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# Explaining the Real Exchange Rate during Sudden Stops and Tranquil Periods

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**Abstract**

This paper untangles the causes behind real exchange rate devaluation events, with particular attention paid to the Sudden Stop of capital flows in the 1980s and 90s. Utilizing the cumulative impulse response function and variance decomposition analysis, we argue that there is an asymmetric response across Sudden Stop and tranquil periods. Further comparison across the Sudden Stop in the 80s (″debt crisis″) and that in the 90s (″Sudden Stop crisis″), however, reveals that the Sudden Stop disturbance is more prominent in explaining the real exchange rate disturbance in the Sudden Stop crisis of the 1990s than the debt crisis of the 1980s.

**Keywords:** Real Exchange rate, Capital flows, Sudden Stop, Asia, Latin America
**JEL classification:** F31, F32, F41

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## 1 Introduction

The violent Sudden Stop of capital inflows during the Asian crisis and the macroeconomic turmoil following the event strongly suggest that these phenomena cannot be explained simply in terms of conventional factors. Events such as these once again have brought our attention to the determination of the real exchange rate and of the current account, particularly on a short horizon, which has been, and remains, a perennial topic of research in empirical open-economy macroeconomics.

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. Figure 1 demonstrates this graphically. In the case of the Asian financial crisis, the contagious withdrawal of liquidity from the region was followed by real depreciations of more than 30% in the affected countries. However, events such as these—the sudden drying up of liquidity and real depreciation—are not new. It is well documented that many Latin American economies and some economies in other regions in the 1980s suffered from debt crises characterized by the loss of access to international capital markets and the depreciation of domestic currencies.

One way to understand the sharp devaluations associated with the Sudden Stop of capital inflows is by looking at risk premium movements. Caballero and Krishnamurthy (2001)[1] argue that to the extent that the reversals of capital flows require additional risk premium, the country becomes more credit-constrained. Under this circumstance, agents are forced to sell more domestic assets, leading to a lower demand and to fire sales of domestic assets, which consequently lead to lower prices for domestic assets. This chain reaction causes the real exchange rate to depreciate.[2] We can therefore expect that the effects on the real exchange rate are different between a Sudden Stop period and a tranquil period; one would lead to a larger depreciation in the real exchange rate than the other in the short run.

[1] Caballero and Krishnamurthy (2001) argue that the currency would depreciate more in countries with external liabilities.
[2] See Edison, Luangaram, and Miller (1998), and Calvo and Reinhart (2000).

In addition to the Sudden Stop factor, Corsetti et al. (1998) argue that the key to understanding the sharp devaluations of these currencies is the conduct of monetary policies before the crisis and after the first round of depreciations in the case of the Asian financial crisis. The first reaction by monetary authorities to speculative pressures in the foreign exchange market was to prevent a significant monetary contraction and a significant increase in domestic interest rates. A relatively loose monetary policy with the goal of preventing further financial problems for firms and banks was of course a very risky strategy. As it turned out, this eventually induced a continuous spiral of currency depreciations as the countries fell into credit crunches.

The Sudden Stops of the 1980s, on the other hand, are given slightly different explanations. The arguments tend to focus on prolonged debt and domestic demand management as well as external factors, i.e., declines in commodity prices and the world interest rate. Edwards (1989) argues that the adjustment package of 1982-1987 was impressive in some areas such as turnarounds of the current account. He says, however, that the costs arising from demand management were also high. Not only did real income decline but real wages also declined in most of the affected countries. Unemployment also soared, which subsequently contributed to further real devaluations of currencies. Oil prices and the world money market rate were also variables of interest in many countries, particularly from the late 1970s to the early 1980s. In Brazil, the increase in the oil bill in 1978-1979 was automatically financed through the budget and current account by borrowing in the world capital market. The increase in world interest rates in 1979-1981 added to the interest bill. These two factors contributed to an increase in the external debt burden of many countries, which eventually led to debt defaults. [3]

Keeping this background in mind, this paper attempts to assess the importance of the exogenous and temporary nature of capital flow movements, namely the impact of a "Sudden Stop" shock on the real exchange rate. In other words, this paper asks if unexpected capital flow movements—such as those triggered by contagious withdrawal of cross-border bank lending—significantly explain the movements

[3] Some countries suffered from deterioration of terms of trade. Being a net exporter of commodities, Brazil was hurt by a decline in real commodity prices, for example.

of real exchange rates. Based on the existing discussions of factors affecting real exchange rates, we interpret fluctuations in the real exchange rate as the result of six types of shocks. They are the external and internal disturbances that arise from (1) the world interest rate, (2) terms of trade, (3) monetary policy, (4) productivity, (5) demand, and (6) the current account.[4] We define the "Sudden Stop shock" as an exogenous temporary shock arising from the current account such as those being associated with market sentiments. We pay particular attention to the dynamic response of the real exchange rate to a Sudden Stop shock to examine whether the responses are different between a Sudden Stop and other, tranquil periods as Calvo (1998) and others suggest.

Our sample includes eight emerging markets from Latin America and Asia: Argentina, Brazil, Chile, Mexico, Indonesia, Korea, the Philippines, and Thailand.[5] Data analysis reveals that these eight countries suffered from a large real depreciation both in the 1980s and 1990s. By utilizing impulse response function and variance decomposition analysis, our results suggest the following. For the comparison across Sudden Stop and tranquil periods, the cumulative impulse response functions reveal that the most significant impact comes from Sudden Stop shocks during Sudden Stop periods—these account for nearly 40% of the real exchange rate variance, while accounting for only about 5% during tranquil periods. Another important factor is demand shock, which accounts for about 40% of the real exchange rate variance during Sudden Stop periods, doubling to around 80% during tranquil periods. This points to a strong impact by demand policy on real exchange rates.

The comparison across two major crises — the debt crisis (1980s) and the Sudden Stop during the Tequila and Asian flu crises (1990s) — allows us to examine different factors affecting the real exchange rate during the two crises. We find by looking at the variance decomposition that the Sudden Stop shock accounts for about 18% of the real exchange rate variance during the debt crisis, while its impact becomes

[4] Note that we do not account for factors such as international productivity difference, namely the Balassa-Samuelson effect, due to limited availability of quarterly sectoral data. Menzie (1997), however, argues that the effect of such difference, if significant, is long-term in nature, and other factors, such as those we examine, can move the exchange rate in the short run. Since our primary purpose is to explain short-term deviations attributable to Sudden Stop disturbances, this missing factor should not significantly affect our interpretation of the findings.

significantly larger, 48% (at maximum), during the Sudden Stop crisis. The comparison across the two crises reveals that the terms of trade and the demand shocks explain more in the 1980s than in the 1990s. Meanwhile, demand shock accounts for more than 60% of the real exchange rate variance during the debt crisis period though it only explains around 30% of the variance during the Sudden Stop period.

Section 2 provides a brief literature review and empirical prediction. Section 3 describes our data set and empirical methodology. Section 4 reports the results of the VAR estimation. Section 5 concludes.

## 2 A Review of Sudden Stop Literature

"Large" and "unexpected" are the two defining characteristics of what the literature calls Sudden Stop (Calvo, 2000). The existent literature on Sudden Stops deals in great detail with the causes of the capital market crisis in general. However, time-series approaches evaluating the response of real exchange rates to Sudden Stops in particular have thus far been quite limited. This paper aims to shed some light in this direction by factoring in other aspects that are generally perceived to be important to real exchange rate movement. Our goal is to assess empirically the importance of the exogenous nature of capital flow movements, namely the "Sudden Stop" shock.

Theoretical literature on "Sudden Stop" shock, such as in Caballero and Krishnamurthy (2001)[6][7], is numerous. The focus is 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. However, despite the abundant theoretical literature, empirical literature evaluating the importance of a Sudden Stop shock on real exchange rates has been only partially explored.

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[5] 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.
[6] See Calvo (1998), Caballero and Krishnamurthy (2001), Mendoza (2001), among others.
[7] See Calvo and Reinhart (2000).

Calvo and Reinhart (2000) conduct a cross-country analysis of Sudden Stops. By documenting 15 recent episodes of large reversals in net private capital inflows, 12 of which took place in the 1990s,[8] they show that Sudden Stop crises produce larger adjustments in real exchange rates than those produced by previous BOP crises.[9] Furthermore, Calvo, Izquierdo, and Talvi (2002) point out that the key to understanding the impact of Sudden Stop shock is its unexpected component and its duration. Since the expectations prevailing before the Russian crisis had not factored into widespread effects in emerging countries, the unexpected element was met, resulting in a large real devaluation. Despite the descriptive nature of the analysis, the two studies above lead us to believe that Sudden Stop shock might have a greater significance in explaining real exchange rate movements in the 1990s, and also motivate us to investigate the events in detail.

Without paying particular attention to Sudden Stop events, there are studies examining the determination of the real exchange rate and of capital flows, as in Agénor and Hoffmaister (1998) and Lee and Chinn (1998). Our empirical approach is similar to that of Lee and Chinn, which perform a structural VAR analysis of the current account and real exchange rate utilizing Blanchard and Quah (1989) decomposition.[10] Though the analysis by Lee and Chinn does not particularly concern Sudden Stop events, it utilizes the decomposition method so as to minimize assumptions for identification. This strategy relies on long-run economic restrictions and allows us to avoid the contemporaneous ordering restrictions of standard VAR analysis. In other words, it allows us to investigate the short-run real exchange rate movements without imposing explicit restrictions while having a long-run structural framework.

## 3. Empirical Methodology

[8] The remaining three episodes are in Argentina, Chile, and Mexico during the period of debt crisis in the early 1980s.
[9] Hutchison and Noy (2002) conduct an analysis of Sudden Stops but only look at their impacts on output and not on real exchange rate.
[10] Their paper examines seven industrialized countries.

**a. Identification of the Shocks**

Our moving average model has the following form:

$$\begin{bmatrix} \Delta i_t^* \\ \Delta tot_t \\ \Delta m_t \\ \Delta y_t \\ \Delta q_t \\ \Delta ca_t \end{bmatrix} = A(L) \times \begin{bmatrix} u_t^{i*} \\ u_t^{tot} \\ u_t^{m} \\ u_t^{y} \\ u_t^{d} \\ u_t^{ca} \end{bmatrix} \qquad (1)$$

where the left-hand side of equation (1) contains the endogenous variables, and A(L) is a square matrix of lag polynominals. The typical element of $A_{ij}(L)$ denotes the response of the ith endogenous variable to the jth structural innovation lagged L periods. $i_t^*, tot_t, m_t, y_t\ q_t\ ca_t$ represent the world interest rate, the terms of trade, monetary policy, productivity, demand, and current account respectively. The structural innovations are assumed to be serially uncorrelated with mean zero, and are mutually orthogonal, that is $E[u_t u_t^{'}] = I$, where the vector $u_t = [\, u_t^{i*} \quad u_t^{tot} \quad u_t^{m} \quad u_t^{y} \quad u_t^{d} \quad u_t^{ca}\,]'$.

In this model, an increase in the world interest rate or marginal productivity of capital in the long run, as captured by $i_t^*$, leads to depreciation of real exchange rate. A conventional relationship suggests that a positive supply shock, $u_t^y$, due to technological progress in the tradable sector leads to real exchange rate appreciation. This is due to the fact that positive wealth effects of these 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.

An impact arising from a demand factor, $u_t^d$, can be interpreted as one that arises from government spending. Hoffmaister and Roldos argue that the fiscal expansion leads to a decline in the capital stock that has an effect on the real exchange rate but only negligible effect on the level of total GDP.[11] An increase in government spending leads to a real exchange rate appreciation since the

[11] Hoffmaister and Roldos (1997) also show that under general parameter assumptions, the response of the real exchange rate to the demand shock is more than twice that of GDP.

government spending is biased towards nontradable goods and 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. We pay particular attention to $u_{ca,t}$, which represents a current account shock—a negative shock is a Sudden Stop 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.

The estimation strategy used in this study to recover the structural innovations is an extension of Blanchard-Quah (1989). This strategy relies on long-run economic restrictions, and 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 identification of the matrix of contemporaneous effects of the structural innovations. We adopt this approach not only because we can avoid the ordering problem, but also because 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 estimation strategy, which we adopt in this paper, does not rely on a specific exchange rate model such as the purchasing power parity, sticky price monetary, productivity differential model (or Balassa-Samuelson effect), or uncovered interest rate parity. It is a composite model that incorporates a number of familiar relationships (see Cheung, Chinn, and Pascual, 2002)[12], such as small open economy assumptions and long-run neutrality of money.

The small open economy assumptions for the foreign interest rate and terms of trade imply to impose the coefficients in $A_{ij}(L)$ for i=1, 2 and j=3, 4, 5, 6 sum to zero. Thus, if $A_{ij}(1) = \sum_{k=0}^{\infty} a_{ij}(k)$, the

[12] Cheung, Chinn, and Pascual (2004) find that none of the models can be successfully used by looking at five mature markets' currencies. Thus, we believe that the composite model approach is more appropriate in our study to capture relatively new phenomena, such as the Sudden Stop shock.

restriction is $A_{ij}(1) = 0$ for i=1, 2 and j=3, 4, 5, 6. In other words, we impose the domestic developments to have no long-run impact on the two exogenous variables. For a nominal variable, $m_t$, following the common practice in the literature on the sources of business fluctuations, we assume long-run neutrality of money, that is $A_{ij}(1) = 0$ for i=4, 5, 6 and j=3. We further assume the demand shock can have long-run effects on the real exchange rate, but not on the output, i.e. $A_{45}(1) = 0$.

As for the current account and the real exchange rate, though the dual nature of their short-run response is well understood, empirical analyses have taken various approaches due to the uncertainty surrounding the precise structural mechanism generating the statistical relationship. Hoffmaister and Roldos (1997)'s empirical examination treat the two as alternative models, while Lee and Chinn introduce the trade balance as dependent on the real exchange rate and a productivity shock. Our treatment is similar to Lee and Chinn in that the temporary shock arising from the current account has no long-run impacts on real variables such as the real exchange rate and output, which allows us to examine the temporary nature of the current account shock. The zero restriction, thus, is imposed on $A_{56}(1)$. Meanwhile the long-run relationship of the two variables such as the one discussed in the classical transfer problem is taken care of by the terms of trade variable having a real impact in the long-run. These assumptions motivate the long-run identifying restrictions that, together with the usual assumption of orthogonality of structural innovations, identify the structural innovations, and help to interpret the empirical results.

In a matrix form, the restrictions are summarized as a following over-identified system, which includes two external shocks, three domestic shocks, and a Sudden Stop shocks:

$$A(1) = \begin{bmatrix} A_{11}(1) & 0 & 0 & 0 & 0 & 0 \\ 0 & A_{22}(1) & 0 & 0 & 0 & 0 \\ 0 & 0 & A_{33}(1) & 0 & 0 & 0 \\ A_{41}(1) & A_{42}(1) & 0 & A_{44}(1) & 0 & 0 \\ A_{51}(1) & A_{52}(1) & 0 & A_{54}(1) & A_{55}(1) & 0 \\ A_{61}(1) & A_{62}(1) & 0 & A_{64}(1) & A_{65}(1) & A_{66}(1) \end{bmatrix} \qquad (2)$$

### b. Defining the Sudden Stop Period

The Sudden Stop of capital inflows is defined as "unexpected severe stops in capital flows of a persistent nature" by Calvo et al. (2002). We interpret this as a period of loss of access to the international capital market. In other words, the Sudden Stop is a period of no capital inflows or a period of capital outflows. Figure 2 plots the development of capital flow[13] for eight countries. All of the countries in our sample experienced large reversals of capital flow in the 1980s and 1990s. The reversals have been particularly severe during the Asian crisis starting in 1997, and in Latin America during the debt crisis (early to mid-1980s) as well as the Mexican crisis (1994).[14] 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.

There are several ways of defining the Sudden Stop period. Calvo et. al. (2002), for example, look at Emerging Market Sovereign Bond Spread (EMBI). The EMBI captures uncertainty in international markets[15] and cost of sovereign bond issuance, which can be a proxy for a loss of access to the international capital market.[16,17] On the other hand, Milesi-Ferretti and Razin (1997) focus on current account imbalances net of official transfers. They set two requirements to be satisfied: (1) an 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 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

[13] Capital flow is defined as a net sum of net errors and omissions, capital accounts, and financial accounts.
[14] The period 1973-1981 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, 1982-1989.
[15] See also Global Financial Stability Report of the IMF (2003).
[16] To be more precise, development of new bond issuance is a better proxy for the accessibility of funds.
[17] We do not use this variable for two reasons. First, 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. Second, the EMBI is available only after 1995 from DataStream while our sample includes

capital account reversal. Calvo and Reinhart (2000) select events with reversals in net private capital flows of more than 4% of GDP.

The Sudden Stop crisis in the 1990s tends to be identified solely by looking at capital flows or current account movements lasting for a relatively short period of one to two years. In contrast, the events of the 1980s can be seen as a prolonged period of loss of access to the international capital market because of the long debt restructuring process. Table 2 compares several papers identifying the Sudden Stop crisis events in the 1980s and 1990s that we would like to examine. Although details differ, it seems that there are core years that are consistently identified as being Sudden Stop periods. We can also find in Table 2 that the debt crisis literature identifies the events as lasting for about five years, from 1982 to 1987, including the restructuring period. Meanwhile, Sudden Stop crisis literature only refers to the onset of events, which occurs in the period from 1981 to 1983. In order to reconcile these different definitions of events, we use two ways of defining a Sudden Stop episode: (1) a period defined by looking at capital flow movements, which we refer to as a "Sudden Stop period," and (2) the two crisis periods: the "Debt crisis in the 1980s" and the "Sudden Stop crisis in the 1990s," as defined based on the existing crisis literature.

For the period defined by capital flows, several criteria must be satisfied. Our dummy variable for Sudden Stop is set to 1 if (1) the change in net capital flow as a percentage of GDP is less than the sample mean, and this situation continues for the following two quarters, and (2) the change in net capital flow is larger than that of the sample's standard deviation, 1.6% (see Table 3).[18] The first definition ensures that the episode is a sustained duration of capital outflows, while the second definition ensures that one-time, sharp reversals are included as well. The defined Sudden Stop episodes are shown in Figure 1 along with real exchange rate development. They include the period of Mexican debt and the Tequila crisis (1982 and 1994), hyperinflation episodes in Argentina (1990) and Brazil (1990 and 1994), and the Asian Crisis

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the events of the 1980s. The variable, therefore, does not allow us to identify the Sudden Stop period consistently throughout our sample.

[18] 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 6.4% as an annualized rate.

(1997 and 1998)[19] among others—some with large real depreciation. This can be seen as a period without access to the international capital market—a Sudden Stop period.

We use these criteria to compare across Sudden Stop and tranquil periods. Table 1 shows that seven out of eight countries in our sample experienced their most severe depreciation events during periods that fit our definition of Sudden Stop periods, the lone exception being the Philippines. In the Philippines, the most severe depreciation falling within a Sudden Stop period took place during the debt crisis. The Philippines was one of the few countries in Asia that was affected severely by the debt crisis. During the Asian crisis the country was forced to depreciate its currency in 1997 Q3 by 23% after Thailand collapsed, and large capital flow reversal started only afterward, in 1999.

As for the period defined based on the existing crisis literature, we define the period between 1982 and 1987 as the debt crisis period. For the Sudden Stop crisis, we use 1994 and 1995 for Latin American countries and 1997 and 1998 for Asian countries. This exercise enables us to compare across the debt crisis and the Sudden Stop crisis to see if there is any difference in factors affecting the two episodes—in other words, to compare the capital market crises in the 1980s to those in the 1990s (see the shaded area of Figure 3 for the two periods).

### c. Data

The variables in the empirical analysis are quarterly data spanning from 1980 Q1 to 2000 Q4, where data is available.[20] Our sample includes eight emerging countries in Asia and Latin America: Argentina, Brazil, Chile, Mexico, Indonesia, Korea, the Philippines, and Thailand. To the extent that Sudden Stop events contain a large unexpected component associated with investor sentiment and the risk premium of the country, such events are more relevant to emerging markets. Therefore, we focus our attention on

[19] Note that there was an episode in Chile with current account reversals in the early 1980s. The current account deficit declined from 15% of GDP in 1981 to 5% of GDP in 1983; however, this event is not captured by our data since there are no quarterly current account data available covering this episode.
[20] Data starts in 1984 for Brazil, 1991 for Chile, and 1981 for the Philippines and Indonesia.

emerging markets[21]. The six variables of interest to us are the US interest rate[22], terms of trade, M2, industrial production (see Table 4 for statistics)[23], current account as a percentage of GDP[24], and real exchange rate.[25] We examine real exchange rate relative to the US dollar. Terms of trade, M2, production, and real exchange rate are presented in terms of natural logs.

Apart from the capital flow developments in Figure 2 that we have looked at, there are two external macroeconomic developments that warrant a closer look. The first is the US interest rate. Figure 3 plots the drastic change in US money market rates in the early 1980s. After the "Volcker Shock[26]," in which the US short-term rate shot up by 6.5%, US treasury bills again dropped below 12% 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 the 1990s except for the expansionary development in the early 1990s.

The second external factor is the decline in commodity prices. The widespread recession in industrial countries in 1981-1982 severely weakened the markets for exports of developing countries. Figure 4 plots terms of trade developments in the eight countries in our sample. The terms of trade deteriorated dramatically in most of these countries during the first half of the 1980s, except perhaps in Korea, which

[21] See also Arellano and Mendoza (2002) for why Sudden Stop phenomena are unique to emerging markets.
[22] As a robustness test, we examine another definition of the world interest rate created by taking the average of the US, Japan, and German interest rates. The impulse response is not significantly different from the regional foreign interest rate that we present in this paper. The explanatory power of the regional foreign rate, however, is slightly (about 5%) higher.
[23] Annual GDP data is interpolated to create quarterly GDP for Thailand from 1980 to 1992, years for which quarterly industrial production data is not available.
[24] A negative current account represents a Sudden Stop of capital inflows. We also estimate the VAR system using capital flows instead, with a result consistent with the estimation using the current account. This may be due to the facts that changes in reserves have significantly less explanatory power and that current account movements mostly mirror those of capital flows.
[25] Despite the fact that Asian economies have become increasingly connected to Japan during the 1990s, particularly in regard to financial flows, the four countries obviously tried to maintain currency stability in relation to the US dollar. Thus, we believe real exchange rates relative to the US dollar to be the most appropriate rates to use. Nonetheless, when we look at the exchange rate with the Japanese yen, we notice some deviations as compared to real exchange rate variations for the US dollar during the first half of 1995, when Asian currencies depreciated in real terms due to nominal appreciation of the yen. Otherwise, there are no significant deviations between the two exchange rate variations in our sample.
[26] Named for the US Federal Reserve chairman who set out to reverse the inflationary excesses of the preceding years following his appointment in 1979.

did not experience a decline in the terms of trade during the debt crisis. However, Korea's terms of trade deteriorated sharply preceding the Asian financial crisis.

To prepare for our estimation, we first transferred the variables to a zero mean one standard deviation series to correct for scale effects, i.e., to prevent any one country from dominating the estimation results. We then performed 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 stationary form. Appendix 2 shows the test results for all the series and countries. The Dickey-Fuller tests failed to reject the unit root hypothesis for most of the variables except for the current account series. As suggested by Enders (1995), we took the first difference of those series to make them stationary.

Second, we performed a lag-length test. The Akaike Information Criterion (AIC) and Schwartz Bayesian criterion (SBC) were calculated to find a reasonable approximation of the infinite-order VAR. The results suggested including 2 lags by AIC and including 1 lag by SBC. We used 1 lag for each estimation, and, given the limited number of observations, did not use the long lags suggested by AIC, as AIC is biased toward selecting an over parameterized model. [27]

## 4. Estimation Results

This section presents the main empirical evidence from 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, the negative and positive net capital flow shock in particular. The results are summarized using variance decompositions and impulse response functions. The estimation result from the pooled sample refers to a typical economy as described by the pooled time series data in the previous section.

[27] See Enders (1995) for details.

### a. "Sudden Stop" and tranquil periods

Figure 5 and Table 5 present the estimation results comparing Sudden Stop and tranquil periods. The impulse response functions and variance decompositions are reported. The cumulative impulse response functions of the real exchange rate to different shocks are presented in such a way that an increase (decrease) represents real appreciation (depreciation). By looking at the impulse response functions, we can see that the most significant impact comes from the Sudden Stop, or current account shock, during the Sudden Stop period, accounting for nearly 40% of the real exchange rate variance. On the other hand, the explanatory power is only around 5% during the tranquil period. The impulse response functions show significant difference across two periods during the first two quarters. The real exchange rate depreciates sharply in response to capital outflows during the Sudden Stop, while real exchange rate fluctuation is minimal during the tranquil period. By the fourth quarter, the real exchange rate returns to zero, suggesting that the impact is rather temporary.[28] This result validates our earlier argument that this unexpected Sudden Stop shock could lead to asymmetric responses of real exchange rates in the short run, as discussed in Calvo et. al. (2002).[29]

We now turn to look at other factors affecting the real exchange rate. During a Sudden Stop period, a positive disturbance in the terms of trade leads to real exchange rate appreciation. However, this impact is only short-term, lasting about two quarters, while it has long-term impact during a tranquil period.

[28] Despite the temporary impulse response to the Sudden Stop shock, the variance decomposition suggests a persistent contribution of the shock until the 12th horizon (3 years). Blanchard and Quah (1989) report similar results in their paper: a demand shock affects output only temporarily in the impulse response while contributing about 50% in the variance decomposition at the 40th quarter horizon. Among the several reasons they give, one possible explanation for this to happen in our case is that the identifying restrictions only impose that (in our case) the contributions of foreign rate, terms of trade, demand, and Sudden Stop disturbances to the real exchange rate sum to unity as the horizon increases (in the long run). Other aspects, such as short-run behaviors from disturbances with temporary effects, are unconstrained. Therefore, the results, i.e., a large contribution from the Sudden Stop shock in the 12th quarter (short run), do not contradict our identifying scheme. See further discussion in Blanchard and Quah (1989) for a limit to the decomposition technique when multiple permanent and temporary disturbances exist, for example.

[29] Forbes and Rigobon (2002) argue, by examining stock market co-movements, that an increase in correlations is due to an increase in market volatilities, which biases the correlations upward. In other words, a caveat that we should keep in mind is that the difference between the Sudden Stop and tranquil periods that we find may have this bias as well. Correction for the "Rigobon effect" is worth considering in future research.

Terms of trade shock accounts to some extent for the variance of the real exchange rate, but the difference is moderate, about 7% higher during a Sudden Stop period than during a tranquil period (4%).

A positive shock in monetary policy (expansionary) has a negative impact leading to real depreciation in the short run in both periods. This result validates our analytical framework that nominal shocks have only short-run impacts. The monetary policy disturbance accounts for around 8% to 10% of the real exchange rate variance, explaining slightly more during a Sudden Stop 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.

Despite dramatic development of external factors (world interest rate and terms of trade, in particular) in the 1980s, we find that their explanatory powers are rather small. Hausman and Gavin (1995) also find only a small correlation between external shocks and real exchange rate volatility for Latin America. In contrast, Calvo, Leiderman, and Reinhart (1994) find a large impact by external factors on the real exchange rate when looking at 18 countries in Latin America and Asia. Dornbusch (1989), looking at periods of debt crisis, argues that the impact of the world interest rate significantly differs across countries. For debtor countries such as our sample countries, the magnitude of the impact largely depends on their share of floating rate debt. While countries such as Mexico and Brazil borrowed at interest rates linked to market rates, other poorer countries borrowed at concessional rates, which would not directly be affected by world interest rate movements.[30] This contrasting result may also be due to the sample period used, the frequency of the data[31], and the fact that domestic policy and supply shocks are not explicitly accounted for.

[30] In order to test for the robustness of the results, we examined taking into account the regional difference using the Japanese money market rate for Asian countries. Nonetheless, the result remained the same.
[31] External factors tend to explain more with higher frequency data (monthly or higher), while our data is of a quarterly frequency.

Finally, we look at the demand shock, which, in fact, explains a significant portion of the real exchange rate variance. The demand shock accounts for about 40% of the real exchange rate variance during a Sudden Stop period, while the explanatory power doubles to around 80% during a tranquil period. This suggests that demand disturbance is the main factor driving real exchange rate development in general, and it is particularly significant during tranquil periods.[32] Hoffmaister and Roldós (1997) also find the real exchange rate to be mostly determined by demand shock—more than 90% in most cases—particularly in Latin America, and explain that the demand factor is driven by fiscal policy. They argue that a positive shock in fiscal policy would lead to real appreciation since fiscal policy mostly impacts the non-tradable sector, leading to real appreciation. While this argument appears to be valid in general and particularly during tranquil periods, demand disturbance during crisis periods requires more attention, as demand management is usually a result of complex policy choices. As such, we will discuss the different factors affecting demand disturbance when examining crisis periods in the next section.

### b. Debt crisis and Sudden Stop crisis during the Tequila and Asian flu periods

We will now compare across Sudden Stop crises in the 1980s (debt crisis) and 1990s (Sudden Stop crisis) to examine if there are differences in factors explaining the real exchange rate during these two crises events that we can identify.[33] Figure 6 and Table 6 report the estimation results comparing the debt crisis and the Sudden Stop crisis. The cumulative impulse response functions and the variance decomposition analysis are presented.

When examining the Sudden Stop shocks, the cumulative impulse response functions reveal similarities across the two crisis periods. A positive Sudden Stop shock leads to real appreciation for two to three quarters both during the debt crisis and Sudden Stop crisis periods. The response is largest in magnitude in the first quarter, and then decreases overtime. However, the variance decomposition reveals

[32] Our result is consistent with what Hoffmaister and Roldós (1997) find. Their VAR analysis concludes that the real exchange rate is mainly driven by its own past history, with that factor having an explanatory power greater than 90%.

a distinct explanatory power of the shock across the two crises. The Sudden Stop shock accounted for about 18% of the real exchange rate variance during the debt crisis. On the other hand, the impact becomes significantly larger, explaining up to 48% (peaking in the second quarter) during the Sudden Stop crisis. This result suggests that the capital flow shock—a shock caused by unexpected market sentiment—was more significant during the 1990s crisis than during the 1980s crisis. This result is consistent with the financial liberalization literature arguing that the globalization of financial flows in the 1990s brought instability to emerging markets. The surge in hot money resulted in contagious withdrawal of financial flows during the Tequila and Asian financial crises, and had a detrimental effect on real exchange rate crises in some countries. [34]

We now turn to look at terms of trade shocks. As we examined in the previous section, the terms of trade deteriorated sharply during the early 1980s in most of our sample countries. Therefore, we would like to examine if this terms of trade disturbance played a significant role in real exchange rate variation during the debt crisis period. The cumulative impulse response functions show that the disturbance has long-run impacts on real exchange rates during the debt crisis, while it is not significantly different from zero during the Sudden Stop crisis. The variance decomposition analysis reveals that about 6% of the real exchange rate variance is due to the terms of trade disturbance during the debt crisis, while it is only about 3% during the Sudden Stop crisis period. Despite its small explanatory power, this result is consistent with our data analysis early on. [35]

As for the domestic shocks, the cumulative impulse response functions reveal that the monetary policy and supply shocks seem to affect the real exchange rate only in the short run during the Sudden Stop crisis, accounting for about 10% and 8% of the variance respectively. A positive (or expansionary)

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[33] We have also estimated using the two sub-samples of the Sudden Stop periods in the 1980s and 1990s. The estimation, unfortunately, is not feasible due to the small sample size.
[34] See Calvo (1998), for example.
[35] The terms of trade deterioration severely affected all of the sample countries except for Korea during the debt crisis, while there was no major development during the Sudden Stop crisis period (see Figure 4). The terms of trade shock during the debt crisis was mainly driven by a collapses in both oil and commodity prices. Countries such as Mexico and Indonesia were the hardest-hit since they export both oil and commodities, leading to real exchange

monetary disturbance leads to real depreciation for about two quarters, and then goes back to zero response. And a positive supply shock leads to real appreciation in the second quarter, and then goes back to zero response. While the short-run impact of monetary policy is consistent with our analytical framework, the short-run impact of supply shocks is surprising. This may reflect the fact that the real sector faces severe financial constraint during the Sudden Stop crisis, but of a temporary nature. This type of shock arising from the supply side would also have temporary effects on the real exchange rate (see Izquierdo, 1998, for example). The two domestic factors, monetary and supply disturbances, on the other hand, had much smaller impacts on the real exchange rate during the debt crisis period. This result demonstrates the fact that the major factors at work during the debt crisis were of an external and demand nature.

Finally, the demand factor is found to account for a major portion of the real exchange rate variance. The shock accounts for more than 60% of the real exchange rate variance during the debt crisis period, while its explanatory power halves to around 30% for the Sudden Stop crisis period. This result may be due to the fact that demand management was the key issue explaining the real exchange rate during the debt crisis. Because of the prolonged period of the crisis, various external, domestic, and political factors affected the countries' demand management. Latin American countries in particular experienced a collapse in demand as a result of difficult policy choices for coping with the crisis. The next section discusses some of the factors that affected demand development during the period.

### c. Determinants of the Demand Disturbance

Given the importance of the demand shock explaining the disturbance of the real exchange rate, it is crucial to understand the factors driving it.[36] Using available data for the Asian and Latin American

depreciation at the same time. Korea, on the other hand, suffered very little, since the country was a net importer of commodities.

[36] See Kamin and Bobson's (1999) explanation of the devaluation crisis in Latin America. They argue that the macroeconomic volatility was mainly due to domestic policy and economic imbalances, with exogenous external factors playing only a secondary role.

countries included in this study, we examined the factors essential to demand. The adjustment period during the debt crisis in particular interests us due to its large explanatory power, greater than 60%.

During the debt crisis, most countries needed to reverse the direction of net transfers by combining expenditure-switching policies, including devaluation, imposition of capital controls, and import quotas during the crisis (see Edwards, 1989). The adjustment required a significant increase in real interest rates as well as major relative price changes or real devaluation. As expenditure-reducing policies center on two major areas—the reduction of public investment and government employees' wages—we examined how public spending developed during the crisis. [37]

First, we examine the development of government spending as a percentage of GDP during the crisis periods to assess the impact of the fiscal factor in line with Hoffmaister and Roldós (1997). Table 7 presents the annual growth rate of government spending and the real exchange rate. Although data at a quarterly frequency are available for only three countries for the period of the debt crisis, we can see that government spending registered negative growth rates during the crisis. The fiscal tightening was particularly severe in the early years, reaching -26% in the Philippines (1984) and -23% in Mexico (1983). [38] Concurrently, real exchange rates depreciated sharply, by 22% and 36%, respectively. This declining government expenditure was largely due to restrictions on aggregate demand implemented immediately after the crisis.

A similar trend can be found by looking at gross investment as a percentage of GDP. Table 8 contains data on investment ratios for the sample countries. Investment declined throughout the crisis

[37] The government employees' wages cannot be assessed because of limited data availability.

[38] Annual data for the growth rate of government spending as a percentage of GDP is presented below for all sample countries except Argentina. The figures reveal that government spending experienced sharp declines in most sample countries during the debt crisis.

| | Brazil | Chile | Indonesia | Korea | Philippines | Thailand | Mexico |
|---|---|---|---|---|---|---|---|
| 1982 | 8% | 15% | 4% | -1% | 4% | 3% | -2% |
| 1983 | -2% | -8% | -11% | -7% | -10% | -2% | -18% |
| 1984 | -14% | 2% | -3% | -8% | -16% | 2% | 5% |
| 1985 | 12% | -8% | 10% | 2% | 8% | 3% | 0% |
| 1986 | 8% | -6% | -2% | -1% | 4% | -6% | -1% |
| 1987 | 13% | -15% | -15% | -3% | 5% | -12% | -4% |

until 1987, when investment growth finally turned positive. Mexico and the Philippines were particularly hard-hit, with investment declining by almost 30%. Public and construction investments were the components most severely curtailed. In the case of public investment, this was again the result of restrictive aggregate demand policies implemented immediately after the start of the crisis. Naturally, this decline in investment had serious consequences for the prospects of renewed growth, and hence the real exchange rate.

Meanwhile, the demand shock explains the relatively small portion of real exchange rate variance during the Sudden Stop crisis despite countries such as Argentina, Mexico, and Indonesia experiencing sharp declines in government spending. Though Table 8 shows that investment declined during the Sudden Stop crisis, the decline was seen as having been caused by the liquidity constraint arising from the Sudden Stop shock. The distinction between the two periods can be found at the level of real interest rates. While experiencing fiscal tightening, in contrast to the 1980s real interest rates were kept relatively low in the 1990s crisis. This policy aimed to aid the already weak financial sector (see Corsetti, Pesenti, and Roubini 1998). Despite low real interest rates and a relatively sound fiscal balance in the 1990s, economic activity was severely affected by a lack of liquidity caused by the Sudden Stop of capital inflows. While demand management was also a major factor in real exchange rate movements during the 1990s crisis, its relative importance was apparently much smaller than in the debt crisis. [39]

## 5. Conclusion

One contribution of this paper is to adopt the Blanchard-Quah decomposition assuming that the real exchange rate is nonstationary, and that a Sudden Stop shock has no long-run effect upon it. This is a powerful identifying assumption for examining the determination of the real exchange rate and of the

[39] One could argue that this demand component might include other impacts such as those arising from different degrees of exchange rate pass-through over time. Factors such as a shift in trade policies, cost of price adjustment, oligopolistic price-setting, and a change in composition of a country's import bundle (see Campa and Golberg, 2002) have been discussed as significant elements affecting the pass-through coefficients. However, there appears

current account at a short horizon, where empirical analysis is often hampered by their well-understood dual nature.

By utilizing the identifying assumptions above, this paper untangles the causes behind the severe real exchange rate depreciation events, with particular attention paid to the Sudden Stop of capital flows. We have examined whether the Sudden Stop of capital inflows led to asymmetric behavior in real exchange rate movements as suggested by Calvo (1999), among others.

By utilizing cumulative impulse response functions and variance decomposition analysis, we have argued that there is an asymmetric response across Sudden Stop and tranquil periods. This appears to be true when we compare across Sudden Stop and tranquil periods. Further comparison across the debt crisis of the 1980s and the Sudden Stop crisis of the 1990s, however, reveals that the Sudden Stop disturbance has become more prominent in explaining real exchange rate disturbances in the Sudden Stop crisis of the 1990s than in the debt crisis of the 1980s.

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to be no compelling evidence supporting why those coefficients might be different across Sudden Stops and tranquil periods.

**Appendix 1: Data Sources**

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

b) Terms of trade: "International Financial Statistics" (lines 74 and 75) and various sources.[40] The missing terms of trade were calculated using the countries' main export's price divided by the OECD's import price index.

c) M2: "International Financial Statistics" (lines 34 and 35)

d) Industrial production index is taken from "International Financial Statistics" (line 66) except for the 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 accounts is taken from "International Financial Statistics." We look at the aggregate capital flow, which consists of net errors and omissions, capital accounts, and financial accounts. 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.

g) Government spending is taken from "International Financial Statistics" (line 80), and divided by GDP (line 99b).

h) Gross capital formation is taken from "International Financial Statistics" (line 93), and divided by GDP (line 99b).

**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** |

Note: US RMMKT: -2.01 and 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

*** indicates 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%.

** indicates 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%.

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

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**Table 1: Real Exchange Rate Depreciation during Sudden Stop Period and Entire Sample**

| | Sudden Stop period 1/ | | | During 1980-2000 (Entire Sample) | | | |
|---|---|---|---|---|---|---|---|
| | Average Depreciation/Appreciation | Maximum depreciation rate | Year of most severe depreciation | Average Depreciation/Appreciation | Standard Deviation | Maximum depreciation | Year of most severe depreciation if not SS period |
| **Argentina** | -2.9% | -161.2% | 1989 q2 | 0.2% | 26.5% | -161.2% | -- |
| **Brazil** | 0.1% | -34.6% | 1990 q4 | 0.1% | 12.4% | -34.6% | -- |
| **Chile** | 0.3% | -7.5% | 1999 q2 | 0.8% | 3.3% | -7.5% | -- |
| **Mexico** | -0.3% | -47.1% | 1982 q4 | 0.4% | 11.0% | -47.1% | -- |
| **Indonesia** | -1.8% | -41.3% | 1998 q2 | -1.2% | 12.4% | -41.3% | -- |
| **Korea** | 0.4% | -60.4% | 1997 q4 | -0.2% | 8.1% | -60.4% | -- |
| **Philippines** | -2.1% | -18.9% | 1984 q2 | -0.3% | 6.6% | -23.2% | 1997 q3 |
| **Thailand** | -1.4% | -32.0% | 1997 q3 | -0.3% | 6.2% | -32.0% | -- |

1/ As defined in the paper.

**Table 2: Defined Sudden Stop Period and Crisis Period**

| | Argentina | Brazil | Chile | Mexico | Indonesia | Korea | Philippines | Thailand |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| ***Sudden Stop Literature*** | | | | | | | | |
| **Calvo and Reinhart (2000)** | 1982-83<br>1994-95 | none | 1990-91 | 1981-83<br>1993-95 | 1996-97 | 1996-97 | 1996-97 | 1996-97 |
| **Hutchison and Noy (2002)** | 1989 | 1987 | none | 1982, 1994 | 1983, 1986 | none | 1983, 1986 | 1981, 1997 |
| | | | | | | | | |
| ***Crisis Literature*** | | | | | | | | |
| **Caprio (2003)** | 1980-82<br>1989-90<br>1995 | 1990<br>1994-1999 | (1981-86)* | 1981-91<br>1994-1997 | 1997-present | | 1981-87<br>1998-present | 1983-87<br>1997-present |
| **"Silent Revolution, IMF 1979-1989" (2001)** | 1982-86 | 1982-86 | (1983-86)* | 1982-86 | | | 1983-84 | |

* Out of sample period.

**Table 3: Capital Flow as % of GDP**

**A. Capital Flow as % of GDP**

| | Number of Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| 8 countries | 613 | 0.51 | 1.59 | -13.80 | 4.95 |
| Argentina | 84 | 0.22 | 1.85 | -13.80 | 4.08 |
| Brazil | 84 | 0.17 | 0.94 | -2.01 | 2.80 |
| Chile | 37 | 1.26 | 1.23 | -1.64 | 3.92 |
| Mexico | 82 | 0.47 | 1.31 | -5.10 | 2.12 |
| Indonesia | 77 | 0.50 | 1.25 | -5.57 | 2.34 |
| Korea | 82 | 0.21 | 1.50 | -9.50 | 3.20 |
| Philippines | 83 | 0.75 | 1.56 | -4.42 | 4.14 |
| Thailand | 84 | 0.88 | 2.30 | -8.59 | 4.95 |

**B. Change in Capital Flow (As % of GDP, quarter on quarter)**

| | Number of Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| 8 countries | 611 | -0.02 | 1.56 | -14.33 | 12.43 |
| Argentina | 84 | -0.01 | 2.38 | -14.33 | 12.43 |
| Brazil | 84 | 0.00 | 0.87 | -3.21 | 2.75 |
| Chile | 36 | -0.05 | 1.62 | -4.57 | 2.99 |
| Mexico | 82 | -0.01 | 1.12 | -4.40 | 3.50 |
| Indonesia | 76 | 0.00 | 1.30 | -5.62 | 5.82 |
| Korea | 82 | -0.01 | 1.72 | -9.40 | 7.76 |
| Philippines | 83 | -0.08 | 1.63 | -4.46 | 4.25 |
| Thailand | 84 | -0.04 | 1.45 | -4.45 | 3.79 |

**Table 4: Data Summary**

| | Number of Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| US Money Market Rate | 672 | 7.49 | 3.39 | 2.99 | 17.78 |
| Terms of Trade | 655 | 1.12 | 0.40 | 0.40 | 2.47 |
| Annual Production Growth Rate | 653 | 5% | 9% | -27% | 51% |
| Annual M2 Growth Rate | 616 | -35% | 68% | -479% | 59% |

**Table 5: Decomposition of Variance for Real Exchange Rate: Sudden Stop Period vs Tranquil Period**

**A. No Access to Capital Market Time**

| Step | Foreign Rate | Terms of Trade | Monetary Policy | Supply | Demand | Sudden Stop |
|---|---|---|---|---|---|---|
| 1 | 1.11 | 7.09 | 9.04 | 1.01 | 47.36 | 34.41 |
| 2 | 1.03 | 6.40 | 10.36 | 0.92 | 42.36 | 38.94 |
| 3 | 1.07 | 6.32 | 10.46 | 0.98 | 41.51 | 39.67 |
| 4 | 1.09 | 6.31 | 10.51 | 1.00 | 41.22 | 39.88 |
| 5 | 1.09 | 6.32 | 10.53 | 1.00 | 41.14 | 39.92 |
| 6 | 1.09 | 6.32 | 10.54 | 1.00 | 41.12 | 39.93 |
| 7 | 1.09 | 6.32 | 10.54 | 1.00 | 41.11 | 39.94 |
| 8 | 1.09 | 6.32 | 10.54 | 1.00 | 41.11 | 39.93 |
| 9 | 1.09 | 6.32 | 10.54 | 1.00 | 41.11 | 39.93 |
| 10 | 1.09 | 6.32 | 10.54 | 1.00 | 41.11 | 39.93 |
| 11 | 1.09 | 6.32 | 10.55 | 1.00 | 41.11 | 39.93 |
| 12 | 1.09 | 6.32 | 10.55 | 1.00 | 41.11 | 39.93 |

**B. Tranquil period**

| Step | Foreign Rate | Terms of Trade | Monetary Policy | Supply | Demand | Sudden Stop |
|---|---|---|---|---|---|---|
| 1 | 0.05 | 3.91 | 7.74 | 1.13 | 81.96 | 5.21 |
| 2 | 0.14 | 4.62 | 8.41 | 2.96 | 78.87 | 5.00 |
| 3 | 0.22 | 4.58 | 8.35 | 3.11 | 78.45 | 5.29 |
| 4 | 0.23 | 4.58 | 8.38 | 3.12 | 78.31 | 5.37 |
| 5 | 0.24 | 4.57 | 8.40 | 3.12 | 78.24 | 5.43 |
| 6 | 0.25 | 4.57 | 8.42 | 3.12 | 78.19 | 5.46 |
| 7 | 0.25 | 4.57 | 8.43 | 3.12 | 78.17 | 5.47 |
| 8 | 0.25 | 4.57 | 8.44 | 3.12 | 78.15 | 5.48 |
| 9 | 0.25 | 4.57 | 8.44 | 3.12 | 78.14 | 5.48 |
| 10 | 0.25 | 4.57 | 8.44 | 3.11 | 78.14 | 5.49 |
| 11 | 0.25 | 4.57 | 8.45 | 3.11 | 78.14 | 5.49 |
| 12 | 0.25 | 4.57 | 8.45 | 3.11 | 78.13 | 5.49 |

**Table 6: Decomposition of Variance for Real Exchange Rate: Debt Crisis Period vs. Sudden Stop Crisis Period**

**A. Debt Crisis Period**

| Step | Foreign Rate | Terms of Trade | Monetary Policy | Supply | Demand | Sudden Stop |
|---|---|---|---|---|---|---|
| 1 | 1.82 | 6.31 | 6.46 | 0.03 | 67.08 | 18.31 |
| 2 | 5.49 | 6.12 | 5.82 | 3.12 | 62.23 | 17.22 |
| 3 | 5.42 | 6.21 | 5.73 | 3.11 | 61.86 | 17.66 |
| 4 | 5.49 | 6.18 | 5.71 | 3.10 | 61.63 | 17.89 |
| 5 | 5.52 | 6.17 | 5.70 | 3.10 | 61.51 | 18.01 |
| 6 | 5.54 | 6.16 | 5.71 | 3.09 | 61.43 | 18.07 |
| 7 | 5.55 | 6.17 | 5.73 | 3.09 | 61.36 | 18.10 |
| 8 | 5.56 | 6.17 | 5.76 | 3.08 | 61.31 | 18.11 |
| 9 | 5.56 | 6.18 | 5.79 | 3.08 | 61.28 | 18.12 |
| 10 | 5.56 | 6.18 | 5.82 | 3.08 | 61.25 | 18.11 |
| 11 | 5.56 | 6.18 | 5.84 | 3.08 | 61.23 | 18.11 |
| 12 | 5.56 | 6.19 | 5.85 | 3.08 | 61.22 | 18.11 |

**B. Sudden Stop Period**

| Step | Foreign Rate | Terms of Trade | Monetary Policy | Supply | Demand | Sudden Stop |
|---|---|---|---|---|---|---|
| 1 | 0.77 | 3.60 | 12.52 | 1.53 | 39.67 | 41.91 |
| 2 | 1.12 | 3.12 | 9.54 | 7.99 | 30.12 | 48.11 |
| 3 | 2.72 | 3.41 | 10.07 | 7.99 | 29.04 | 46.76 |
| 4 | 3.60 | 3.40 | 10.11 | 8.14 | 28.58 | 46.18 |
| 5 | 3.98 | 3.39 | 10.15 | 8.18 | 28.38 | 45.92 |
| 6 | 4.15 | 3.39 | 10.17 | 8.20 | 28.30 | 45.80 |
| 7 | 4.22 | 3.38 | 10.18 | 8.20 | 28.27 | 45.75 |
| 8 | 4.25 | 3.38 | 10.18 | 8.20 | 28.25 | 45.73 |
| 9 | 4.26 | 3.38 | 10.19 | 8.20 | 28.25 | 45.72 |
| 10 | 4.27 | 3.38 | 10.19 | 8.20 | 28.24 | 45.72 |
| 11 | 4.27 | 3.38 | 10.19 | 8.20 | 28.24 | 45.72 |
| 12 | 4.27 | 3.38 | 10.19 | 8.20 | 28.24 | 45.72 |

**Table 7: Growth Rate of Government Spending as % of GDP**

| Debt Crisis Period | | | | |
|---|---|---|---|---|
| Country | Crisis Period Average | Most Severe Decline | Year | Real Exchange Depreciation |
| Korea | -3% | -13% | 1984 q4 | -5% |
| Mexico | -4% | -23% | 1983 q3 | -30% |
| Philippines | 0% | -26% | 1984 q2 and q3 | -36% |

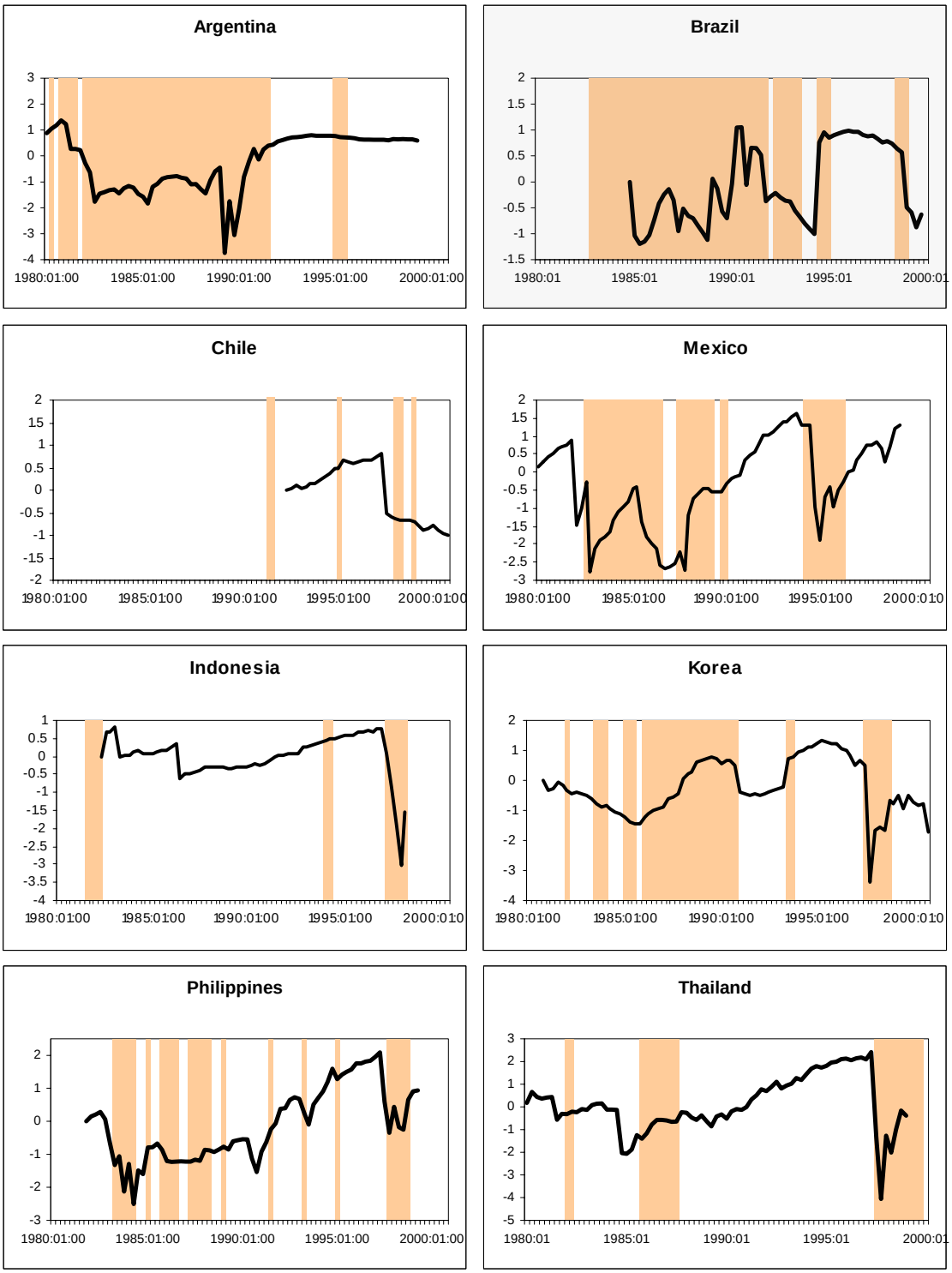
| Sudden Stop crisis period | | | | |
|---|---|---|---|---|
| Country | Crisis Period Average | Most Severe Decline | Year | Real Exchange Depreciation |
| Argentina | -1% | -8% | 1995 q1 | 2% |
| Brazil | 6% | -8% | 1995 q1 | 60% |
| Mexico | -3% | -20% | 1995 q2 | -36% |
| Indonesia | -16% | -32% | 1998 q1 | -101% |
| Korea | 4% | -3% | 1997 q4 | -67% |
| Philippines | 5% | -1% | 1998 q1 | -22% |
| Thailand | 4% | -8% | 1997 q4 | -56% |

**Table 8: Growth Rate of Investment as % of GDP**

| Crisis | Year | Argentina | Brazil | Chile | Mexico | Indonesia | Korea | Philippines | Thailand |
|---|---|---|---|---|---|---|---|---|---|
| Debt Crisis | 1982 | -4% | -6% | -24% | -14% | 4% | 1% | -1% | -4% |
| | 1983 | -4% | -16% | -20% | -27% | -1% | 4% | 8% | 5% |
| | 1984 | -5% | -12% | 3% | 2% | -11% | -1% | -26% | 0% |
| | 1985 | -13% | 15% | 31% | 6% | 3% | -2% | -34% | -5% |
| | 1986 | -1% | 0% | 2% | 2% | 5% | -1% | -3% | -5% |
| | 1987 | 11% | 15% | 12% | -6% | 3% | 3% | 3% | 7% |
| Sudden Stop Crisis | 94,97 1/ | 5% | 8% | -8% | 4% | -4% | -5% | 4% | -18% |
| | 95,98 | -10% | -1% | 6% | -17% | -10% | -15% | -13% | -34% |
| Tranquil Period | | -1% | -5% | 1% | 3% | 0% | 2% | 4% | 4% |
| Sample Average | | -2% | -3% | 1% | -1% | -1% | 0% | -1% | -1% |

1/ Sudden Stop crisis period is defined as 1994 and 95 for Latin America, and 1997 and 98 for Asia.

**Figure 1: Real Exchange Rate and Sudden Stop Period (Shaded Area)**




1/ Real exchange rate is normalized to zero mean and one standard deviation for all countries. The shaded area is the "Sudden Stop" period that we define in the paper.

**Figure 2: Sudden Stop (Capital Flow in Millions of US$) by country**

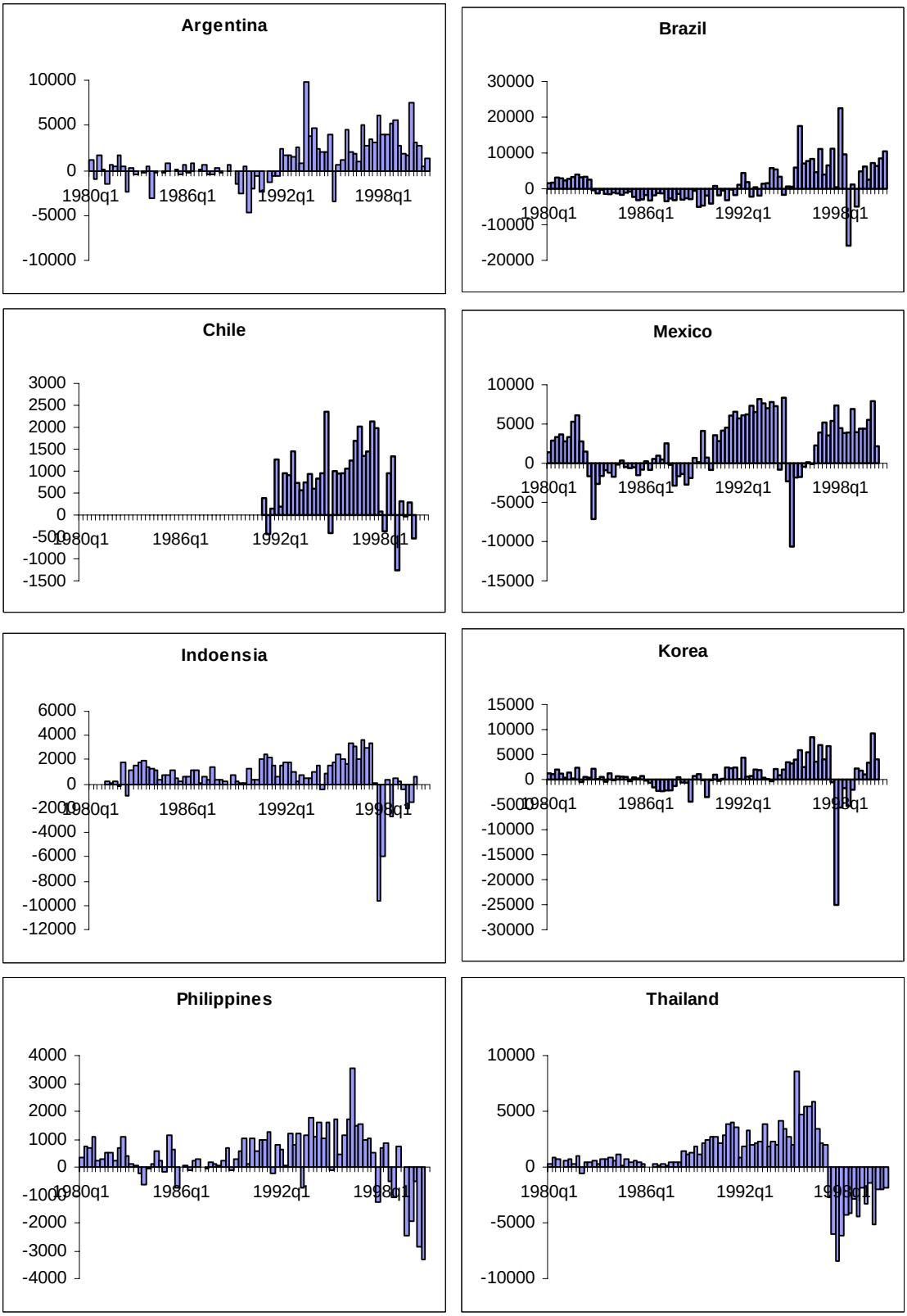


**Figure 3: Money Market Rate of USA during the Debt Crisis and Sudden Stop Crisis (Shaded Area)**

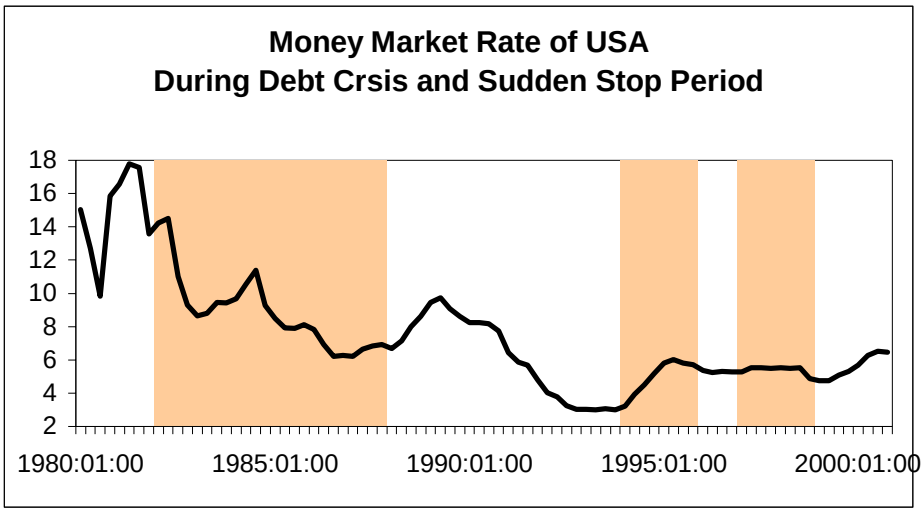


**Figure 4: Terms of Trade Developments in the 8 countries during the Debt Crisis and Sudden Stop Crisis (Shaded Area)**

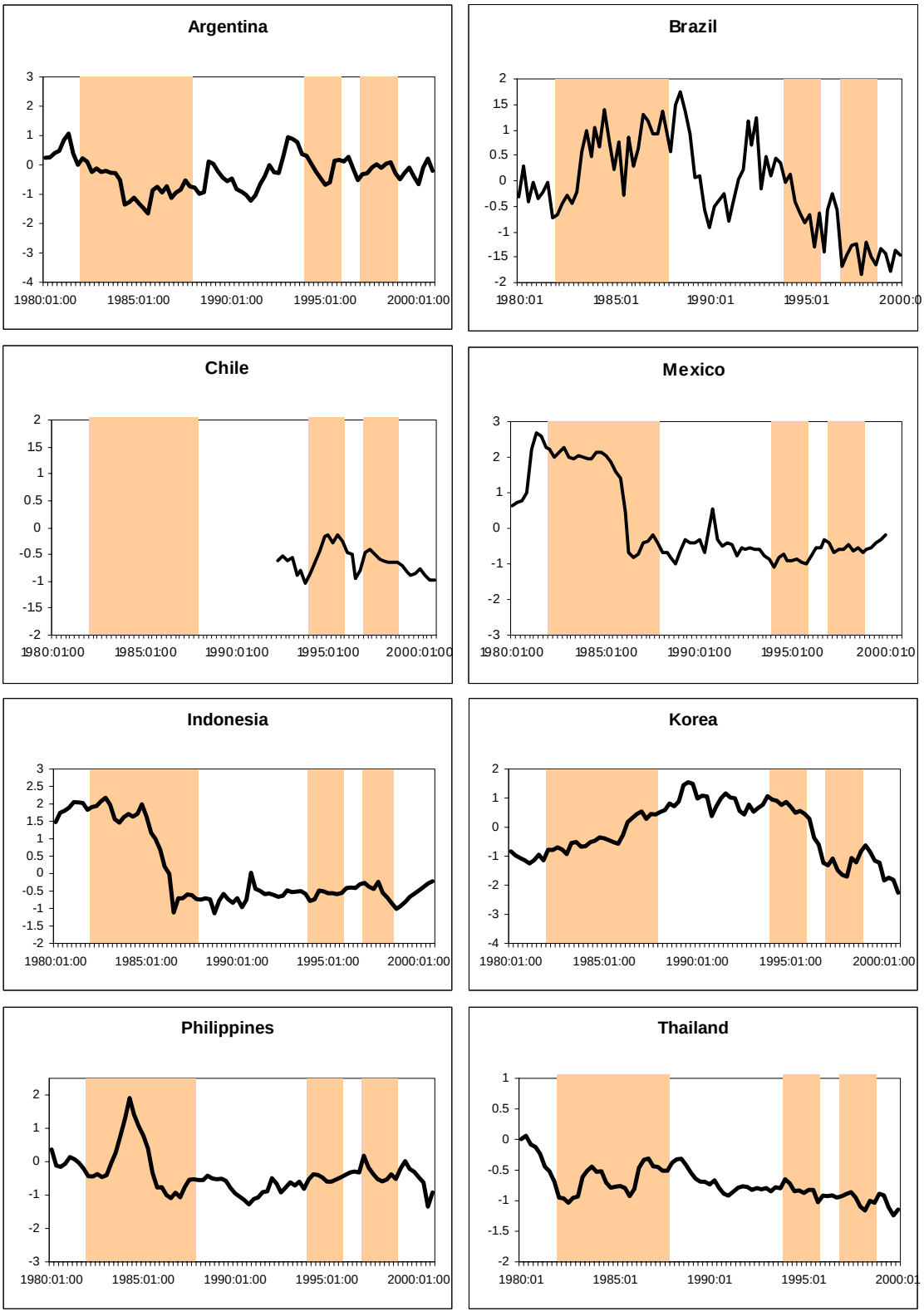


**Figure 5: Cumulative Impulse Response Functions of Real Exchange Rate (Solid line for Tranquil period and ▲ for Sudden Stop period)**

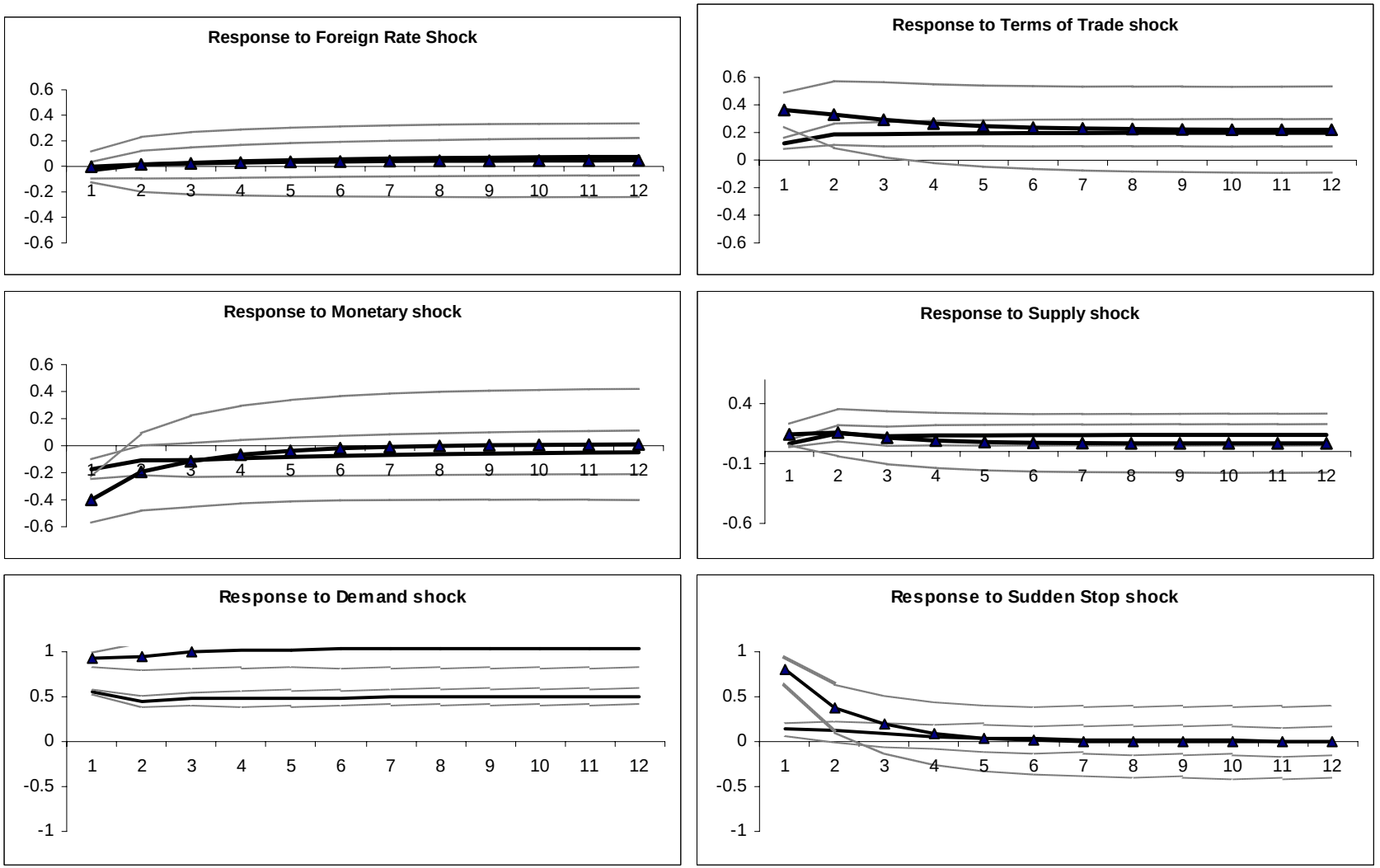


**Figure 6: Cumulative Impulse Response Functions of Real Exchange Rate (Solid line for Sudden Stop Crisis period and ▲ for Debt Crisis)**