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SUDDEN STOPS AND THE MEXICAN WAVE: CURRENCY CRISES, CAPITAL FLOW REVERSALS AND OUTPUT LOSS IN EMERGING MARKETS

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Abstract

Sudden Stops are the simultaneous occurrence of a currency/balance of payments crisis with a reversal in capital flows (Calvo, 1998). We investigate the output effects of financial crises in emerging markets, focusing on whether sudden-stop crises are a unique phenomenon and whether they entail an especially large and abrupt pattern of output collapse (a "Mexican wave"). Despite an emerging theoretical literature on Sudden Stops, empirical work to date has not precisely identified their occurrences nor measured their subsequent output effects in broad samples. Analysis of Sudden Stops may provide the key to understanding why some currency/balance of payments crises entail very large output losses, while others are frequently followed by expansions. Using a panel data set over the 1975-97 period and covering 24 emerging-market economies, we distinguish between the output effects of currency crises, capital inflow reversals, and sudden-stop crises. We find that sudden-stop crises have a large negative, but short-lived, impact on output growth over and above that found with currency crises. A currency crisis typically reduces output by about 2-3 percent, while a Sudden Stop reduces output by an additional 6-8 percent in the year of the crisis. The cumulative output loss of a Sudden Stop is even larger, around 13-15 percent over a three-year period. Our model estimates correspond closely to the output dynamics of the 'Mexican wave' (such as seen in Mexico in 1995, Turkey in 1994 and elsewhere), and out-of-sample predictions of the model explain the sudden (and seemingly unexpected) collapse in output associated with the 1997-98 Asian Crisis. The empirical results are robust to alternative model specifications, lag structures and using estimation procedures (IV and GMM) that correct for bias associated with simultaneity and estimation of dynamic panel models with country-specific effects.

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1. Introduction

"Sudden Stops" in capital flows to emerging market economies are a key characteristic of several recent financial crises. The sudden stop phenomenon, emphasized by Calvo (1998), features an abrupt cessation in foreign capital inflows and/or a sharp capital outflow concurrently with a currency/balance of payments crisis. Most currency/balance of payments crises are *not* characterized by Sudden Stops (Table 1). Capital inflow reversals occur with some regularity in emerging markets (about 22% of the observations in our sample), and currency crises are also fairly common (12% of the observations). But most of these occurrences are not the *joint* occurrence of capital flow reversals and currency/balance of payments crises-- Sudden Stops occur in only about 6% of the observations in our sample of emerging market economies.

Sudden Stops may have severe consequences for the economy, as the abrupt reversal in foreign credit inflows may cause a sharp drop in domestic investment, domestic production and employment. The adverse consequences of a sharp reversal in foreign capital inflows could be the reason that only a subset of currency/balance-of-payments crises in emerging market economies are found to be associated with deep recessions (Gupta et al., 2000). The pattern of a sudden cessation in capital inflows and currency crisis followed by an abrupt, but short lived, output collapse has been termed the "Mexican Wave" by the Financial Times in light of the Mexican experience in 1995. By our metric, there have been 24 episodes of Sudden Stops among emerging markets since the collapse of the Bretton Woods system of fixed exchange rate parities in the early 1970s (listed in the appendix).

Recent theoretical literature, following the work of Calvo (1998) and Calvo and Reinhart (2000), emphasizes the linkages between Sudden Stops and output losses (e.g. Aghion et al., 2001; Mendoza, 2001; and Gopinath, 2001). Sudden Stops cause particularly large drops in output when economies face financial frictions associated, for example, with price stickiness combined with an external financing premium (e.g. Bernanke et al., 1999), debt-deflation combined with collateral constraints (e.g. Kiyotaki and Moore, 1997), and other forms of imperfect credit markets (e.g. Mendoza, 2001).

Empirical work to date has not systematically distinguished between different types of currency/balance of payments crises, and this may help to explain the mixed results of studies attempting to measure the output effects of financial crises. Ventura (2000), for example, notes the importance of distinguishing between different types of current account reversals, and by extension of currency crises, in attempting to evaluate their real output costs. Analysis of Sudden Stops may provide the key to understanding why some currency/balance of payments crises entail very large output losses, while others are frequently followed by expansions.

To address this issue, we investigate the output growth dynamics following currency crises, capital flow reversals and Sudden Stops in a panel data set of 24 emerging-market economies covering the 1975-97 period. We measure the impact of crises in a panel regression framework, carefully controlling for domestic and external factors, country time-invariant effects, and state of the business cycle. Simultaneity between financial crises and output growth is likely in this context, and we employ the fixed-effects panel IV and GMM estimation procedures, respectively, of Hausman and Taylor (1981) and Arellano and Bond (1991) to address this issue.

We find that sudden-stop crises have a large negative, but short-lived, impact on output growth over and above the effect found with currency crises. Our results also correspond very closely with the output dynamics of the 'Mexican wave' (such as seen in Mexico in 1995, Turkey in 1994 and elsewhere), and out-of-sample predictions of the model explain the sudden (and seemingly unexpected) collapse in output associated with the 1997-98 Asian Crisis.

Section 2 reviews the literature on Sudden Stops and highlights our contribution. Section 3 presents the basic empirical model. Section 4 discusses the data employed in the study. Section 5 reports summary statistics on key macroeconomic variables and the primary empirical results of the study. This section presents estimation results of the output equations, model dynamics and robustness checks. Section 6 presents evidence as to the channel through which a sudden stop in capital inflows affects the real economy and how well the dynamics of the model correspond with the Mexican wave pattern of output losses. We also present predictions for output development in the East Asian crisis obtained by simulating our empirical results for the out-of-sample data for the five Asian 1998 crisis countries. Section 7 concludes the paper.

2. Why should a Sudden Stop cause a collapse in output?

The sudden stop phenomenon involves a reversal in capital inflows associated with a currency and balance of payments crisis. There are several reasons why one would expect a Sudden Stop to cause a severe recession. Calvo (1998, 2000) and Calvo and Reinhart (2000) analyse several mechanisms through which a sudden stop in international capital flows may bring about a currency and balance of payments crisis and the reasons that an output collapse may follow. The first mechanism may be termed the traditional Keynesian effect whereby a fall in credit, attributable to the sudden stop in capital inflows combined with an external financing premium and a "financial accelerator", reduces aggregate demand and causes a fall in output (e.g. Bernanke et al., 1999).

The second mechanism, termed the "Fisherian" channel by Mendoza (2001), emphasizes that a Sudden Stop enhances the severity of a currency crisis since it hits the financial sector and, given collateral constraints, induces a debt-deflation and a real contraction (e.g. Kiyotaki and Moore, 1997). Furthermore, firm bankruptcies may cause negative externalities-- banks may become more cautious and reduce loans. This is turn induces a further fall in credit—termed the "vanishing credit effect" by Calvo (2000)--and contributes to recession. Credit that would normally automatically be rolled over is now conditioned upon passing more in-depth viability tests. The resulting "highway congestion" in credit markets amounts to a negative supply shock.

A number of new theoretical studies have developed models further formalizing the linkages between sudden stops in capital inflows, financial crises and declining output. This literature includes, among others, the works of Aghion, Baccheta and Banerjee (2000), Caballero and Krishnamurthy (2000 and 2001), Céspedes, Chang and Velasco (2001), Daniel (2002), Gopinath (2001), Mendoza (2001), and Schneider and Tornell (2001).

Empirical literature on Sudden Stops and output collapse

By contrast with the rapidly emerging theoretical literature linking Sudden Stops with output losses, there is no empirical literature formally addressing this issue. Several recent papers empirically analyze output developments around the time of currency crises in broad samples of countries (e.g. Aziz et al., 2000; Gupta et al., 2000; Hutchison and Noy, forthcoming). Similarly, Barro (2001), Bordo et al. (2001) and Hutchison and Noy (2002) measure output costs associated with the occurrence of both currency crises and banking crises.

No study of which we are aware, however, analyses Sudden Stops in the sense of a capital inflow reversal in tandem *with* a currency/balance of payments crisis. As Table 1 indicates, there are many instances of a currency crisis that are not associated with a capital flow reversal (about 50% of the cases). Our objective is to focus on the joint occurrences that we believe are the best empirical representations of the Sudden Stop problem.

Milesi-Ferretti and Razin (2000), in the work most closely related to ours on Sudden Stops, analyse *separately* the output costs of current account reversals and the output costs of currency crises.[1] They consider output developments around instances of current account reversals (and, separately, currency crises), and analyse the factors that influence these developments in the context of a cross-sectional data set of developing and emerging market economies.[2] Unlike our paper, however, they do not attempt to measure directly the marginal effect of a crisis or reversal on output growth either separately or jointly (holding other macroeconomic and institutional factors constant) in a panel data set of emerging markets.

Section 3. Estimating the Effects of Sudden-Stop Crises on Real Output Growth

Our contribution is to measure the output cost of a sudden-stop crisis**.** Unlike other literature that evaluates the outcomes of financial crises, we control for simultaneity issues, and biases associated with estimation of dynamic panel data models. Estimating this model for emerging market economies, we are also able to address whether sudden-stop crises are unique phenomena in general terms and whether the deep recessions in East Asia were typical of the "bad" outcome associated with sudden-stop crises.

Our approach begins by explaining output growth in emerging markets by a standard set of variables. The determinants of output in this model are a set of domestic policy, structural, and external factors, as well as country-specific effects and lagged output growth. Domestic policy factors are changes in government budget surpluses and credit growth. External factors are growth in foreign output and real exchange rate overvaluation. The structural factor we consider is the openness of the economy to international trade. Country-specific fixed effects (in the context of panel data) are introduced in order to account for the widely varying growth experiences in our set of emerging-market economies over the past 25 years. All of the variables, with the exception of foreign output, are introduced with a one-year lag in order to capture the delayed response of output to macroeconomic developments. This formulation of the model avoids the potential for biased coefficient estimates on the domestic policy variables due to feedback effects from output growth to policy formulation (simultaneous equation bias).

Our main concern with the benchmark model is to introduce relevant control variables into the regression equation so that the identified impact of a crisis on output growth is not simply due to omitted-variables bias. We refrain from including a larger set of macroeconomic variables as these are typically not robust to model specification (Levine and Renelt, 1992).

In the context of our benchmark model, we test for the additional effect on output growth arising from a currency crisis (we define the currency crisis and capital account reversal variables in section 4). We consider both lagged and contemporaneous effects of crises on output growth, and also estimate several variants of the model, including changes in the lag structure and definition of crises, to check the robustness of the basic results. The coefficient estimates on our crisis measure may be interpreted as the marginal effects of crises, after controlling for several of the other factors that may influence the evolution of output growth. Additionally, we include a 'capital account reversal' variable and interpret its coefficient as the marginal effect of such a reversal on output growth. An interactive term of a capital account reversal and a currency crisis – which we label as a sudden-stop crisis – then permits us to directly estimate the effect of a sudden-stop crisis on the evolution of output.

The formal specification of the empirical model is as follows. The growth of real GDP for the *i*th country at time *t* (y_{it}) is explained by policy variables ($x_{i(t-1)}$); external and structural factors ($w_{i(\cdot)}$); the recent occurrence of a currency crisis and a current account reversal ($D^{CC}_{i(\cdot)}$, $D^{KA}_{i(\cdot)}$), a sudden-stop crisis ($D^{CC}_{i(\cdot)} * D^{KA}_{i(\cdot)}$), and an unobservable random disturbance (ε_{it}).

$$y_{it} = \mu_0 + \beta_k x_{i(t-1)} + \alpha_h w_{i(\cdot)} + \beta^{CC} D^{CC}_{i(\cdot)} + \beta^{KA} D^{KA}_{i(\cdot)} + \beta^{SS}(D^{CC}_{i(\cdot)} \cdot D^{KA}_{i(\cdot)}) + \varepsilon_{it} \qquad (1)$$

where *x* is a *k*-element vector of policy variables for country *i* at time *t,* w is an *h*-element vector of external variables for country *i* at times (*t* or *t-1)*, $D^{CC}_{i(t)}$ is a dummy variable equal to unity if the country has recently experienced a currency crisis or balance of payments crisis (and zero otherwise) and likewise for a capital account reversal. The interactive term is therefore equal to unity if a currency crisis and a capital account reversal were observed in the same year. ε_{it} is a zero mean, fixed variance, disturbance term. μ_0 is a vector of country effects (allowing average growth rates to vary across countries in the sample), β_k is a *k*-element vector measuring the impact of policy changes on output, α_h is an *h*-element vector measuring the impact of exogenous factors on output, and β^{CC}, β^{KA} and β^{SS} measure the output growth effects of a currency crisis, a capital account reversal and a sudden-stop crisis, respectively. In our robustness regressions we examine possible non-linearities and size effects for the crises variables, a larger sample including developing countries and different estimation methods.

In our main estimates we follow a procedure first suggested by Hausman and Taylor (1981) that takes into account the bias in estimation of a dynamic panel with predetermined and endogenous variables (for a rigorous formulation of this bias, see Nickel, 1981). When a correlation exists between the independent variables and the individual country-specific effects, a least-squares estimation of a dynamic model ignores the correlation between the time-invariant country-fixed effects and the error term. A similar correlation between the "crisis" explanatory variables and the error term exists when output fluctuations contribute to the onset of a crisis. The Hausman-Taylor three-step estimation methodology is an instrumental variable estimator that takes into account the possible correlation between the independent variables and the individual country-specific effects, as well possible simultaneity issues running from output growth (our dependent variable) and currency crises and capital account reversals and their interaction (three of the explanatory variables).

In the first step, least squares estimates (with fixed effects) are employed to obtain consistent but inefficient estimates for the variance components for the coefficients of the time-varying variables. In the second step, an FGLS procedure is employed to obtain variances for the time-invariant variables. The third step is a weighted IV estimation using deviation from means of lagged values of the time-varying variables as instruments.[3] The procedure requires specifying which explanatory variables are to be treated as endogenous. In our specification, the endogenous explanatory variables are the three binary crisis measures (currency, reversals and Sudden Stops) and the lagged dependent variable.[4]

While the Hausman-Taylor (HT) procedure provides asymptotically unbiased estimates, a recent literature suggests it is not the most efficient estimator possible. A more efficient General Methods of Moments (GMM) procedure relies on utilizing more available moment conditions to obtain a more efficient estimation (e.g., Ahn and Schmidt, 1995; and Arellano and Bond, 1991 and 1998).[5] This procedure, however, is usually employed in estimation of panels with a large number of individuals and short time-series such as in the literature on long-run growth (Bond et al., 2001). In our case, the data makes this procedure difficult to implement for most specifications of the model. We provide some results using the Arellano and Bond (1998) GMM framework. These coefficient estimates are very similar to those obtained from the benchmark Hausman-Taylor procedure.[6]

Section 4. Data Description

We concentrate our investigation on emerging markets since they are the focus of policy discussions and recent experiences of financial crises and output collapses. Several recent studies indicate that emerging markets may be different with respect to the factors that make them susceptible to a financial crisis (Glick and Hutchison, 2001; Caballero and Krishnamurthy, 2002) and how they respond to them (IMF, 1998). Specifically, emerging markets tend to be open to international capital inflows, and have experienced pre-crisis large private inflows that are typically short-term. Large short-term foreign-currency debt positions also increase the vulnerability of these economies to swings in exchange rates and cessation of new capital to roll over existing debt. Emerging markets therefore appear most vulnerable to sudden-stop crises and, potentially, their adverse consequences.

Defining Currency and Balance of Payments Crises

Our indicator of currency and balance of payments crises is constructed by identifying "large" values in an index of currency pressure, defined as a weighted average of monthly real exchange rate changes and monthly (percent) international reserve losses.[7] Following convention (e.g. Kaminsky and Reinhart, 1999) the weights are inversely related to the variance of changes of each component over the sample for each country. This excludes some large depreciations that occur during high inflation episodes, but it avoids screening out sizeable depreciation events in more moderate inflation periods for countries that have occasionally experienced periods of hyperinflation and extreme devaluation.[8] Our measure, taken from Glick and Hutchison (2001), presumes that any nominal currency changes or reserve changes associated with exchange rate pressure should affect the purchasing power of the domestic currency, i.e. result in a change in the real exchange rate (at least in the short run). An episode of serious exchange rate pressure, i.e. a standard crisis episode, is defined as a value in the index—a threshold point-- that exceeds the mean plus 2 times the country-specific standard deviation, provided that it also exceeds 5 percent.[9] The first condition insures that, relative to its own history, unusually large values of the index of currency pressure are counted as a crisis while the second condition attempts to screen out values that are insufficiently large in an economic (real) sense.

For each country-year in our sample, we construct binary measures of currency crises, as defined above (1 = crisis, 0 = no crisis). A currency crisis is deemed to have occurred for a given year if the currency pressure index for any month of that year satisfies our criteria. To reduce the chances of capturing the continuation of the same currency crisis episode, we impose windows on our data. In particular, after identifying each indication of currency pressure, we treat any similar threshold point reached in the following 24-month window as a part of the same currency episode and skip the years of that change before continuing the identification of new crises. With this methodology, we identify 51 currency crises, 68 crisis years and 40 major currency crises for our emerging markets dataset over the 1975-97 period (see appendix).

Defining Capital Account Reversals and Sudden-Stop Crises

As in Milesi-Ferretti and Razin (1998 and 2000) we identify capital account reversals by examining changes in the current account deficit. As our focus is on the short and medium term costs of sudden-stop events, we define a capital account reversal as a positive change in the annual current account surplus that is bigger than a pre-specified threshold (measured as a percentage of current GDP).10 Following Milesi-Ferretti and Razin (1998) we use thresholds of 3% (5%) for standard (major) current account reversals.11 Similarly to our currency crisis variable, we construct, for each country-year, a binary measure of reversals, as defined above (1 = reversal, 0 = no reversal) for both thresholds and impose a 24-month window on our data.12

We use an alternative definition for capital account reversals in our robustness tests. We impose an additional condition that the post-reversal current account deficit is higher than –1% of GDP. This is motivated by the hypothesis that capital inflow reversals will be especially painful if they constitute an almost complete stop in capital inflows (or even capital outflows). In our robustness checks we also control for the size of the reversal (as a percent of GDP).

We define a sudden-stop crisis as one in which there is the contemporaneous occurrence of a currency crisis (a deviation in our currency pressure index of more than two standard deviations), and a capital account reversal (a change in the current account of more than 3% of GDP). As we examine contemporaneous occurrences, we do not speculate on the exact casualty structure between the two.

Control Variables in the Output Growth Equation

As discussed in section 2, the domestic policy factors included in our estimation are lagged changes in government budgets and lagged credit growth; external factors are (trade-weighted) external growth rates of the G-3 and lagged index of real exchange rate overvaluation; and the structural factor we consider is the openness of the economy to international trade.[13] The macroeconomic data series are taken from the International Monetary Fund's IFS CD-ROM.

The minimum data requirements to be included in our study are that GDP figures are available for a minimum of 10 consecutive years over the period 1975-97. We use annual observations. We employ monthly data for our (real) exchange rate and international reserves pressure index to identify currency crises and date each by the year in which it occurs; monthly or quarterly data on current account deficits is available only for a sub-sample of our emerging markets sample so we use annual data for the identification of reversals.

Section 5. Empirical Results

Table 1 presents the number and frequency of currency crises, capital flow reversals and Sudden Stops for our data set. The top panel is for "normal" currency crises and the lower panel is for "major" currency crises. The panels are divided into four parts: the upper left quadrant shows the number and frequency of sudden stop crises (combination of a currency crisis and a capital flow reversal); the lower left quadrant reports the number and frequency of currency crises *not* associated with reversals; the upper right quadrant gives the number and frequency of capital flow reversals *not* associated with currency crises; and the lower right quadrant represent the number and frequency of tranquil episodes (neither a currency crisis nor a capital flow reversal).

Tranquil periods are the most common, of course, representing 72 percent of the sample observations (300 observations). Sudden-stop crises (24 observations) and currency crises (25 cases without capital reversals) each represent about 6 percent of the sample. Capital flow reversals without currency crises are more frequent, at about 16 percent of the sample. With the higher threshold levels for major crises shown in the lower panel, the frequency of occurrences is lower but the basic pattern is the same as with the standard crisis definitions. Clearly, sudden-stop crises are *not* one and the same with currency crises nor with capital flow reversals. It is not uncommon to have capital flow reversals without currency crises and vice versa. Sudden Stops are distinct phenomena.

Conditional Probabilities for Crises Onsets

Table 2 presents hypothesis tests on the likelihood that currency crises and capital account reversals (both standard and major) are statistically independent. The hypothesis that they are not correlated when a currency crisis occurs contemporaneously with a capital account reversal *cannot* be rejected. Yet, the hypothesis that the occurrence of a capital account reversal is not associated with a currency crisis in the previous year can be clearly rejected with probability of more than 99%. Furthermore, there is no statistically significant correlation between contemporaneous currency crises and lagged reversals. While this observation is suggestive as to the possible causal links between the two, assuming a causal link is not necessary for the empirical work and discussion that follow.

Macro Developments: Before/After Crises Statistics

Table 3 presents summary statistics on key macroeconomic developments around currency crises (upper panel) and capital account reversals (lower panel). It presents before-after statistics for the standard definitions of a 'normal' currency crisis and the standard (3%) capital account reversal event as described in section 4. Four-year windows are imposed on the data to clearly delineate the macroeconomic developments around the time of crises.

Our focus variable, real GDP growth, shows an average decline of about 1.3 percentage points in the year a currency crisis takes place, and it recovers only minimally the following year (by 0.3 percentage points). Average output growth goes back to its previous level two years after the crisis, and this upturn is statistically significant. This pattern is almost identical for standard and major crises (not reported for brevity). Average losses appear to be somewhat bigger (smaller) for our sub-sample of currency crises with (without) a capital account reversal--reducing output growth by 1.5 (1.1) percentage points, respectively.

By contrast, output developments around capital account reversals are striking both by the larger costs involved (1.9 percentage points for the year of the reversal) and by the rapid growth turnaround. A capital account reversal is typically followed by an increase in output growth of

3.3 percentage points in the following year. Hence, at first pass, the summary statistics indicate significant and—in some cases—prolonged effects of financial crises and a short-lived but more pronounced effect of a capital account reversal.

Benchmark Model Estimates

Table 4 presents results from our benchmark model. The statistically significant control variables are external output growth, real exchange rate overvaluation, and lagged output growth. A one- percent rise in the growth rate of the G-3 economies raises output growth in emerging-market economies by about, on average, 0.3-0.4 percentage points. A rise in real exchange rate overvaluation significantly reduces output growth. This is noteworthy in its own right, indicating that emerging market economies should avoid currency overvaluation, but also because real exchange rate overvaluation is a reliable predictor of future currency crises (see Glick and Hutchison, 2001). However, the coefficients for budget changes, credit growth and the openness measure are not significantly different from zero. The coefficient estimates for the control variables are consistent across many alternative specifications of the model reported in columns (1)-(4) of table 4 and in the other tables.

Turning to the currency/balance of payments crisis variables, the coefficient estimates reported in column (2) indicate that the onset of a currency crisis is associated with a contemporaneous (lagged) fall in GDP growth of about 2.5 (2.6) percentage points. Very similar results are obtained, but not reported, when including only the contemporaneous or the lagged currency crisis binary variable. After a two-year period, the cumulative negative effect of a currency crisis on output is therefore about 5.1 percent.

Table 4 also presents more information on the dynamics of output adjustment to currency crises. Adding further lags (second, third and fourth year lags) to the model, reported in column (3), indicate that the contemporaneous and one-year ahead effects of a currency crisis remain negative and highly significant and with the same magnitudes as reported previously. This is followed by statistically insignificant effects on the second, third and fourth year following a crisis. This result remains when some of the insignificant lags are dropped. Our results therefore predict that the output costs of a currency crisis do not extend beyond a two-year horizon.

We also include lead values of currency crises in the equations, shown in column (4), to further investigate the dynamic responses. The one-year lead coefficient for the currency crisis variable is statistically significant. This result indicates that a currency crisis tends to follow a decline in real output growth. On the other hand, a currency crisis is also associated with a further decline in output growth contemporaneously and over a period of two years. These model estimates suggest that, within 4 years, output declines cumulatively by almost 8 percent for an average currency crisis in an emerging-market economy.

An important question is whether a particularly severe crisis—substantially larger than the normal crisis—has an especially severe effect on growth. To investigate this issue, we introduce a "major" currency crisis variable that is identified by a threshold point in our pressure index that exceeds 3-standard deviations from the mean. For brevity we do not report these results. Somewhat surprisingly, the output effects of a major crisis are not larger than the typical crisis situation. Coefficients for a version of column (2) using the major crisis measure yield coefficients of –2.3 and –2.8 for the contemporaneous and lagged major currency crisis variables, respectively. Major currency and balance of payments crises therefore do not appear to have a substantially different impact on output growth than the average crisis (identified using a 2-standard deviation threshold).

Reversals and Sudden Stops

The full results for our model are reported in Table 5. Columns (1) and (2) report the cost of a capital account reversal for the 5 percent and 3 percent thresholds, respectively, with the inclusion of lagged and contemporaneous currency crises variables. In both cases, reversals are costly. Surprisingly, "normal-sized" reversals (3 percent of GDP) seem to have, on average, a larger effect on output growth (with almost 2 percentage points decline) than do large reversals (1.2 percentage point decline).[14]

Our main results are presented in columns (3)-(4). The coefficient on the sudden-stop crisis interactive variable is negative, *large* and statistically significant. The output costs of sudden-stop crises appear to be very large—a drop in output growth of 4.7-6.5 percentage points in the same year of the crisis. Furthermore, while the coefficients on the currency crisis variables are smaller they are still statistically significant for the 99% confidence level. Neither does the inclusion of leads and lags for the capital account reversal dummy, reported in column (5), change the magnitude of these coefficients.[15] We find that a sudden-stop crisis has a very large average effect on output growth—depressing GDP by about 10 percent over a short (2-year) period.

Robustness Tests

To check the robustness of our results we first examine whether our estimation technique, based on the Hausman and Taylor (1981) IV estimator, gives similar coefficient estimates to those obtained by the least-squares fixed effects estimator with a White heteroscedasticity correction (LSDV) or the more efficient first-differenced GMM estimator suggested by Arellano and Bond (1991 and 1998). These results are reported in Table 6, columns (1)-(3), where we also include the HT estimation for exactly the same sample.16 There is relatively little difference between the coefficients obtained on our focus variables—currency crises and reversals—in all three estimation techniques. As can be expected, the GMM estimator yields higher t-statistics.

We also run the same model for a larger sample including 42 developing countries as well as the emerging markets sample. Data availability guided our choice of additional countries.17 A comparison of column (4) with column (2) in Table 5 leads us to conclude that both currency crises, reversals and Sudden Stops have a weaker impact on output growth in our larger sample of developing countries-- -1.5 instead of –1.9 for lagged currency crises, -1.1 instead of –2.0 for capital account reversals and –3.6 instead of –6.6 for sudden-stop crises. Column (5) adds a lagged currency crises variable, which further reduces the coefficient on our sudden-stop variable. The larger set of developing countries does indeed seem to be less vulnerable, on average, to both turmoil in currency markets and reversals in capital flows than emerging markets. This may simply be attributable to the fact that poor developing countries attract very little private capital inflows and hence a substantial reversal observable in the current account is different.

In column (6) of Table 6 we investigate whether the main results are robust when we account for the size of the capital account reversal. To our central regression--reported in table 5 column (4)--we add the size of the capital flow reversal as a percentage of GDP. The coefficient on the reversal's size variable is statistically different from zero and indicates that any flow reversal of one percent (of GDP) reduced output growth by 0.2 percentage points. More central to our argument is the finding that the coefficient on the sudden-stop dummy does not change much—indicating that non-linearities are important in understanding the effects of crises. A Sudden Stop is found to constitute a unique event that is important above and beyond the actual size of the reversal.

In column (7) of table 6 we modify the definition used for a current account reversal and its corresponding sudden-stop interactive term. We now use only a subset of our reversal observations—only those for which the reversal actually meant a full stop of capital inflows. Technically, we discard reversal observations for which the current account deficit, following the reversal event was still bigger than 1 percent of GDP. As can be expected the coefficient on the newly defined sudden-stop variable is now even bigger and indicates a drop of 8 percentage points in GDP growth in the same year of the crisis. This result further supports our other findings on the very substantial negative average effects of Sudden Stops.

It is possible that the results reported to this point are subject to sample selection bias. Countries that experience a currency crisis may be different in important respects from other countries or episodes. That is, it may not be the currency crisis per se but several other factors contributing to them that are causing the decline in output growth. This is a variant of the sample selection bias problem.

We employ Heckman's (1979) Inverse Mills Ratio (IMR) to control for sample selection bias of this form. This statistic is constructed from the results of a probit regression explaining currency crises and added as an additional explanatory variable in the output growth regressions.18 Including the IMR in the regression of interest prevents possible bias in our coefficient estimates and is a standard approach to account for sample selection bias.19 For brevity, these results are not reported. In no case is the IMR coefficient statistically significant and, assuming the probit equation was correctly specified, sample selection bias may be rejected. More importantly, the coefficient estimates on the other explanatory factors, both the control and the crisis variables, are very similar to those reported in table 5.

Section 6. Predictive Accuracy, Dynamics and Channels of Transmission

Out of Sample Predictions

The models in the previous section explain up to 45 percent of the variation in output growth in our sample of emerging market economies. The sudden-stop proxy variables are highly significant and contribute to the overall explanatory power of the models. As an additional test of the robustness of the findings, we consider out-of-sample predictions for countries involved in the 1997 Asian crisis and subsequent collapse in output. All of these countries experienced Sudden Stops. In particular, Table 7 presents the predicted values for output growth for the five East Asian countries that experienced a severe financial crisis in 1997 and large output contractions in 1998—Indonesia, Korea, Malaysia, the Philippines and Thailand. These predictions are for 1998 output growth rates and are based on 1997 values of the explanatory variables and the coefficient estimates obtained from the model presented in column (4) of Table 5. Predicted values are decomposed into three different groups of explanatory variables: (a) domestic factors (lagged output growth, change in budget surplus, credit growth, and country-specific effects); (b) external/structural factors (external growth, real exchange rate overvaluation and openness); and (c) the currency crisis, the capital account reversal and the sudden-stop crises.

Predicted output growth (from the Sudden Stop model) for all five countries is around negative 5 percent in 1998. Output is predicted to be worst for the Philippines (-5.2%) and best for Korea (-4.5%), with intermediate predictions for Indonesia, Malaysia and Thailand. The forecast errors (unexpected declines in output) are therefore substantial as the growth performances of the Philippines and Korea were radically different in 1998. At the extremes, the Philippines experienced the mildest recession (-0.5 output growth rate) while Indonesia experienced a -14.1 percent contraction of its economy. More importantly for our focus, the contemporaneous negative effect of a sudden-stop crisis is dominating our predictions with a cumulative negative effect of –9.4 percentage point decline in GDP growth. There is a positive domestic effect – mainly a history of very strong growth in the region and the consequently large country-specific effects-- and a modestly supportive external structural growth environment.

Although the forecast errors of the sudden-stop model are fairly large, the average prediction of a substantial decline in output (-5.0 percent) across four of the East Asian countries (Korea, Malaysia, Philippines and Thailand) is quite close to the actual average decline in output (-6.5 percent). Indonesia, perhaps due to political and social turmoil, seems to be a special case and experienced a –14.2 percent drop in output. Moreover, besides the sudden-stop model, we are not aware of other models that forecast (out-of-sample) large *declines* in output for East Asia in

1998. Hutchison and Noy (2002), for example, examined the output effects of currency, banking and "twin" crises. They conclude that "twin" crises lead to significant real costs, but cannot explain the depth of the recessions and the rapid recovery that the Asian-5 experienced between 1997 and 1999.

Dynamics and the Mexican Wave

The V-shaped output developments of the Asian-5 following the financial crisis also appear to fit the pattern associated with the Mexican Wave. Panel A of Figure 1 presents the output developments around some of the most famous sudden-stop crises: Turkey (1994), Mexico (1995), Indonesia (1998) and Korea (1998). Turkey, Indonesia and Korea follow the same output dynamics as Mexico--sharp output declines at the time of the crisis followed by large rebounds.

The sudden-stop model predictions, shown in Panel B of Figure 1, also correspond closely with the country experiences shown above. The panel shows the dynamic predictions for output around the time of a (i) currency crisis, (ii) a capital flow reversal, and (iii) a Sudden Stop.20 Both currency crises and capital flow reversals, taken alone, are associated with modest declines in output. Taken together, however, they constitute a Sudden Stop and induce a very large but short-lived drop in output. The model estimates mimic very closely the actual dynamics of Sudden Stops observed in Mexico, Turkey, Indonesia, Korea.

Channels of Transmission: Sudden Stops and Collapsing Investment

The sudden-stop theory reviewed in section 2 discussed several potential transmission mechanisms through which Sudden Stops could cause an output collapse. A common element in these explanations is that a Sudden Stop causes domestic investment to collapse, perhaps through financing constraints that sharply limit imported investment goods or imported intermediate goods.

This view appears to be borne out. Table 8 shows average domestic investment growth, domestic fixed investment growth, export growth, and import growth around the 24 sudden-stop crises that we have identified in our emerging-market sample. Investment and imports are sharply reduced at the time of Sudden Stops. In particular, investment (import) growth was 8.5% (11.0%) two years prior to the Sudden Stop, decreases to 0.8% (2.0%) one-year prior, and then shows a large 6.0% (2.5%) *drop* at the time of the Sudden Stop. The declines in investment and imports continue for two years, and then sharply rebound two years after the sudden-stop crisis. By contrast, exports boom both the year of the crisis and in the year following the Sudden Stop.

These stylised facts are consistent with several case studies. Agénor et al. (2000) find, for example, that the sharp contraction in bank lending accompanying Thailand's financial crisis was due to a "supply crunch" on credit (presumably due to foreign financial constraints). Ghosh and Ghosh (1999) report similar findings for Korea and Indonesia as do Ito and da Silva (1999). Microeconomic research into firms' responses to changes in the exchange rate also suggests that firms generally reduce their investment when facing large domestic currency depreciation (Forbes, 2001 and Nucci and Pozzolo, 2001).

Section 7. Conclusions

The sudden-stop phenomenon seems to provide the key to understanding why some currency/balance of payments crisis entail very large output losses, while others are frequently followed by expansions. Using a panel data set over the 1975-97 period and covering 24 emerging-market economies, we distinguish between the output effects of currency crises, capital inflow reversals, and sudden-stop crises. We find that sudden-stop crises have a large negative, but short-lived, impact on output growth; and that these effects are substantially larger (almost three times greater) than those associated with a currency crisis alone. The empirical results are robust to alternative model specifications, lag structures and using estimation procedures (IV and GMM) that correct for bias associated with simultaneity and estimation of dynamic panel models with country-specific effects.

The sudden-stop model predictions also mimic the output dynamics of many countries facing sudden-stop crises. The Mexican Wave pattern that the model predicts was seen not only in Mexico at the time of the 1995 crisis, but also in such disparate countries facing Sudden Stops as Turkey, Indonesia and Korea. The channel of transmission also appears consistent with theory that points to an external "credit crunch" as a key element in capital flow reversals at the time of a currency crisis. Sudden Stops are associated with a collapse of imported goods and a dramatic fall in domestic investment. Clearly, the large output costs associated with Sudden Stops are a policy concern; even more so if the underlying cause of the capital inflow reversal and currency crisis are not attributable to "fundamentals" but rather to multiple equilibria or imperfections in the working of international capital markets.

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Table 1 – Sudden Stops [a]

Number of Events (Percentage of Sample)

'Normal' Crises and Capital Flow Reversals		
	Currency Crisis	**No Crisis**
Capital Flow Reversal	**Sudden-Stop Crisis 24 (6%)**	**65 (16%)**
No Reversal	**25 (6%)**	**Tranquil period 300 (72%)**
Major Crises and Major Capital Flow Reversals		
	Currency Crisis	**No Crisis**
Capital Flow Reversal	**Sudden-Stop Crisis 18 (4%)**	**35 (9%)**
No Reversal	**22 (5%)**	**Tranquil period 339 (82%)**

[a] For currency crises, a standard crisis is defined as a deviation of the currency pressure index of more than 2 standard deviations from the country-specific mean (3 standard deviations for major crises). For the current account reversal, a standard reversal is defined as a change in the current account to GDP ratio of more than 3 percentage points (5% points for a major CA reversal). The number in parentheses is the percent out of country years in our sample.

Table 2 - Conditional Probabilities [a]

	3% threshold	5% threshold
% of CA reversals associated with a contemporaneous onset of currency crisis	10 (0.88)	14 (0.26)
% of currency crisis associated with a contemporaneous CA reversal	20 (0.88)	18 (0.26)
% of CA reversals associated with a previous (t-1) currency crisis	20*** (0.00)	23*** (0.00)
% of currency crisis associated with a following (t+1) CA reversal	46***[b] (0.00)	31*** (0.00)

[a] chi square probability of independence of the two series in parenthesis.

Table 3 - Descriptive Statistics [a]

	Type of Crisis	t-2	t-1	t	t+1	t+2
A. Currency Crises						
Real GDP growth rate (%)	Currency	4.0	2.7	1.4	1.7	3.6*
	Currency (no reversal)	4.2	3.5	2.4	2.2	3.4
	Sudden Stop	3.8	2.0	0.5	1.3	3.8*
Change in budget surplus (%)	Currency	-1.2	-1.4	-1.1	-1.0	-1.1
	Currency (no reversal)	-1.8	-1.7	-0.9	-1.5	-1.2
	Sudden Stop	-0.8	-1.1	-1.2	-0.6	-1.2
Inflation rate (%)	Currency	30.5	31.6	36.3	43.4	42.0
	Currency (no reversal)	36.4	38.7	36.2	40.5	47.3
	Sudden Stop	23.3	23.0	34.4	44.0	34.9
Current account to GDP ratio (%)	Currency	-4.4	-4.3	-4.0	-1.4*	-0.4
	Currency (no reversal)	-2.8	-2.5	-3.0	-2.1	0.9*
	Sudden Stop	-5.7	-4.8	-0.8*	-1.3	-2.2
B. Capital Account Reversals						
Real GDP growth rate (%)		5.4	4.6	2.7**	6.0***	5.9
Change in budget surplus (%)		-0.9	-0.5	0.1	-0.6	0.1
Inflation rate (%)		18.2	19.5	30.9	17.4	12.6
Current account to GDP ratio (%)		-5.5	-7.5	0.9***	0.8	-0.9

[a] *, **, and *** denote rejection of same mean as the number to the left with 10, 5 and 1 percent confidence levels.

Table 4 - Growth Equation – HT – Benchmark [a]

Dependent Variable: real GDP growth rate (DLRGDP)

Real GDP growth (t-1)	**0.327***** (6.75)	**0.266***** (5.47)	**0.249***** (4.87)	**0.240***** (4.72)
Change in budget surplus to real GDP ratio (t-1)	-1.601 (-0.21)	-0.385 (-0.05)	-0.678 (-0.09)	-2.460 (-0.32)
Credit growth (t-1)	-0.009 (-1.38)	-0.007 (-1.05)	-0.007 (-1.04)	-0.006 (-0.88)
External growth rates - weighted average (t)	0.360*** (3.42)	0.381*** (3.75)	0.386*** (3.77)	0.390*** (3.81)
Real exchange rate overvaluation (t-1)	-0.024* (-1.88)	-0.028** (-2.28)	-0.029** (-2.28)	-0.019 (-1.39)
Openness (t)	0.011 (1.05)	0.010 (0.97)	0.010 (0.95)	0.010 (0.89)
Currency crises onset dummy - lead (t+2)				-0.457 (-0.66)
Currency crises onset dummy - lead (t+1)				-1.558** (-2.21)
Currency crises onset dummy (t)		-2.453*** (-3.78)	-2.622*** (-3.93)	-2.793*** (-4.16)
Currency crises onset dummy - lag (t-1)		-2.634*** (-3.77)	-2.671*** (-3.64)	-2.838*** (-3.87)
Currency crises onset dummy - lag (t-2)			-1.008 (-1.31)	-1.034 (-1.35)
Currency crises onset dummy - lag (t-3)			0.545 (0.71)	0.470 (0.61)
Currency crises onset dummy - lag (t-4)			-0.066 (-0.08)	0.010 (0.01)
Adjusted R^2 [e]	0.27	0.32	0.32	0.33
Number of observations	374	373	370	370
Correlation of error terms	0.09	0.09	0.11	0.12

[a] The Adjusted R^2 reported is for the fixed-effects least squares stage in the Hausman-Taylor procedure.

Table 5 - Growth Equation – HT - Current Account Reversals

Dependent Variable: real GDP growth rate (DLRGDP)

Real GDP growth (t-1)	0.218*** (4.46)	0.207*** (4.31)	0.207*** (4.32)	0.239*** (5.04)	0.197*** (4.02)
Change in budget surplus to GDP ratio (t-1)	1.212 (0.16)	2.351 (0.33)	3.607 (0.51)	4.146 (0.58)	11.706 (1.61)
Credit growth (t-1)	-0.009 (-1.47)	-0.009 (-1.49)	-0.007 (-1.16)	-0.007 (-1.25)	0.002 (0.26)
External growth rates - weighted average	0.399*** (4.03)	0.394*** (4.05)	0.393*** (4.09)	0.390*** (4.01)	0.341*** (3.36)
Real exchange rate overvaluation (t-1)	-0.033*** (-2.70)	-0.034*** (-2.83)	-0.036*** (-3.11)	-0.037*** (-3.14)	-0.037*** (-3.19)
Openness	0.019* (1.91)	0.018** (2.05)	0.010 (1.11)	0.011 (1.20)	0.014 (1.15)
Current Account Reversal (5% threshold)	-1.122* (-1.75)				
Lead for Current Account Reversal (3%) (t+1)					-0.683 (-0.90)
Current Account Reversal (3% threshold)		-1.958*** (-3.88)	-1.243** (-2.33)	-0.924* (-1.75)	-1.685*** (-3.03)
Lag for Current Account Reversal (3%) (t-1)					-0.480 (-0.58)
currency crises dummy (t)	-2.862*** (-4.92)	-2.961*** (-5.18)	-1.902*** (-2.97)		-2.029*** (-3.09)
currency crises dummy (t-1)	-2.333*** (-3.73)	-2.052*** (-3.33)	-1.894*** (-3.11)	-1.874*** (-3.04)	-1.425** (-2.33)
sudden-stop crises dummy (t)			-4.727*** (-3.59)	-6.593*** (-5.63)	-5.066*** (-3.80)
Adjusted R^2	0.35	0.37	0.39	0.38	0.44
Number of observations	374	374	374	374	320
Correlation of error terms	0.10	0.08	0.08	0.07	0.19

Table 6 - Growth Equation - Robustness

Dependent Variable: real GDP growth rate (DLRGDP)

	(1) LSDV	(2) HT	(3) GMM1	(4) HT[a]	(5) HT[a]	(6) HT	(7) HT[b]
Real GDP growth (t-1)	**0.133****	**0.175*****	**0.193*****	**0.262*****	**0.257*****	**0.228*****	**0.263*****
	(2.23)	**(3.03)**	**(7.74)**	**(6.81)**	**(6.73)**	**(4.73)**	**(5.31)**
Change in budget surplus to GDP ratio (t-1)	**-12.296**	**-9.492**	**5.972****	**7.191***	**6.420**	**13.751***	**8.987**
	(-1.30)	**(-1.05)**	**(2.01)**	**(1.66)**	**(1.49)**	**(1.85)**	**(1.19)**
Credit growth (t-1)	**-0.007**	**-0.008**	**0.003***	**-0.001**	**-0.002**	**0.001**	**-0.002**
	(-0.83)	**(-1.09)**	**(1.96)**	**(-0.36)**	**(-0.61)**	**(0.16)**	**(-0.23)**
External growth rates (t)	**0.394*****	**0.387*****	**0.360*****	**0.339*****	**0.343*****	**0.326*****	**0.308*****
	(3.31)	**(3.29)**	**(8.75)**	**(4.29)**	**(4.38)**	**(3.19)**	**(2.95)**
Real exchange rate overvaluation (t-1)	**-0.041****	**-0.045*****	**-0.033*****	**-0.026*****	**-0.025*****	**-0.038*****	**-0.037*****
	(-2.46)	**(-2.82)**	**(-6.40)**	**(-3.26)**	**(-3.11)**	**(-3.25)**	**(-3.07)**
Openness	**0.053***	**0.021***	**0.016*****	**0.016***	**0.023****	**0.025****	**0.023***
	(1.67)	**(1.88)**	**(8.98)**	**(1.84)**	**(2.53)**	**(2.00)**	**(1.83)**
Current Account Reversal (3%) (t)	**-1.972*****	**-2.050*****	**-1.249*****	**-1.075****	**-1.355*****	**0.169**	**0.421**
	(-3.28)	**(-3.45)**	**(-11.90)**	**(-2.40)**	**(-3.01)**	**(0.17)**	**(0.55)**
Currency crises dummy (t)					**-1.624*****		
					(-3.31)		
Currency crises dummy (t-1)	**-2.612*****	**-2.492*****	**-2.951*****	**-1.515*****	**-1.421*****	**-1.328****	**-1.892*****
	(-3.29)	**(-3.19)**	**(-6.24)**	**(-3.26)**	**(-3.09)**	**(-2.15)**	**(-3.02)**
sudden-stop crises dummy (t)				**-3.550*****	**-1.957***	**-6.554*****	**-8.021*****
				(-3.90)	**(-1.92)**	**(-5.40)**	**(-5.76)**
Reversal's size (t)						**-0.234***	
						(-1.72)	
Sample	**280**	**280**	**280**	**550**	**550**	**320**	**320**

[a] The sample contains also developing countries (with per capita income of less the 2000 in PPP$ for 1992.
[b] C(7) includes a different definition of current account reversals. In addition to (1) a change of at least 3% of GDP, it includes (2) the post reversal current account is above –1% of GDP.

Table 7- Out of Sample Growth Forecasts for East Asian Crisis Countries – 1998 [a]

	Domestic variables [b]	External variables	Currency crises	CA reversal	Sudden stop	Predicted growth	Actual growth
Indonesia	3.69	0.58	-1.87	-0.92	-6.59	-5.11	-14.16
Korea	3.78	1.13	-1.87	-0.92	-6.59	-4.47	-6.92
Malaysia	3.83	0.54	-1.87	-0.92	-6.59	-5.01	-7.65
Philippines	3.74	0.40	-1.87	-0.92	-6.59	-5.24	-0.54
Thailand	3.63	0.81	-1.87	-0.92	-6.59	-4.94	-10.73

[a] Estimates are based on Table 5 column (4) coefficients.
[b] Also includes the time invariant (fixed) effects.

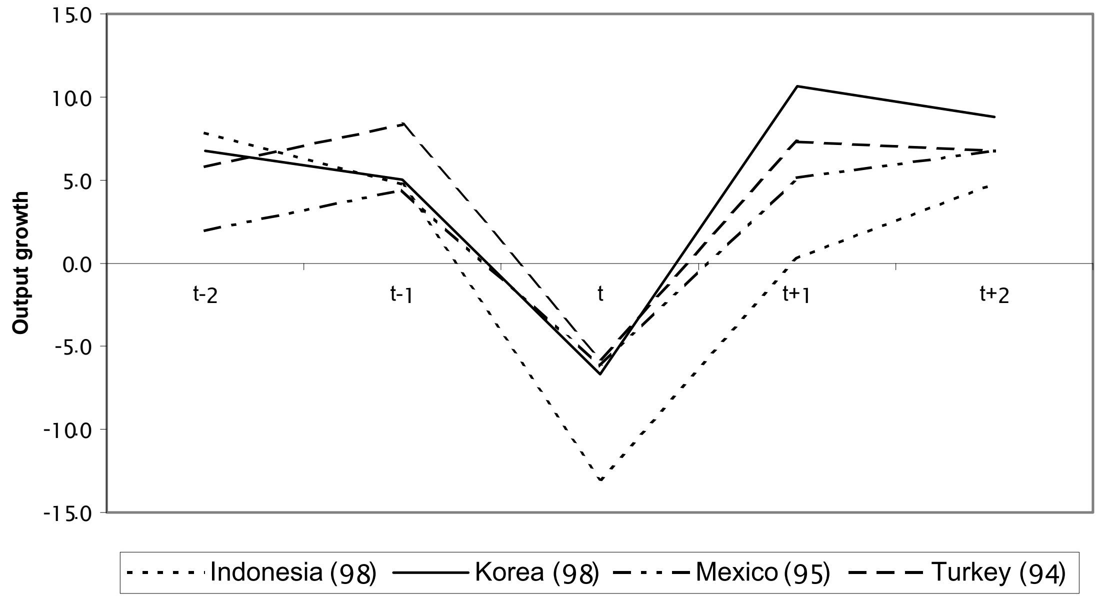
Table 8 – Investment, Exports and Imports Around Sudden-Stops [a]

	t-2	t-1	t	t+1	t+2
Domestic investment growth	**8.50**	**0.84**	**-5.96**	**-4.81**	**8.07**
Domestic fixed investment growth	**6.87**	**2.81**	**-4.53**	**-7.82**	**3.83**
Export growth	**5.41**	**2.49**	**13.05**	**9.96**	**3.31**
Import growth	**11.04**	**2.03**	**-2.55**	**-1.03**	**11.51**
Exports [b]	**17.98**	**17.97**	**20.17**	**22.76**	**24.41**
Imports [b]	**21.00**	**21.96**	**20.91**	**19.20**	**21.87**

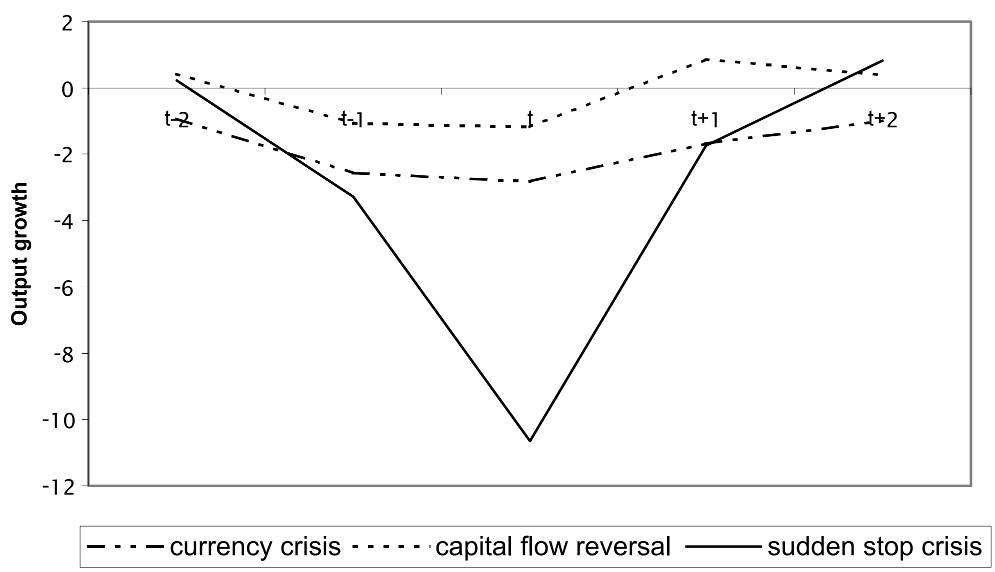
[a] Data is from the World Bank's *World Development Indicators, 2001.*
[b] Average in billion constant 1995 US$.

Figure 1 – Output Developments

Panel A – Recent Sudden Stops



Panel B – Sudden Stop Model Estimation



Appendix

Data for Currency and Sudden-Stop Crises

	Currency Crises	Sudden-Stop Crises
Argentina	1975-1976, 1982-1983, 1989-1991	1989
Brazil	1982-1983, 1987, 1990-1991, 1995	1987
Chile	1985	
Hong Kong (China, P.R.)		
Columbia	1985	1985
Costa Rica	1981	1981
Cyprus		
Indonesia	1978, 1983, 1986, 1997	1983, 1986
Jordan	1983, 1987-1989, 1992	1989, 1992
Korea	1980, 1997	
Malaysia	1986, 1997	1986
Malta	1992, 1997	1997
Mauritius	1979, 1981	
Mexico	1976, 1982, 1985, 1994-1995	1982, 1994
Panama		
Philippines	1983-1984, 1986, 1997	1983, 1986
Singapore	1975	1975
South Africa	1975, 1978, 1984-1986, 1996	1984
Thailand	1981, 1984, 1997	1981, 1997
Trinidad & Tobago	1985, 1988, 1993	1985
Tunisia	1993	
Turkey	1978-1980, 1994	1994
Uruguay	1982-1983	1982
Venezuela	1984, 1986, 1989, 1994-1996	1986, 1989, 1994

Footnotes:

[1] Milesi-Ferretti and Razin (1998) also explore the determinants of the costs of reversals. They consider a cross-section of current account reversal episodes in a sample of 86 low and middle-income developing economies for the period 1971-1992. They search for the determinants of reversals and find both domestic and external variables that seem to play a role in explaining their occurrence. They find that a less appreciated exchange rate, higher investment and more openness prior to the reversal make recovery faster and more pronounced.

[2] Milesi-Ferretti and Razin (2000) examine a cross section of currency crises and current account reversals in a broad set of 105 low and middle-income countries (for 1970-1996). They identify the determinants of reversals and currency crises in probit regression and also provide an analysis of the costs of each separately (in terms of output growth). They estimate a linear cross-sectional model with average output growth in the 3 years following the episode in question as the dependent variable and identify macroeconomic variables that determine the costs of such episodes (either a currency crisis or a current account reversal).

[3] In the final step all variables are transformed by: $v_{it}^* = v_{it} - (1 - \theta_i)\bar{v}_i$ where $\theta_i = \sqrt{\dfrac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + T_i\sigma_u^2}}$

where v_{it} denotes any of the aforementioned variables and $\bar{v}_i$ denotes a group mean and the variance components are the one obtained in first two steps. For exact details on the motivation and estimation procedure, see Hausman and Taylor (1981) and Greene (2001) respectively.

[4] Assuming any of the other control variables is not exogenous does not change our empirical results

[5] For a detailed survey of asymptotic consistency results and GMM estimation methods casting doubts on some of the results in this literature, see Arellano and Honoré (forthcoming) and Bond et al. (2001).

[6] We use the Limdep software suite in all our estimations. We thank Professor William Greene for generously providing us with an update of the LIMDEP package and some of the statistical procedures used to estimate the models.

[7] Our currency pressure measure of crises does not include episodes of defence involving sharp rises in interest rates. Data for market-determined interest rates are not available for much of the sample period in many of the countries in our dataset.

[8] This approach differs from that of Kaminsky and Reinhart (1999), for example, who deal with episodes of hyperinflation by separating the nominal exchange rate depreciation observations for each country according to whether or not inflation in the previous 6 months was greater than 150 percent, and they calculate for each sub-sample separate standard deviation and mean estimates with which to define exchange rate crisis episodes.

[9] Kaminsky and Reinhart (1999) use a three standard deviation cut-off. While the choice of cut-off point is somewhat arbitrary, Frankel and Rose (1996) suggest that the results are not very sensitive to the precise cut-off chosen in selecting crisis episodes. Our output equation estimates using “major” currency crises, evaluated with the 3-standard deviation threshold, are very similar to the benchmark crisis measure.

[10] In contrast, Milesi-Ferretti and Razin (1998) examine changes in 3-year rolling averages of the current account. They also impose a condition that the maximum deficit after the reversal must be no larger than

the minimum deficit in the 3 years preceding the reversal. In our identification of reversal episodes we are interested in short-run to medium run phenomena and therefore we examine annual changes in the current account.

[11] Their work indicate that the exact (and admittedly ad-hoc) threshold used does not affect their results significantly. We present results to that effect as well.

[12] Bagnai and Manzoochi (1999) use a different statistical methodology to differentiate between permanent and transitory changes in current account trends and define permanent changes as reversal episodes. They find that GDP growth is not statistically significant in their regression for the determinants of positive reversals, giving some support to the Sudden Stop argument that reversal episodes are a leading causal factor in declining output growth.

[13] The 'openness' variable is defined as the sum of imports and exports relative to GDP. Real exchange rate overvaluation is defined as deviations from a fitted trend in the real trade weighted exchange rate. The real trade-weighted exchange rate is the trade-weighted sum of the bilateral real exchange rates (defined in terms of CPI indices) against the U.S. dollar, the German mark, and the Japanese yen. The trade-weights are based on the average bilateral trade with the United States, the European Union, and Japan in 1980 and 1990.

[14] The difference between the two estimates is not statistically significant.

[15] Interestingly, both the coefficients on the lead and lag of capital account reversals are insignificantly different from zero.

[16] The sample here is somewhat smaller than the one used in the results reported in Tables 4 and 5. The GMM estimator poses both data restrictions and restrictions on the models that could be estimated with our data.

[17] We also restricted our sample for non-OECD countries with a population of more than one million.

[18] The exact specification of the probit regression is taken from Glick and Hutchison, 2001. Details are available from the authors upon request.

[19] For a survey of sample selection correction methodologies see Blundell and Costa Días (2000) and for empirical examination of the IMR model see Heckman (1990).

[20] These predictions are derived from an output equation, not reported in the text for brevity, where two leads and lags of currency crises, capital flow reversals, and Sudden Stops are included. The control variables are the same as in the benchmark equations (e.g. Table 4, column 1).