44*	-4.38***	-3.69*	-4.57***	-4.08***	-6.41***	-2.33
D.CapFlow	--	--	--	--	---	--	--	-7.38***
Current Acct	-5.69**	-3.33*	-4.11**	-2.38	-2.43	-2.48	-1.77	-2.14
D.CA	--	--	--	-8.01**	-12.62**	-9.25**	-12.45**	-10.28**

US RMMKT -2.01
D.US RMMKT -8.73**

D.X stands for the first difference of the variable X.

TOT: Terms of trade, REX: Real exchange rate, CA: Current account

** stands for that the test statistics reject the hypothesis that there is a unit root in the time series at the interpolated Dickey-Fuller critical value at 1%.
* stands for that the test statistics reject the hypothesis that there is a unit root in the time series at the interpolated Dickey-Fuller critical value at 5%.