ESSAYS ON THE HETEROGENEITY OF SUDDEN STOP CRISES

BY

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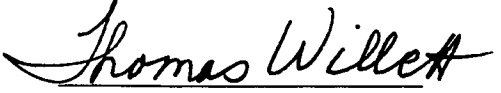

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We, the undersigned, certify that we have read this dissertation of Samuel M. Schreyer and approve it as adequate in scope and quality for the degree of Doctor of Philosophy.

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DISSERTATION ABSTRACT

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The 1990s witnessed several prominent external crises in emerging markets in which these countries were abruptly and unexpectedly cut off from the international capital markets, leaving their economies in dire financial straits and teetering on the brink of a complete collapse. These crises—commonly referred to as sudden stops—now constitute a major topic of policy concern and of academic research. While the literature has made much headway in better understanding this phenomena, care must be taken that these crises are not overly generalized. This cautionary note motivates the underlying theme of the three essays what compose this dissertation: sudden stop crises occur in many different shades and have been conceptually interpreted in the literature as very different phenomena.

Empirically defining sudden stop crises is an inherently subjective exercise, and as such, it is not surprising various definitions exist in the literature. The first essay of this dissertation reviews definitions used in the literature to identify sudden stops and discusses the implications of their dissimilarities. The results in this essay suggest

researchers should heed considerable caution when comparing empirical results within the sudden stop literature, since in some instances it amounts to little more than an apples-to-oranges comparison despite studies referencing the same type of external crisis.

The second essay considers the near-ubiquitous assumption in the literature involving the output costs of sudden stop crises that their magnitudes are sufficiently homogenous to treat them as such. Contrary to this literature, this essay finds that the intensity of these crises does help determine the resulting output loss, with estimates for ranging from effectively no impact up to an 11% loss in GDP growth.

The third essay considers a recent argument made in the literature that a non-trivial number of sudden stop crises in emerging markets occur largely because of domestic capital flight. This essay extends these papers' methodologies in several important ways and finds that domestic capital flows often fail to display a marked change in behavior during a sudden stop crisis and thus play only a minor role in exacerbating these crises.

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CHAPTER I

IDENTIFYING SUDDEN STOP CRISES:

A SURVEY OF THE LITERATURE

1. Introduction

Calvo (2003) describes a sudden stop crisis as "a large reduction in the flow of international capital." These crises have been associated with severe recessions and protracted disruptions in the financial sector, thus it is not surprising there is a large and growing literature on this topic. While the essence of Calvo's description of sudden stops is broadly representative of that taken in the literature, there has been less consensus in how to define these crises empirically. This point is not entirely surprising. A succinct description of sudden stops—as with most macroeconomic phenomena—does not lend itself well to a single, precise mathematical criterion to define these crises.

Given that varied sudden stop definitions exist in the literature, it is useful to discuss why economists define these crises in the first place. After all, prominent sudden stops such as in Mexico 1994-95, Thailand 1997-98, and Argentina 2001-02 are well known, thus a researcher could use his or her informed knowledge to distinguish crisis periods from non-crisis periods. However, identifying sudden stops based on the researcher's discretion risks incorporating selection bias into the analysis in favor of more severe episodes. Indeed, the three crises cited here are well known, at least in part, because of the severe economic recessions and the resulting intense media coverage.

Thus it is incumbent on the researcher to apply an objective criterion to identify sudden stop crises.

This essay discusses several issues confronting the researcher when developing an objective criterion to identify sudden stops by reviewing empirical definitions employed in the recent literature. Particular focus is on the (dis)similarities between the various sudden stop definitions and why they arise. These issues are illustrated using a sample of 36 emerging market countries from 1980Q1 to 2005Q4. The essay proceeds as follows: section 2 reviews the sudden stop definitions commonly employed in the literature; section 3 illustrates the differences between the various crisis definitions; and section 4 concludes.

2. The literature

To motivate a survey of the literature involved with empirically defining sudden stop crises, a keyword search using "sudden stops" was conducted in the EconLit database. The search yielded thirty-one papers published since 2004 which are shown in Table 1, along with a brief definition and description of the main crisis definition used in each paper. A brief examination of this table reveals myriad criteria have been used by the recent literature to identify sudden stops. Nonetheless, there are several facets that many of these definitions have in common. First, the overwhelming majority of papers consider negative changes in net capital flows as the main variable of interest and do so using data on a country's financial account from its balance of payments statement. A country's net financial account, denoted as FA, represents the sum of purchases/sales of

domestic assets by foreigners with purchases/sales of foreign assets by domestic residents. Negative changes in FA imply that the aggregated financial flows are moving away from the country at a faster rate than the previous period, or, alternatively, these flows are coming into the country at a slower rate than the previous period. It is important to emphasize that crisis definitions considering only negative changes to FA allow for the possibility of a sudden slowdown of capital inflows, despite the conjured image of capital flows ceasing to flow inward as suggested by the moniker sudden stops. The additional constraint that FA be negative when measured in levels rather than first differences ensures that only episodes of capital outflows will be considered (e.g., Edwards, 2004; Sula, 2006). Ironically, FA must be zero in order for capital flows to literally stop—a criterion omitted in all the sudden stop definitions surveyed.

Another commonality shared between many of the sudden stop definitions surveyed in Table 1 is that change in a country's financial account (ΔFA) be less than a particular threshold involving the mean and/or standard deviation of the ΔFA series (e.g., Calvo et al., 2004; Bordo et al., 2007; and Rothenberg and Warnock, 2006). Specifically, the following criterion is used:

$$\Delta FA_t \leq \mu_{\Delta FA} - \beta\sigma_{\Delta FA} \qquad (1)$$

which indicates a sudden stop occurs in a country when the change in its capital flows at time t is at least β standard deviations below its mean, with the choice of β tending to take a value between 1 and 2 (e.g., Guidotti et a., 2004; Gallego and Jones, 2005). Yet many variations of equation (1) exist. For example, Catao (2006) simply omits $\mu_{\Delta FA}$;

Rothenberg and Warnock (2006) measure $\mu_{\Delta FA}$ and $\sigma_{\Delta FA}$ on a rolling basis such that all data up to time t is used to compute these statistics; and Frankel and Cavallo (2004) replace $\mu_{\Delta FA}$ with the mean of the standard deviation of ΔFA for each decade of their nearly three-decade long sample.

Several sudden stop definitions in Table 1 require the negative ΔFA be sufficiently large relative to GDP in absolute terms, which often ranges from 3% to 5% of GDP (e.g., Bordo et al., 2007; Catao, 2006). In this manner the reduced capital inflows or increased capital outflows during a sudden stop crisis are required to be economically large which contrasts with equation (1) since the latter requires only that ΔFA be large relative to its own history. Indeed, solely using this criterion to indicate sudden stop crises has been favored by some authors, such as Becker and Maruo (2006). However, large negative changes in FA are not necessarily interpreted as a sudden stop in the literature. For example, Edwards (2007) interprets a 3% drop in FA relative to GDP as a capital flow contraction and distinguishes this from a sudden stop since the latter, according to the author, must be preceded by capital inflows. On a related note, some authors require a decline in GDP, as a whole or on a per capita basis, in order for a sudden stop crisis to occur (e.g., Frankel and Cavallo, 2004; Calvo et al., 2004). This criterion necessarily limits analysis to a subset of costly sudden stops, rather than considering the broader scenario of a marked reduction of capital inflows (Honig, 2008).

3. Comparing sudden stop definitions

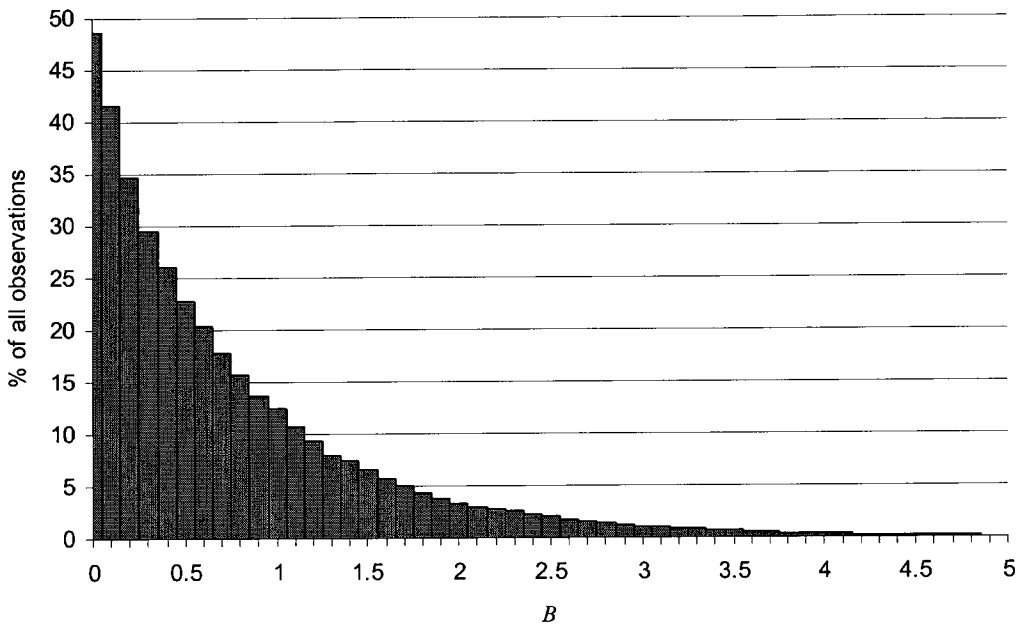
The previous section of this essay demonstrates the general approach, and the subtle differences thereof, taken in the literature to empirically identify sudden stop crises. The subtlety of these different methodologies, however, does not necessarily imply broad agreement in the literature as to what constitutes a sudden stop crisis. Data taken from the IMF's International Financial Statistics database for 36 emerging market economies from 1980Q1 to 2005Q4 is used to illustrate the differences that arise from employing the various sudden stop definitions used in the surveyed literature.

3.1 Choosing the mean and standard deviation

Table 2 in the appendix shows 40 sudden stops are identified by applying equation (1) to this paper's sample and setting β equal to 2. Note that consecutive periods satisfying this equation are assumed to be of the same episode. The sudden stops identified in Table 2 can be interpreted as negative outliers in the ΔFA series, and as with any set of data, qualifying an observation as an outlier is inherently subjective. The scalar β plays a crucial role in equation (1) since its value distinguishes how much variability around the mean is considered normal, and thus determines what is and is not identified as a sudden stop. As discussed in the previous section, the literature has tended to use values of β between 1 and 2. Figure 1 below shows how the observations identified as sudden stops (as a percentage of all observations) change as β increases in equation (1). About 12.4% of the 2297 observations are qualified as a sudden stop when $\beta = 1$, which contrasts with 3.3% of the observations deemed as a crisis when $\beta = 2$.

The right-most part of Figure 1 shows two observations which satisfy equation (1) when $\beta = 4.8$, which represent Indonesia 1998Q3 and Thailand 1998Q1.

Figure 1 – Sudden stop observations for different values of β

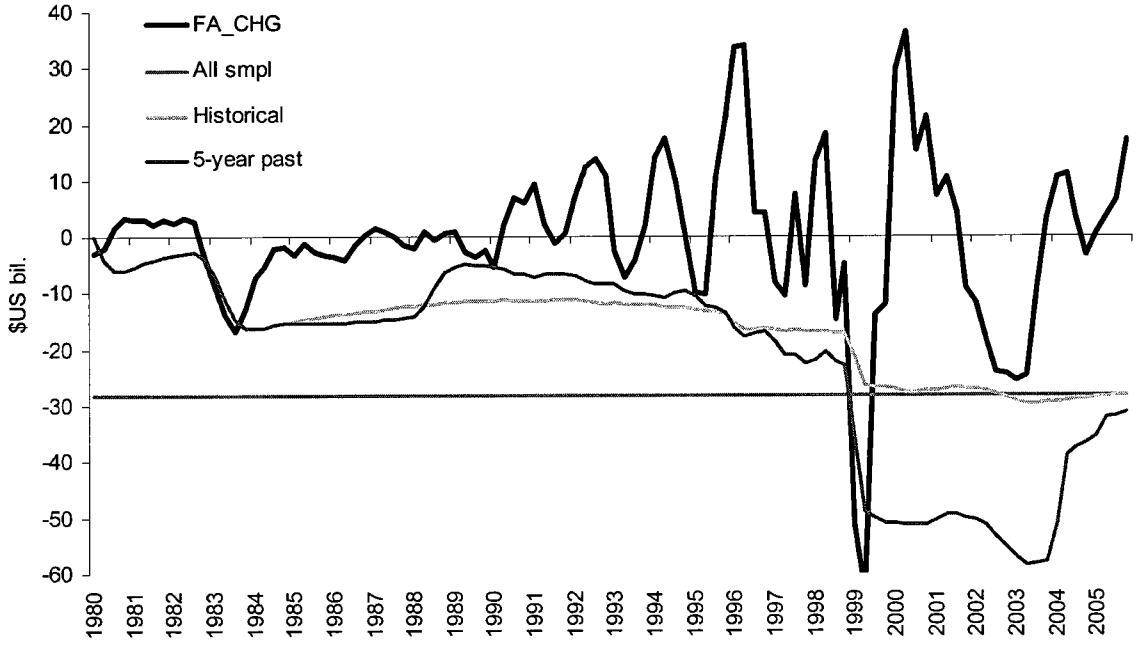


Sudden stops identified by equation (1) are also affected by the data that the mean and standard deviation are computed over. Each of the sudden stops shown in Table 2 is based off of a mean and standard deviation taken across the respective country's entire sample of data, and therefore the threshold used to distinguish a sudden stop is time-invariant. The alternative is to use a unique sub-sample of data at time t to generate these statistics (also termed rolling statistics). Two factors will lead to a divergence between statistics calculated on a rolling basis versus using the full sample period. First, if the

ΔFA series is trending or displaying heteroskedasticity then clearly a divergence between rolling statistics may diverge from the full sample counterpart. Secondly, the effect of the sudden stop observation(s) can have considerable effect on μ and σ in equation (1) which becomes more pronounced for time-variant methods.

The implications of letting μ and σ be time-variant as opposed to time-invariant are illustrated in Figure 2 which shows ΔFA for Brazil from 1980.1 to 2005.4.

Figure 2 - Sudden stops in Brazil



An observable increase in volatility of this series began in the early 1990s and persisted through the end of the sample. In fact, the average change in net capital flows for Brazil has centered around zero, although a large and sustained increase in volatility occurred during the sample with $\sigma = 4.6$ during the 1980s and equal to 18.0 afterwards.

Thus, letting μ and σ be time-invariant (i.e., using the full sample) means that negative changes in net capital flows before 1990 are less likely to be identified as sudden stops simply because these observations are being judged in part by the higher volatility occurring a decade later. This systematic increase in volatility is likely why Brazil's debt crisis in the early 1980s is not identified as a sudden stop using the equation (1) with μ and σ based on the full sample (*All smpl*). An alternative to basing this threshold on the entire time span of the sample is to use a moving average of data for the past X years up to and including the observation at time t. For demonstration purposes, a 5-year moving average is used (*5-year past*).[1] While this method does capture the debt crisis in the early 1980s it does so before this rolling statistic has actually accumulated an entire five years worth of data and also narrowly avoids classifying reduced net inflows in 1990, 1993, and 1995 as sudden stops. Moreover, when large reductions in ΔFA do occur—such as when Brazil devalued and subsequently floated the real in January 1999—the effect on this threshold is dramatic and persists for the next X periods. A middle ground between the two methods discussed here is to base μ_t and σ_t strictly on historical data at each point in time. This approach prevents, for example, the markedly higher volatility in ΔFA post-1990 from dominating the threshold in the 1980s, while dissipating the effect of the 1999 crisis among more than just 5 years worth of observations.

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[1] To ensure the time variant methods have sufficient data to be calculated, I exclude sudden stop observations occurring during the first 3 years of data for each country. For the threshold using the 5-year moving average, it would be ideal to exclude the first 5 years worth of data. I avoided doing this, however, so that the Latin American debt crises in the early 1980s could be considered.

The manner in which the mean and standard deviation are calculated clearly has implications for what constitutes a crisis and the specific timing of each crisis. The percentage of sudden stop observations found using each of the 3 thresholds discussed here that are also identified by methods are shown in

Table 3. For example, 92% of the sudden stop observations determined by applying the 5-year moving average to μ_t and σ_t in equation (1) correspond to the sudden stop observations identified when the mean and standard deviation are calculated for the entire period; yet only 67% of the latter observations occur with the former.[2]

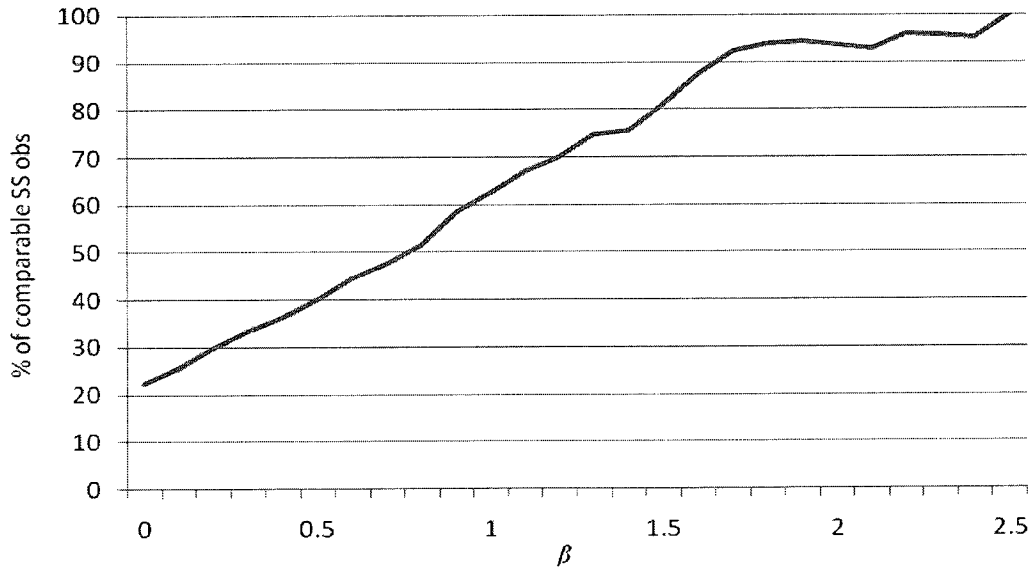
3.2 Economically large sudden stops

A considerable number of the surveyed sudden stop definitions in this essay require that ΔFA be sufficiently large relative to GDP in absolute terms (often ranging from 3% to 5% of GDP). It is important to stress that equation (1) identifies sudden stops based on whether ΔFA deviates significantly from its own behavior, and not based on whether ΔFA is large in an economic sense. This distinction can be illustrated using an analogy with a baseball player. Equation (1) indicates when the player hits the ball further than normal, yet there is no assurance this hit is a homerun. Ensuring sudden stops are economically large is clearly desirable, yet doing so can come with a cost in the form of fewer observations to consider. For example, adding the requirement $\Delta FA \leq 5\%$ of GDP to equation (1) results in 38 sudden stops with this essay's sample—16 fewer

[2] The specific episodes found using thresholds constructed from historical data and from a 5-year moving average are listed in Table 4 and Table 5, respectively.

episodes than when only equation (1) was used. The additional stringency that this criteria adds to equation (1) is in part a function of the choice of β. As β increases, there is a greater likelihood that crisis observations determined by equation (1) will also be economically large despite the imposition that they be so. Indeed, Figure 3 below shows that when β ranges between 1 and 2, 63% to 93% of all sudden stop observations identified from equation (1) also satisfy $\Delta FA \leq 5\%$ of GDP.

Figure 3 - Sudden stops that are economically large & β



Given that there can be a tradeoff between ensuring sudden stops are economically large and having fewer observations, it is useful to know how many sudden stops identified using equation (1) are already economically large. In other words, it is useful to know how many of the baseball player's "big" hits are also homeruns. The Venn diagram in Figure 4 of the appendix shows that 30 of the 150 crisis observations (or

20%) are lost if the requirement that $\Delta FA \leq 5\%$ of GDP were added to equation (1) simply because no GDP data exists. Of the remaining 120 crisis observations, 97 (or 81%) satisfy this requirement. Thus, the percentage of the 150 "big" hits that are homeruns lie between 65% and 85%, depending on the economic impact of the 30 sudden stop observations without corresponding GDP data.[3]

3.3 Balance of payments relationships

The majority of definitions surveyed in Table 1 identify sudden stops based on the financial account from a country's balance of payments (BOP). Yet the BOP identity indicates a sharp reduction in the financial account occurs simultaneously with an abrupt improvement in the current account (typically referred to as a current account reversal, or CAR), unless offset by a liquidation of international reserves. This relationship has led to varying interpretations how CARs are related to sudden stops. For instance, Guidotti et al. (2004) define a CAR conditional on the occurrence of sudden stops,[4] while Hutchison and Noy (2006) and Komarek and Melecky (2005) define a sudden stop conditional on the occurrence of a CAR.[5] Behind these definitions lies an implicit assumption on where

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[3] Some papers define sudden stops simply when the financial account reduction is at least 5% of GDP without considering equation (1) (for e.g., Becker and Mauro, 2006; and Levchenko and Mauro, 2006). Using this crisis definition yields 61 crisis episodes as shown in Table 7. While only 65% of these 163 sudden stop observations do not satisfy equation (1), many of these observations actually lengthen episodes identified using equation (1).

[4] Guidotti et al. (2004, p. 79) identify 313 sudden stop observations (of a total of 3579) using a variant of equation (1). Of these observations, they find 265 occurred with a current account reversal and 48 did not. "As can be immediately concluded, sudden stops most likely lead to current account adjustments."

[5] Specifically, Hutchison and Noy (2006), and Komarek and Melecky (2005) define sudden stops as the joint occurrence of current account reversals and currency crises.

the shock to the BOP originates (i.e., the international financial markets if sudden stops lead to CARs, and the domestic economy via savings / investment or fiscal budget if CARs lead to sudden stops).

To begin an investigation into the identification problem between CARs and SSs, I first follow previous definitions in the literature and define a CAR when the positive change in a country's current account is at least 5% of its GDP.[6]

[6] See, for e.g., Edwards (2004).

Table 8Table 8 shows the 39 episodes of CARs identified using this method. For symmetry with its BOP counterpart, I define a sudden stop when the negative change in the financial account is at least 5% of GDP, which yields 61 episodes as shown in Table 7. Two-thirds of the sudden stop observations occur in the absence of CARs, while 59% of the CAR observations occur in the absence of sudden stops—clearly these phenomena are not necessarily one and the same, nor is either phenomena a subset of the other. Having established this point, attention is now focused on CARs occurring during sudden stops since the latter is the focus of this essay. The fact that about one-third of sudden stop observations occur in concert with CARs suggests that central banks are often able to sufficiently reduce international reserves to prevent the effect of sudden stops from reaching the domestic economy via the current account in a significant manner. The bubble plot in Figure 5 of the appendix illustrates the relationships between the BOP accounts during sudden stops. Larger net capital outflows as a percentage of GDP (i.e., moving leftward along the x-axis) are more frequently countered with a larger reduction in international reserves (i.e., larger diameter of the bubbles), than occurring with an increase in the current account (i.e., upward movement along the y-axis). In fact, the coefficient of determination between changes in the financial account in reserves is 51%, while being only 8% for changes in the financial and current accounts as shown in the scatter plot found in Figure 6 of the appendix. A 1:1 relationship between sudden stops and CARs implies a trend line from a scatter plot of changes in the financial account and current account will yield a slope coefficient of -1. Using the sudden stop observations, a linear trend fitted to changes in the current account (y-axis) and changes in the financial

account (x-axis) yields $y = 0.23x + 1.4$. Replacing the current account with reserves on the y-axis yields $y = 0.85x - 2.8$, whose slope coefficient is about 4 times that with the current account. This shows that sudden stop is more typically offset in the balance of payments with a reduction in reserves than with a CAR.

The bubble plot, scatter plot, and percentages of joint occurrence discussed above yield information regarding the dissimilarity between changes in the financial account and current account, but they do not adequately address whether the identification problem because the BOP relationships are examined strictly at each point in time of a sudden stop. To gain insight into the dynamic relationship between sudden stops and CARs I find instances when these two events are associated by assuming that CARs occurring no more than 1 adjoining period apart from a sudden stop are associated, thus I allow these phenomena to be associated even if the timing of their respective episodes are not identical.[7] Using this criterion, 25 of the 61 sudden stops are associated with a current account reversal (or 41%). Table 6 shows the overwhelming majority of the associated CARs start after and end after sudden stops (72% in both cases), although the difference in timing is often by just 1 quarter. The remaining 28% of sudden stops associated with CARs—numbering 7 episodes—occur not because of a shock to the international capital markets, but rather as a byproduct of a shock to the current account. Viewing these results as a whole, reduced international reserves are able to withstand

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[7] This associates a CAR with a sudden stop whenever the two occur simultaneously at least once during their episode, as well when either episode immediately precedes the other (e.g., a CAR from 1990.4-1991.1 is associated with a sudden stop from 1991.2-1991.4). Only in the case of Russia did this timing criteria result in attributing the same CAR to multiple sudden stops, to which I chose the first sudden stop because it had the most observations in common with the CAR.

most sudden stops from becoming major current account reversals, and major CARs that do take place during sudden stops are usually forestalled by a country's central bank for at least 1 quarter.[8]

4. Summary

This essay has reviewed several important considerations involved with defining sudden stop crises using a sample of 36 emerging market countries from 1980.1-2005.4 for illustration. The representative method in the literature used to identify sudden stops, albeit arguably, is when reduced net capital flows falls below β standard deviations below the mean—this amounts to a criterion to distinguish negative outliers. The number of standard deviations used in this approach is a non-trivial matter. Indeed, the norm in the literature is to use 1 to 2 standard deviations, which means the difference of identifying 12% or 3% of this paper's sample as sudden stops. Taking the means and standard deviations over the full sample or over a sub-sample can also have major implications on what constitutes a sudden stop, particularly when the changes in net capital flows display a trend or heteroskedasticity. Additionally, the mean and standard deviation incorporate the very outlier they are used to detect which can have a dramatic effect on the choice of using full-sample statistics or their sub-sample counterpart.

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[8] The relationship between sudden stops and CARs is also explored in a subsection of Edwards (2004), in which a close, but less than 1:1 relationship is found. He says "this indicates that when facing a 'sudden stop' of capital inflows many countries have been able to effectively use their international reserves in order [to] avoid an abrupt and major current account reversal. At the same time, these results suggest that a number of countries have gone through large current account reversals without having faced a sudden stop in capital inflows. Most of the countries in this group were not receiving large inflows to begin with, and had financed their large deficits by drawing down international reserves."

There are no guarantees sudden stops defined using the representative method are large relative to the economy. Yet ensuring these episodes are economically large by adding the requirement reduced net capital flows be at least 5% of GDP results in losing observations when data coverage for GDP is less than that for capital flows. The effect on this paper's sample was to lose about 20% of the crisis observations, despite the fact that between 65% and 85% of the crisis observations were already economically large. The final consideration discussed in this paper was the identification problem between current account reversals and sudden stops. About 66% of the sudden stop observations occur in the absence of these reversals. Sudden stops observations have a much stronger linear relationship with reduced international reserves ($R^2 = 51\%$) than with increases in the current account ($R^2 = 8\%$). About 59% of the sudden stop crises occur without major current account reversals when these phenomena are considered dynamically. And when current account reversals do occur in the vicinity of sudden stops, they typically occur 1 quarter after sudden stops. In total, 7 of the 61 sudden stops appear to be the byproduct of a current account reversal.

An intentional effort was made in this paper not to cast a particular identification scheme as being categorically superior. There are several reasons for this. First, the identification schemes used in papers are often more complicated versions of the schemes discussed here. For instance, Calvo et al. (2004) applied equation (1) using a lower threshold of $\beta = 1$ to date episodes, conditional on at least one observation within that episode satisfying the higher threshold with $\beta = 2$—this "blending" of thresholds was not considered in this essay. Second, the prima facie evidence found in this paper is that the

slightest alteration of an identification scheme or the sample period can potentially result in markedly different sudden stops. Thus, declaring a particular method superior may very well change if, for example, the sample period were altered. Lastly, it is unclear what basis a given identification method could be deemed categorically superior. After all, the different sudden stop definitions are just that, different. And comparing these methods from the perspective of whether or not a particular crisis is identified violates the very reason for developing an objective criterion.

Nonetheless, it is quite useful to see how and why various definitions yield different sudden stops. Clearly it is important to make an informed decision as to which definition to employ in an analysis, as well as for robustness tests. The considerations posed in this paper may also help guide the type of data used in an analysis. For example, a researcher will be hard pressed to determine causality between sudden stops and current account reversals if annual data is used. The counterpoint to examining the various sudden stop definitions in this paper is that care is needed to avoid "engineering" the identification scheme to obtain the desired output. The choice of identification scheme employed should be done in an informed manner of the costs and benefits, and as a general rule the scheme should deviate only slightly, if at all, from the practices set forth in the literature. This is particularly pertinent to the topic at hand since a sudden stop is ultimately a subjective event, regardless of the degree of sophistication in how it is determined.

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6. Appendix

Table 1 - Sudden stop definitions in the literature

Author(s)	Brief Definition	Description	Sample
Becker and Mauro (2006)	ΔFA / GDP $\leq$-5%	A sudden stop occurs when the financial account balance worsens by more than 5 percentage points of GDP relative to the previous year.	1970-2001, annual; all possible countries
Bordo, Cavallo, and Meissner (2007)	(1) $\Delta RGDP < 0$; (2) $\Delta FA \leq \mu - 2\sigma$; and / or (3) ΔFA / GDP $\leq$-3%	FA is obtained by subtracting the trade balance from changes in reserves. A sudden stop must occur with (1) a decrease in real GDP (RGDP) at time t and/or $t+1$, and either or both of the following conditions: (2) ΔFA be at least 2 stdevs below its mean; (3) the first year that a drop in FA is 3% of GDP over a period shorter than 4 years.	1880-1913, annual; 20 emerging markets
Calvo, Izquierdo, and Loo-Kung (2006)	(1) $\Delta FA \leq \mu - 2\sigma$; (2) Δ(spread) $\leq \mu - 2\sigma$	A *systemic* sudden stop (SSS)—that is, a crisis reflecting shocks to the capital markets—requires that (1) ΔFA is at least 2 stdevs below its mean, and (2) the change in the aggregate bond spread (e.g., J.P. Morgan's Emerging Market Bond Index (EMBI) spread over U.S. Treasury bonds, measured in logs) is at least 2 stdevs below its mean. A "capital flow window" and "aggregate spread window" is constructed by marking the start/end of each window as the first period that ΔFA and Δ(spread) are 1 stdev below their mean before/after (1) and (2) are satisfied, respectively. An SSS occurs when these windows overlap. The means and stdevs in (1) and (2) are measured on a rolling basis (historical), with the first two years of data excluded. Capital flow windows occurring 6 months or less apart from another are considered the same window	1990-2001, monthly; 15 emerging markets and 17 developed economies
Calvo, Izquierdo, and Mejia (2004)	(1) $\Delta FA \leq \mu - 2\sigma$; (2) $\Delta GDP < 0$	A "capital flow window" is constructed as described in Calvo, Izquierdo, and Loo-Kung (2006) when ΔFA is at least 2 stdevs below its mean. A sudden stop occurs when output drops during the "capital flow window." The mean and stdev in (1) is measured on a rolling basis (historical), with the first two years of data excluded.	1990-2001, monthly; 15 emerging markets and 17 developed economies
Calvo, Izquierdo, and Mejia (2008)	See Calvo, Izquierdo, and Loo-Kung (2006).	--	1990-2004, monthly; 21 developed and 89 developing economies
Calvo, Izquierdo, and Talvi (2006)	See Calvo, Izquierdo, and Loo-Kung (2006).	--	1990-2001, monthly; 15 emerging markets and 17 developed economies
Catao (2006)	(1) $\Delta FA \leq -2\sigma$; and / or (2) ΔFA / GDP $\leq$-3%	ΔFA represents deviations from a linear trend, rather than year-on-year changes. A sudden stop occurs when (1) ΔFA is at least 2 stdevs below zero, and/or (2) ΔFA is at least 3% of GDP. A sudden stop begins when FA attains its peak and ends when FA starts rising relative to trend without falling back to its lowest level within a 4-year period.	1870-1913, annual; 16 countries

Author(s)	Brief Definition	Description	Sample
Cavallo (2005)	See Frankel and Cavallo (2004).	--	--
Cowan et al. (2007)	(1) $\Delta FA \leq \mu - \sigma$; (2) $\Delta FA / GDP \leq -5\%$	The net capital flow series is scaled by a linear trend of GDP to "disentangle" fluctuations in capital flows from fluctuations in real GDP and the real exchange rate. After doing this, a sudden stop occurs when (1) the scaled ΔFA is at least 1 stdev below its average, and (2) the scaled ΔFA is at least 5% of GDP.	1975-2004, annual; 32 emerging markets and 21 developed economies
Deb (2005)	(1) $\Delta FA / GDP \leq -5\%$ (2) Currency crisis	A sudden stop occurs when a drop in FA is at least 5% of GDP and a currency crisis occurs at time t or $t+1$.	1975-1999, annual; all possible countries
Durdu, Mendoza, and Terrones (2007)	--	The authors use sudden stops identified "in various empirical studies, including Calvo et al. (2004), Cavallo and Frankel (2004), and Rothenberg and Warnock (2006)."	1985-2004, annual; 17 emerging markets
Edwards (2004)	(1) $FA > \chi$ (2) $\Delta FA / GDP \leq -5\%$	A sudden stop occurs when (1) a country receives an inflow of capital larger than the third quartile of inflows for the region (χ) during the previous two years of the crisis, and (2) net capital inflows decline by at least 5% of GDP.	1970-2001, annual; all possible countries
Edwards (2005)	See Edwards (2004).	--	--
Edwards (2006)	See Edwards (2004).	--	--
Edwards (2007)	$\Delta FA / GDP \leq -3\%$	Edwards calls this a "capital flow contraction" (CFC) and distinguishes this from a sudden stop since, according to Edwards, the latter must be preceded by net capital inflows.	1970-2004, annual; all possible countries
Frankel and Cavallo (2004)	(1) $\Delta FA \leq \psi - 2\sigma$; (2) $\Delta CA \geq 0$; (3) $\Delta(PCGDP) < 0$	A sudden stop occurs when (1) the financial account falls at least 2 standard deviations below the mean stdev (ψ) at time t and is preceded by a FA surplus, (2) the current account increases at time t or $t+1$ and is preceded by a CA deficit, and (3) per capita GDP (PCGDP) falls at time t or $t+1$. The mean stdev (ψ) is calculated by taking the average of the stdevs during the 1970s, 80s, and 90s+.	1970-2002, annual; all possible countries
Gallego and Jones (2005)	(1) $\Delta FA \leq \mu - 2\sigma$	A sudden stop is defined by a "capital flow window" (see Calvo, Izquierdo, and Loo-Kung, 2006) when ΔFA is at least 2 stdevs below its mean.	1990-2003, monthly; 14 emerging markets
Gallego and Tesseda (2008)	See Gallego and Jones (2005).	--	Time sample is country dependent (see paper), quarterly; 4 emerging markets
Guidotti, Sturzenegger, and Villar (2004)	(1) $\Delta FA \leq \mu - \sigma$; (2) $\Delta FA / GDP \leq -5\%$	Sudden stops are identified by (1) a reduction in net capital flows by at least 1 stdev below its mean, and (2) the reduction in net capital flows are at least 5% of GDP.	1974-2002, annual; all possible countries

Author(s)	Brief Definition	Description	Sample
Honig (2008)	(1) $\Delta FA \leq -2\sigma$; (2) $\Delta CA \geq 0$; (3) $\Delta(PCGDP) < 0$	A sudden stop occurs when (1) the financial account falls at least 2 standard deviations below zero at time t and is preceded by a FA surplus, (2) the current account increases at time t or $t+1$ and is preceded by a CA deficit, and (3) per capita GDP (PCGDP) falls.	1982-2004, annual; all possible countries
Hutchison and Noy (2006)	(1) ΔCA / GDP $\geq 3\%$; (2) Currency crisis	A sudden stop is defined by the joint occurrence of an increase in the current account by at least 3% of GDP and a currency crisis.	1975-1997, annual; 24 emerging markets
Hutchison, Noy, and Wang (2007)	(1) $\Delta FA \leq -2\sigma$; (2) $\Delta CA \geq 0$	A sudden stop crisis is defined as a year in which (1) the financial account decreases by at least 2 stdevs, and (2) the current account increases at time t or $t+1$ and is preceded by a deficit.	1980-2003, annual; 83 SSs (occurring in 66 non-OECD countries)
Jeanne and Rancier (2006)	See Becker and Mauro (2006).	--	1975-2003, annual; 34 emerging markets
Joyce and Nabar (2008)	--	Joyce and Nabar use sudden stops identified by either Frankel and Calvo (2004) or Calvo, Izquierdo, and Mejia (2004).	1976-2002, annual; 26 emerging markets
Komarek and Melecky (2005)	ΔCA / GDP $\geq 3\%$	A sudden stop is defined by a current account reversal that is at least 3% of GDP.	1993-2001, annual; 59 emerging markets
Komarek, Komarkova, and Melecky (2005)	ΔCA / GDP $\geq 2.5\%$	A sudden stop is defined by a current account reversal that is at least 2.5% of GDP.	1993-2000, annual; 23 emerging markets and developing economies
Levchenko and Mauro (2006)	See Becker and Mauro (2006).	--	1970-2003, annual; all possible countries
Ortiz et al. (2007)	See Calvo, Izquierdo, and Loo-Kung (2006)	--	1990-2006, monthly; 31 emerging markets
Rothenberg and Warnock (2006)	$\Delta FA \leq \mu - 2\sigma$	A sudden stop is defined by a "capital flow window" (see Calvo, Izquierdo, and Loo-Kung, 2006) when ΔFA is at least 2 stdevs below its mean. The mean and stdev are calculated on an rolling basis (historical).	1989-2005, monthly; 28 emerging markets
Sula (2006)	(1) ΔFA / GDP $\leq 4\%$; (2) $FA < 0$	A sudden stop occurs when (1) the reduced capital inflows are at least 4% of GDP, and (2) the financial account balance is in deficit in the year of the sudden stop.	1989-2003, annual; 38 emerging markets and developing economies

Author(s)	Brief Definition	Description	Sample
Terada-Hagiwara (2005)	(1) $\Delta FA / GDP \leq \mu$; (2) $\Delta FA \leq \sigma$,	A sudden stop occurs when (1) reduced net capital flows is less than the sample mean and persists for another 2 quarters, and (2) reduced FA is larger than the sample stdev. The sample mean and stdev are not country-specific, but are instead taken for the panel of countries.	1980-2000, quarterly; 8 emerging markets

Thirty-one papers are cited above. All information in this table pertains to the construction of the main, or preferred, measure of a sudden stop in the respective paper. Multiple conditions listed for a sudden stop definition in this table must both hold, and do so at time *t*, unless otherwise indicated in the *Description* column. All definitions and thresholds are expressed on an annualized basis. Lastly, to simplify the information in the table, the definitions are discussed as if net capital flows were used, despite some authors using specific types of capital flows (e.g., Sula 2006, uses non-FDI capital flows).

Table 2 - Sudden stops identified using equation (1) with $\beta = 2$

Country			
Argentina	1995.1-1995.1	2001.3-2002.2	-
Belarus	-	-	-
Belize	-	-	-
Bolivia	2001.2-2001.2†	2003.3-2003.4	-
Brazil	1999.1-1999.2	-	-
Chile	1998.3-1998.3	1999.1-1999.1	-
Colombia	1999.3-1999.3	-	-
Costa Rica	2004.1-2004.1	-	-
Croatia	1998.4-1998.4	2004.4-2004.4†	-
Czech Rep.	2003.3-2003.3	-	-
Ecuador	2000.3-2000.3	-	-
Estonia	1999.2-1999.2	-	-
Georgia	-	-	-
Greece	1996.2-1996.2†	1997.4-1997.4†	2001.3-2001.4†
Hong Kong	-	-	-
Hungary	1996.4-1996.4	2002.2-2002.2	-
India	1995.3-1995.4†	1998.2-1998.2†	-
Indonesia	1998.1-1998.3	-	-
Jordan	1992.4-1993.3	-	-
Korea	1997.4-1998.3	2001.2-2001.2	-
Latvia	-	-	-
Lithuania	2005.2-2005.2†	-	-
Malaysia	-	-	-
Malta	-	-	-
Mexico	1983.1-1983.3	1995.1-1995.4	-
Pakistan	1998.3-1999.2†	-	-
Peru	1998.4-1999.3	-	-
Philippines	1998.1-1998.4	-	-
Poland	-	-	-
Portugal	1993.1-1993.2	2003.4-2003.4†	-
Russia	-	-	-
Slovak Rep.	2003.4-2003.4	-	-
South Africa	1999.1-1999.1†	-	-
Thailand	1997.3-1998.3	-	-
Turkey	2001.2-2001.4	-	-
Venezuela	2002.4-2002.4†	-	-

The table shows 40 sudden stop crises (76 observations) are identified using equation (1) with $\beta = 2$. Episodes with the symbol (†) indicate reduced net capital outflows during the crisis did not meet 5% of GDP.

Table 3 - Common observations using alternative sudden stop definitions

		...in common with these methods						
	Method letter *Brief description* *(# obs / # episodes)*	(A) SS, B=2 (76 / 40)	(B) SS, Historical (145 / 66)	(C) SS, 5yr MA (105 / 55)	(D) SS, 3% GDP (272 / 95))	(E) SS, 5% GDP (163 / 61)	(F) CAR, 3% GDP (234 / 59)	(G) CA, 5% GDP (135 / 39)
% of obs using these methods ...	(A) SS, B=2 (76 / 40)	--	93%	63%	80%	75%	46%	36%
	(B) SS, Historical (145 / 66)	49%	--	67%	65%	54%	31%	22%
	(C) SS, 5yr MA (105 / 55)	46%	92%	--	70%	57%	33%	24%
	(D) SS, 3% GDP (272 / 95))	22%	35%	27%	--	60%	42%	28%
	(E) SS, 5% GDP (163 / 61)	35%	48%	37%	100%	--	50%	34%
	(F) CAR, 3% GDP (234 / 59)	15%	19%	15%	49%	35%	--	58%
	(G) CAR, 5% GDP (135 / 39)	20%	24%	19%	56%	41%	100%	--

The table shows the percentage of all crisis observations using the method listed on the left column that occur at the same point in time using the method listed on the top row. The details for each method listed are as follows: (A) equation (1) is used with $\beta = 2$ and full sample mean and standard deviation; (B) equation (1) is used with $\beta = 2$ and the means and standard deviations are 5-year moving averages; (C) equation (1) is used with $\beta = 2$ and the means and standard deviations use all historical data; (D) a sudden stop occurs when $\Delta FA \leq -3\%$ of GDP; (E) a sudden stop occurs when $\Delta FA \leq -5\%$ of GDP; (F) a current account reversal occurs when $\Delta CA \geq 3\%$ of GDP; (G) a current account reversal occurs when $\Delta CA \geq 5\%$ of GDP.

Table 4 - Sudden stops identified using a historical roll, $\beta = 2$

Country					
Argentina	1989.4-1990.1	1995.1-1995.1	2001.1-2001.1	2001.3-2002.2	-
Belarus	2004.1-2004.1	-	-	-	-
Belize	-	-	-	-	-
Bolivia	1999.2-2000.1	2000.4-2001.2	2003.3-2003.4	-	-
Brazil	1983.1-1983.3	1999.1-1999.2	-	-	-
Chile	1995.4-1995.4	1998.2-1999.1	-	-	-
Colombia	-	-	-	-	-
Costa Rica	2000.4-2000.4	2004.1-2004.1	-	-	-
Croatia	1998.4-1998.4	2004.4-2004.4	-	-	-
Czech Rep.	2003.3-2003.3	-	-	-	-
Ecuador	1999.3-1999.4	2000.3-2000.4	-	-	-
Estonia	1998.4-1999.2	-	-	-	-
Georgia	-	-	-	-	-
Greece	1992.1-1992.2	1995.4-1996.2	1997.4-1997.4	2001.3-2001.4	-
Hong Kong	-	-	-	-	-
Hungary	1996.4-1996.4	2002.2-2002.2	-	-	-
India	1990.2-1990.4	1991.4-1992.1	1993.2-1993.2	1995.3-1996.1	1998.2-1998.2
Indonesia	1997.4-1998.3	-	-	-	-
Jordan	1992.4-1993.3	-	-	-	-
Korea	1986.4-1987.3	1997.4-1998.3	2001.2-2001.2	-	-
Latvia	-	-	-	-	-
Lithuania	1999.3-1999.3	2005.2-2005.2	-	-	-
Malaysia	-	-	-	-	-
Malta	-	-	-	-	-
Mexico	1995.1-1995.3	-	-	-	-
Pakistan	1995.3-1995.3	1997.2-1997.2	1998.1-1999.2	-	-
Peru	1983.3-1983.4	1998.4-1999.3	-	-	-
Philippines	1983.3-1984.2	1997.4-1998.4	-	-	-
Poland	-	-	-	-	-
Portugal	1991.2-1991.2	1992.4-1993.2	2003.3-2003.4	-	-
Russia	-	-	-	-	-
Slovak Rep.	1999.2-1999.2	2003.4-2003.4	-	-	-
South Africa	1985.1-1986.2	1998.3-1999.1	2001.1-2001.1	2001.3-2001.3	-
Thailand	1985.2-1985.2	1992.3-1992.3	1997.1-1998.3	-	-
Turkey	1991.4-1991.4	1994.3-1994.4	1998.3-1998.3	1999.1-1999.2	2001.2-2001.4
Venezuela	2002.4-2002.4	-	-	-	-

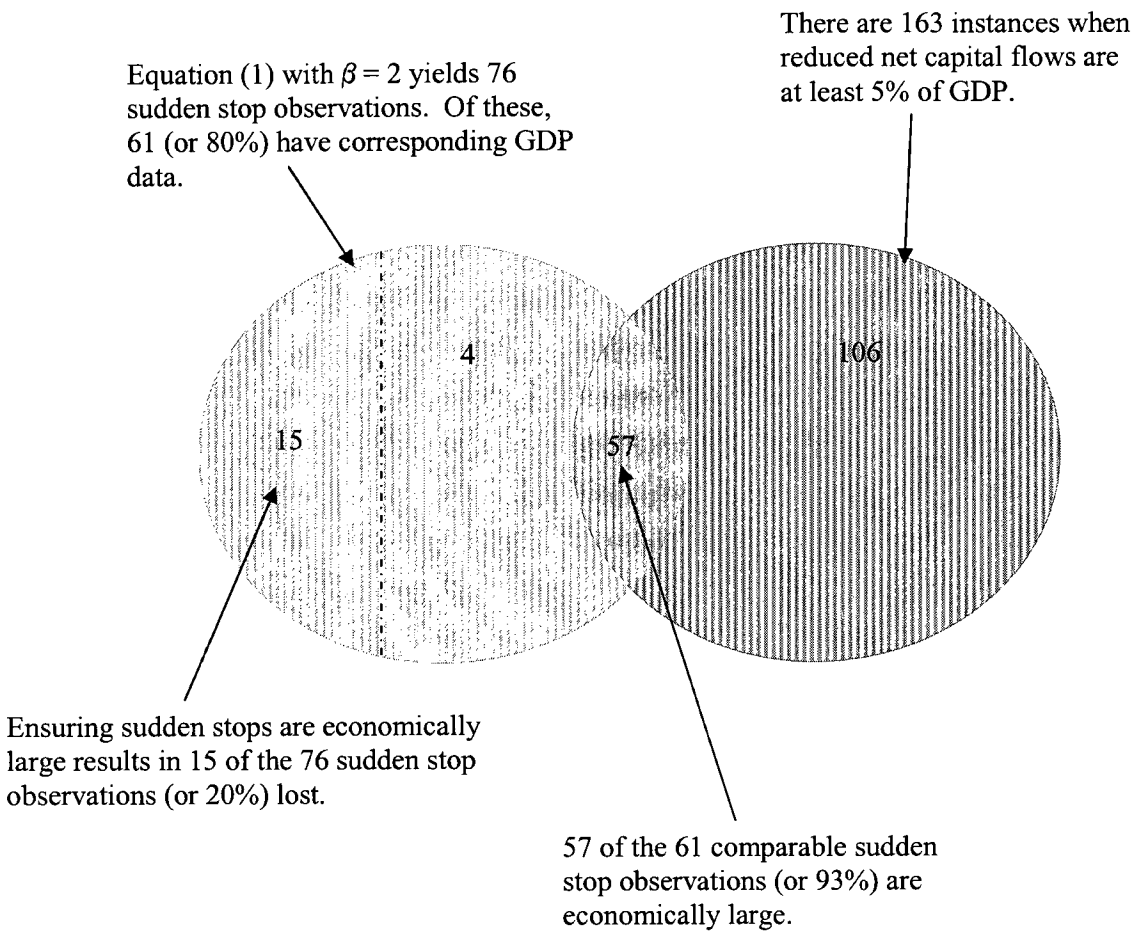
A total of 66 sudden stops are identified using equation (1) with $\beta = 2$, where the means and stdvs are based on all historical data at time *t*. Sudden stops occurring within the first 3 years worth of data for each country are not included.

Table 5 - Sudden stops identified using 5-year moving average, $\beta = 2$

Country				
Argentina	1989.3-1990.1	1995.1-1995.1	2001.1-2001.1	2001.3-2001.4
Belarus	2004.1-2004.1	-	-	-
Belize	-	-	-	-
Bolivia	1999.3-2000.1	2003.3-2003.3	-	-
Brazil	1983.1-1983.3	1999.1-1999.2	-	-
Chile	1995.4-1995.4	1998.3-1998.3	1999.1-1999.1	2004.4-2004.4
Colombia	-	-	-	-
Costa Rica	-	-	-	-
Croatia	1998.4-1998.4	2004.4-2004.4	-	-
Czech Rep.	2003.3-2003.3	-	-	-
Ecuador	1999.3-1999.4	2000.3-2000.4	-	-
Estonia	1998.4-1999.2	-	-	-
Georgia	-	-	-	-
Greece	1992.1-1992.1	1995.4-1995.4	1996.2-1996.2	1997.4-1997.4
Hong Kong	-	-	-	-
Hungary	1996.4-1996.4	2002.2-2002.2	-	-
India	1990.1-1990.3	-	-	-
Indonesia	1997.4-1998.3	-	-	-
Jordan	1992.4-1993.1	-	-	-
Korea	1986.4-1987.3	1997.4-1998.3	-	-
Latvia	-	-	-	-
Lithuania	1999.3-1999.3	-	-	-
Malaysia	-	-	-	-
Malta	-	-	-	-
Mexico	1994.3-1995.3	2004.2-2004.2	-	-
Pakistan	1995.3-1995.3	1998.3-1998.4	-	-
Peru	1983.3-1983.4	1998.4-1998.4	1999.2-1999.2	-
Philippines	1983.3-1984.2	1992.2-1992.2	1997.4-1998.3	-
Poland	-	-	-	-
Portugal	1992.4-1993.2	-	-	-
Russia	-	-	-	-
Slovak Rep.	1999.2-1999.2	2003.4-2003.4	-	-
South Africa	1985.1-1986.2	1998.3-1998.3	1999.1-1999.1	-
Thailand	1985.2-1985.2	1992.2-1992.3	1997.1-1998.1	-
Turkey	1994.3-1994.4	2001.2-2001.3	-	-
Venezuela	2002.4-2002.4	-	-	-

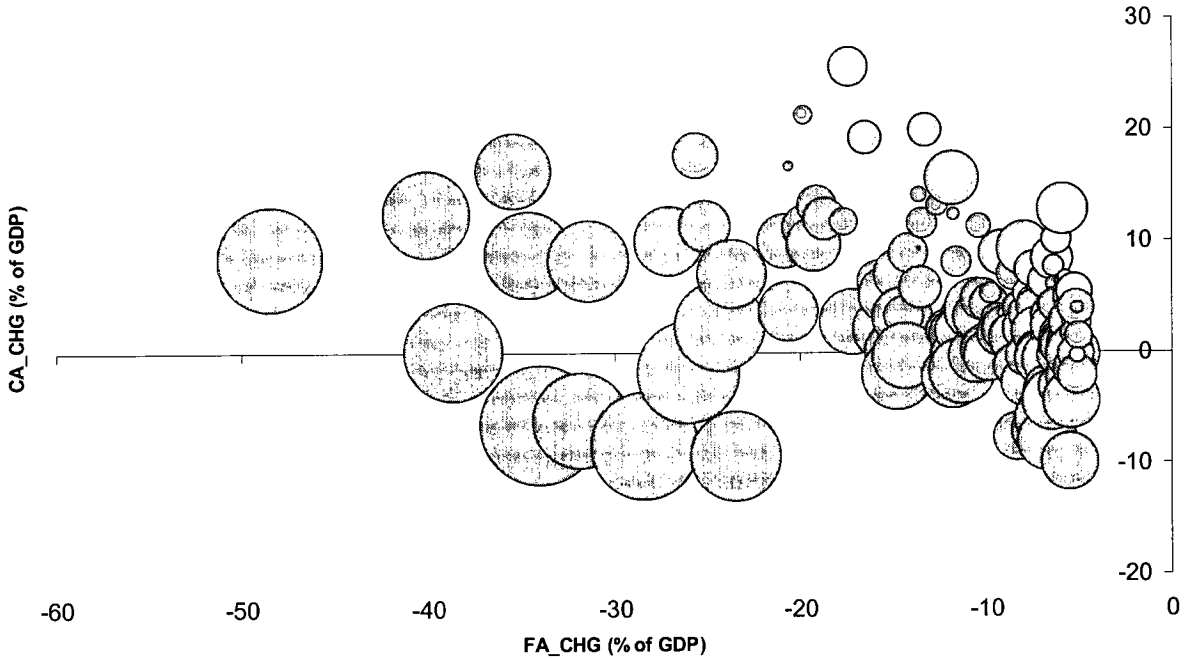
A total of 55 sudden stops are identified using equation (1) with $\beta = 2$, where the means and stdvs are based on the past 5 years worth of data at time *t*. Sudden stops occurring within the first 3 years worth of data for each country are not included.

Figure 4- Sudden stop observations that are economically large



The Venn diagram shows that 57 of 76 sudden stop observations (or 75%) defined using β=2 in equation (1) are also economically large (i.e., are at least 5% of GDP). There are 15 observations without corresponding GDP data—assuming these observations also satisfy the 5% of GDP threshold, then the percentage of economically large crisis observations becomes 95% (= 15 + 57 / 76).

Figure 5 - BOP relationships during sudden stops



Each bubble represents a sudden stop observation as defined when ΔFA is at least 5% of GDP (163 observations). The x and y-axes are the changes in the financial account and current account, respectively, while the size of each bubble is determined by the change in international reserves (all series are expressed as a percentage of GDP). The white bubbles indicate the change in international reserves are negative, and are found mostly in the upper right-hand portion of the graph. The relatively flat trend of the bubbles and the increase in the diameter of the bubbles for observations occurring leftward of the origin suggest that central banks typically counter adverse changes in capital flows with a deaccumulation of international reserves rather than letting the brunt of the change impact the current account. Moreover, the occurrence of a sudden stop does not guarantee an increase in the current account as indicated by bubbles lying below the x-axis.

Figure 6 - BOP 2-way relationships during sudden stops (5% of GDP)

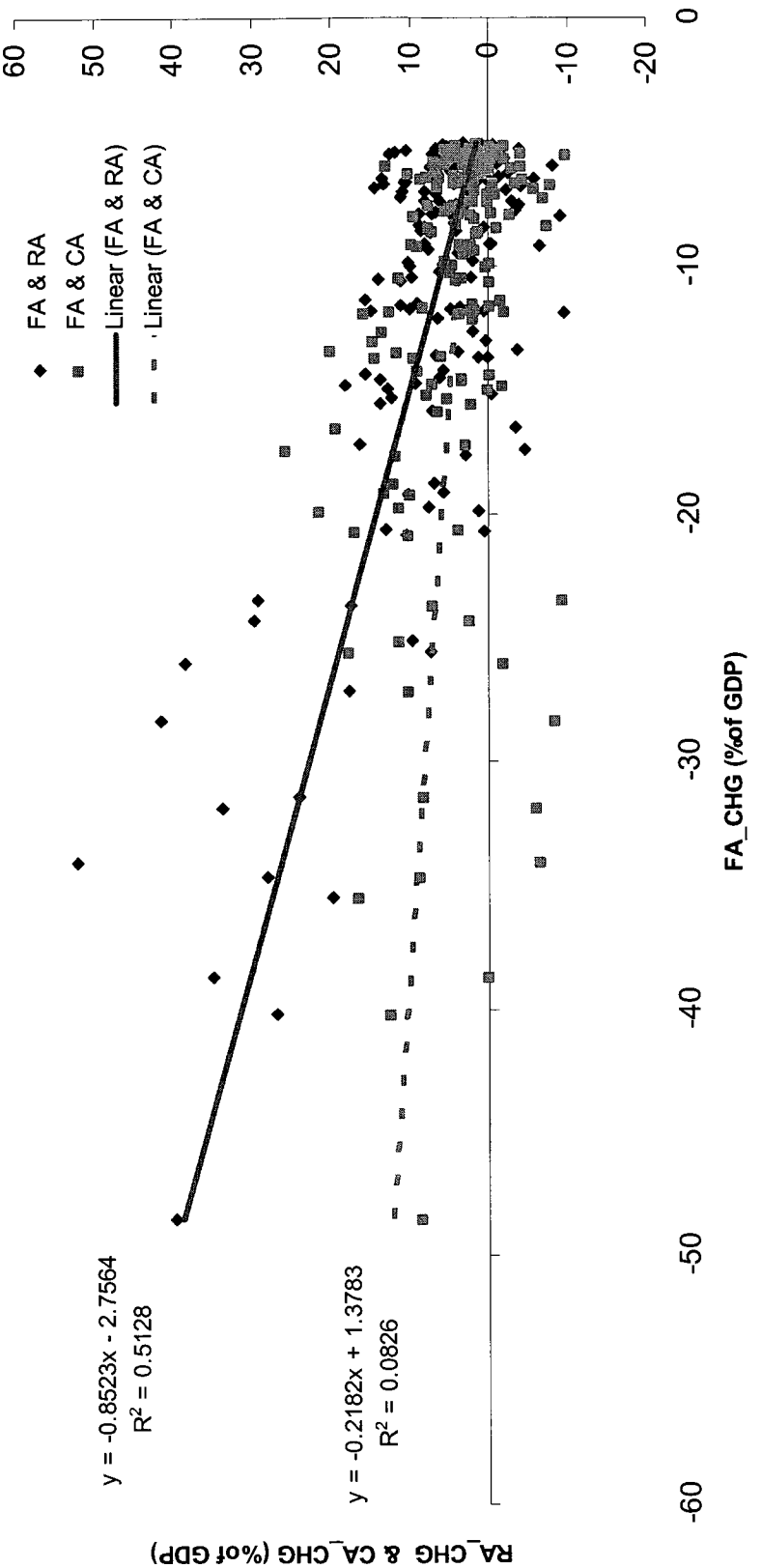


Table 6 – Current account reversals in the vicinity of sudden stops

Country	SS	*t*	*t**	SS	*t*	*t**	SS	*t*	*t**	SS	*t*	*t**
Argentina	1995.1-1995.1	-	-	2001.1-2001.1	-	-	2001.3-2002.4	+2	+1			
Belarus	1999.3-1999.3	-1	+2									
Belize												
Bolivia	2003.4-2003.4	0	+3									
Brazil	1999.1-1999.2	-	-	2002.3-2003.2	-	-						
Chile	1998.3-1999.1	+3	+3									
Colombia	1999.3-1999.3	-1	+2									
Costa Rica	2004.1-2004.1	-	-									
Croatia	1998.4-1998.4	0	+3	2000.3-2000.4	+1	0						
Czech Rep.	1996.4-1996.4	-	-	1997.4-1998.1	+2	+2	2003.3-2004.1	-	-			
Ecuador	1999.2-2001.2	+1	-3									
Estonia	1998.4-1999.3	+3	0									
Georgia	1999.4-2000.1	-	-	2002.4-2002.4	-	-						
Greece												
Hong Kong	2001.3-2002.4	-	-	2003.2-2003.3	-	-	2005.1-2005.2	+1	+1			
Hungary	1996.4-1997.2	-	-	2002.1-2002.3	-	-						
India												
Indonesia	1997.4-1998.4	+1	+1									
Jordan	1992.4-1994.1	-	-	1998.3-1998.4	-	-	2000.3-2000.3	-	-	2001.1-2001.1	-	-
Korea	1986.4-1987.3	+1	0	1997.4-1998.3	+1	+2	2001.2-2001.2	-	-			
Latvia												
Lithuania	1999.3-1999.3	-	-									
Malaysia	2001.1-2001.2	-	-	2003.1-2003.2	+2	+2	2005.4-2005.4	-	-			
Malta	2000.2-2000.2	-	-	2000.4-2001.3	+4	+5						
Mexico	1982.4-1983.3	0	+1	1988.2-1988.2	-	-	1995.1-1995.4	+2	+1			
Pakistan												
Peru	1998.4-1999.3	-	-									
Philippines	1983.4-1984.2	-	-	1986.3-1986.3	-	-	1997.4-1998.4	+3	+1	2001.1-2001.3	-	-
Poland												
Portugal	1983.3-1984.3	-3	+1	1986.4-1986.4	-	-	1991.2-1991.2	-	-	1992.4-1993.3	-	-

Russia	1998.4-1999.3	+1	+6	2000.4-2001.1	-	-						
Slovak Rep.	1999.2-1999.3	-	-	2003.4-2003.4	-	-						
South Africa												
Thailand	1997.2-1998.3	+1	+2									
Turkey	1994.2-1995.1	+1	0	1998.3-1998.3	-	-	1999.1-1999.2	-	-	2001.2-2002.1	+1	0
Venezuela												

Sudden stops (SS) and CARs are identified here when the change in the FA and CA is at least 5% of GDP, respectively. The start and end dates of each CAR is given relative to an SS starting at time *t* and ending at time *t, provided the CAR episode is at most 1 adjoining period away from the SS episode. For example, Turkey experienced a SS from 1994.2-1995.1 and a CAR from 1994.3-1995.1. Only in the case of Russia did this timing criteria result in attributing the same CA reversal to multiple SSs, to which I chose the first SS because it shared the most overlapping observations. Two SSs in Jordan are not shown for space consideration: (i) 2001.4-2001.4 which was not associated with a CA reversal, and (ii) 2003.4-2004.2 that was preceded by a CAR during 2002.2-2003.4.**

Table 7 - Sudden stops (5% of GDP)

Country	1	2	3	4
Argentina	1995.1-1995.1	2001.1-2001.1*	2001.3-2002.4	-
Belarus	1999.3-1999.3*	-	-	-
Belize	-	-	-	-
Bolivia	2003.4-2003.4	-	-	-
Brazil	1999.1-1999.2	2002.3-2003.2*	-	-
Chile	1998.3-1999.1	-	-	-
Colombia	1999.3-1999.3	-	-	-
Costa Rica	2004.1-2004.1	-	-	-
Croatia	1998.4-1998.4	2000.3-2000.4*	-	-
Czech Rep.	1996.4-1996.4*	1997.4-1998.1*	2003.3-2004.1	-
Ecuador	1999.2-2001.2*	-	-	-
Estonia	1998.4-1999.3	-	-	-
Georgia	1999.4-2000.1*	2002.4-2002.4*	-	-
Greece	-	-	-	-
Hong Kong	2001.3-2002.4*	2003.2-2003.3*	2005.1-2005.2*	-
Hungary	1996.4-1997.2	2002.1-2002.3	-	-
India	-	-	-	-
Indonesia	1997.4-1998.4	-	-	-
Jordan	1992.4-1994.1	1998.3-1998.4*	2000.3-2000.3*	2001.1-2001.1*
Korea	1986.4-1987.3*	1997.4-1998.3	2001.2-2001.2	-
Latvia	-	-	-	-
Lithuania	1999.3-1999.3*	-	-	-
Malaysia	2001.1-2001.2*	2003.1-2003.2*	-	-
Malta	2000.2-2000.2*	2000.4-2001.3*	-	-
Mexico	1982.4-1983.3	1988.2-1988.2*	1995.1-1995.4	-
Pakistan	-	-	-	-
Peru	1998.4-1999.3	-	-	-
Philippines	1983.4-1984.2*	1986.3-1986.3*	1997.4-1998.4	2001.1-2001.3*
Poland	-	-	-	-
Portugal	1983.3-1984.3*	1986.4-1986.4*	1991.2-1991.2*	1992.4-1993.3
Russia	1998.4-1999.3*	2000.4-2001.1*	-	-
Slovak Rep.	1999.2-1999.3*	2003.4-2003.4	-	-
South Africa	-	-	-	-
Thailand	1997.2-1998.3	-	-	-
Turkey	1994.2-1995.1*	1998.3-1998.3*	1999.1-1999.2*	2001.2-2002.1
Venezuela	-	-	-	-

Sudden stops are identified here when ΔFA is at least 5% of GDP. The symbol (*) indicates that at no point during the respective crisis was equation (1) satisfied with β equal to 2. Two SSs in Jordan are not shown for space consideration: (i) 2001.4-2001.4 and (ii) 2003.4-2004.2, both of which are at least 5% of GDP.

Table 8 - Current account reversals (5% of GDP)

Country	1	2	3	4	5
Argentina	2002Q1-2003Q1	-	-	-	-
Belarus	1999Q2-2000Q1	-	-	-	-
Belize	-	-	-	-	-
Bolivia	2003Q4-2004Q3	-	-	-	-
Brazil	-	-	-	-	-
Chile	1999Q2-1999Q4	-	-	-	-
Colombia	1999Q2-2000Q1	-	-	-	-
Costa Rica	-	-	-	-	-
Croatia	1998Q4-1999Q3	2000Q4-2000Q4	-	-	-
Czech Rep.	1998Q2-1998Q3	-	-	-	-
Ecuador	1999Q3-2000Q3	-	-	-	-
Estonia	1999Q3-1999Q3	-	-	-	-
Georgia	1998Q4-1999Q2	-	-	-	-
Greece	-	-	-	-	-
Hong Kong	2005Q2-2005Q3	-	-	-	-
Hungary	1995Q4-1996Q2	-	-	-	-
India	-	-	-	-	-
Indonesia	1998Q1-1999Q1	-	-	-	-
Jordan	1995Q1-1995Q3	1997Q3-1997Q3	1998Q1-1998Q1	1999Q3-1999Q3	2002Q2-2003Q
Korea	1987Q1-1987Q3	1998Q1-1999Q1	-	-	-
Latvia	-	-	-	-	-
Lithuania	-	-	-	-	-
Malaysia	2003Q3-2003Q4	-	-	-	-
Malta	1997Q4-1998Q2	2001Q4-2002Q4	-	-	-
Mexico	1982Q4-1983Q4	1995Q3-1996Q1	-	-	-
Pakistan	-	-	-	-	-
Peru	-	-	-	-	-
Philippines	1984Q4-1985Q3	1992Q1-1992Q1	1998Q3-1999Q1	-	-
Poland	-	-	-	-	-
Portugal	1982Q4-1984Q4	-	-	-	-
Russia	1999Q1-2001Q1	-	-	-	-
Slovak Rep.	1994Q4-1995Q2	2000Q2-2000Q2	-	-	-
South Africa	1983Q1-1983Q3	1985Q3-1986Q1	-	-	-
Thailand	1997Q3-1999Q1	-	-	-	-
Turkey	1994Q3-1995Q1	2001Q3-2002Q1	-	-	-
Venezuela	-	-	-	-	-

CHAPTER II

THE INTENSITY OF SUDDEN STOPS & THEIR EFFECTS ON THE REAL ECONOMY

1. Introduction

The 1990s witnessed several prominent external crises in emerging markets in which these countries were abruptly and unexpectedly cut off from the international capital markets, leaving their economies in dire financial straits and teetering on the brink of a complete collapse. These crises—now called *sudden stops*—were notable not only for the dramatic fashion in which capital inflows ceased, but also for their seemingly contagious nature. Perhaps equally as notable was the lack of a thorough understanding of these crises in the economics profession at the time. Consequently, these crises now constitute a major topic of policy concern and of academic research.

A cursory examination of emerging markets' experiences with sudden stops reveals, however, that not all of these crises result in deleterious outcomes. The obvious question then, and the question that forms the basis of this paper, is why some countries fare better than others with sudden stop crises. The recent literature has addressed this question in a number of interesting ways. For instance, Hutchison, Noy, and Wang (2007) and Ortiz et al. (2007) find evidence that countries who respond to sudden stops using tight monetary and fiscal policies recover less quickly than countries who implement looser policies. Rothenberg and Warnock (2006) and Cowan et al. (2007) find that sudden stops characterized primarily by large domestic capital outflows—as opposed to reduced foreign inflows—are not uncommon and are typically associated with

smaller adverse effects on output. Edwards (2006) finds that countries belonging to currency unions experience greater output loss from sudden stops and current account reversals than countries with flexible exchange rates. Joyce and Nabar (2008) find that sudden stops affect investment only when the domestic banking system is in distress.

Curiously, however, the empirical literature has not thoroughly considered how the magnitude of a sudden stop crisis might explain the varied economic experiences observed in emerging markets. Instead, the near-ubiquitous approach taken in this literature has been to identify sudden stops in a binary fashion—i.e., either a sudden stop does occur or it does not occur—after which econometric analysis is run and conclusions are formed. Interestingly, the few studies that have addressed the severity of sudden stops—including Guidotti et al. (2004), Edwards (2004a), and Hutchison and Noy (2006)—find that while the occurrence of a crisis is costly, the severity of a crisis has no bearing on output loss.

The lack of an empirical relationship between the intensity of a sudden stop and output loss is counterintuitive. Take, for instance, the simple theoretical explanation offered by Calvo (1998) as to why a sudden stop can result in reduced output. Using the identity that a current account deficit equals aggregate demand less GNP, a reversal in capital flows will, at least partially, be met with a current account reversal and therefore a reduction in aggregate demand. In the presence of market imperfections, such as the Keynesian assumption of sticky prices and wages, reduced aggregate demand will lead to a recession. In this framework, a greater reversal in capital flows results in a greater reduction in aggregate demand, which in turn leads to greater output loss. Li, Sula, and Willett (2008) note that the output effects of sudden stops can be countered by financing

them by the sale of reserves, but the larger are the reversals the larger is the likely to be the gap not cushioned by reserve sales.

This paper contributes to the empirical literature on sudden stop crises by analyzing their magnitudes and estimating their effects on real GDP growth. The focus is on three primary questions involving the intensities of sudden stop crises: (i) how varied have sudden stops been in this regard?; (ii) how, and in what ways, does this affect output?; and (iii) why have previous papers not found a statistically significant relationship with output? In brief, this paper contends that tremendous variation exists in the intensities of sudden stop crises over the past 25 years and previous attempts to find a successful relationship between output loss and the size of these crises were unsuccessful at least in part because of the manner in which crisis magnitude was measured. The paper proceeds as follows: section 2 reviews the literature involved with the output effects of sudden stop crises, including several studies that have incorporated the magnitude of sudden stops into their analysis; section 3 discusses how this paper measures sudden stop magnitude and how this differs from papers; section 4 presents the data, model, and regression estimates of how the magnitude of sudden stop magnitude affects real GDP growth; and section 5 concludes.

2. The literature on the real effects of sudden stops

2.1 Theoretical literature

The theoretical literature has proposed various channels through which a sudden stop crisis may result in output loss. Calvo (1998a, 1998b, 2001) and Calvo and Reinhart (2000) illustrate some of these channels by starting with the identity that a current

account deficit equals aggregate demand less GNP. Thus, a reversal in capital flows will, at least partially, be met with a current account reversal and therefore a reduction in aggregate demand. At this point, the so-called "Keynesian channel" becomes apparent, since given the assumption of sticky wages/prices, a reduction in aggregate demand will lead to a recession. An alternative channel—and one which Calvo and Reinhart indicate is potentially more damaging—concerns the effect a real depreciation has on the financial sector. The foundation for this "Fisherian channel" is the notion that often interest rates in financial contracts are set at fixed, predetermined values based on future expectations, but not conditional on the realization of these expectations. Given this situation, reduced aggregate demand following a sudden stop will result in excess inventories of tradable and nontradable goods, the thus followed by a nominal price decline and depreciation in the real exchange rate. This, in turn, leads to a rise in the real interest rate ex post faced by nontradable producers, and consequently, an increase in non-performing loans.[1]

Formal theoretical models have generally analyzed sudden stops by adopting a version of the financial accelerator model proposed by Bernanke, Gertler, and Gilchrist (1999), or by introducing collateral constraints along the lines of Kiyotaki and Moore (1997). Importantly, not all of these models indicate output will contract following a sudden stop. Chari, Kehoe, and McGrattan (2005), henceforth CKM, consider a small, open economy where sudden stops are modeled as an abrupt tightening of domestic agents' collateral constraints on foreign borrowing. The authors show that a sudden stop is equivalenct to an increase in net exports, and hence, output will actually *increase* in response to a crisis. Noting that their finding opposes that of several previous papers—

[1] Of course, a country may devalue its currency which would attenuate the need for the price of nontradables to fall. As Calvo and Reinhart (2000) point out, however, many emerging markets are heavily dollarized, particularly with their liabilities.

including Mendoza (2004), Mendoza and Smith (2006), Neumeyer and Perri (2005), and Christiano, Gust, and Roldos (2004), all of which model additional financial frictions[2]—CKM argue that output drops occur only when these additional constraints dominate the positive effect of a sudden stop. However, Chakraborty (2006) shows that whether sudden stops lead to output contractions or expansions can be driven by the type of preferences specified.[3] Curdia (2007) uses a financial accelerator model in which a sudden stop arises when foreigners become skeptical about firm's productivity, leading to tighter credit conditions. Among his findings, is that the higher is the foreign demand price elasticity for domestic goods, the weaker is the contraction in output. Curdia's calibrated model indicates that output does, in fact, decrease, although he notes it is possible to generate output increases consistent with CKM's model.

2.2 Empirical literature

The empirical literature, in contrast to its theoretical counterpart, has generally found sudden stop crises to have contractionary effects on the real economy. Despite this, the empirical literature is far from reaching a consensus on just how costly these crises can be. Included among the more costly estimates is Calvo, Izquierdo, and Talvi (2006) who find the median peak-to-trough GDP loss at 4.4% during sudden stops in emerging markets since 1980; this figure increases to 10% for sudden stops that are

[2] These frictions include costs to foreign investors in trading bonds, margin calls, and requiring firms to pay in advance for labor or imported inputs.

[3] Specifically, Chakraborty shows that when only a collateral constraint is modeled, a sudden stop will result in an increase in output when Cobb-Douglas preferences are specified, whereas a sudden stop will result in an output drop when Greenwood, Hercowitz, Huffman (GHH) preferences are specified. GHH preferences have the property that the marginal rate of substitution between consumption and leisure is independent of consumption. This property prevents lower wealth from leading to increased labor supply, which is a key mechanism behind CKM's finding that output increases.

systemic in nature.[4] Hutchison and Noy (2006) define a sudden stop as the joint occurrence of a currency crisis and current account reversal, and estimate a loss in real GDP growth of 6-8% in the year of the crisis for emerging markets between 1975 and 1997. Using the same sudden stop definition as Hutchison and Noy, but with a sample of 59 emerging and developing countries over 1993-2001, Komarek and Melecky (2005) estimate that sudden stops reduce GDP by about 5% in the current year.

Bordo, Cavallo, and Meissner (2007) examine the period from 1880 to 1913 and find that sudden stops were the most frequent type of financial disruption (relative to banking, currency, and debt crises), with output drops equal to about 4% below long-run average. Becker and Mauro (2006) study output drops arising from a vast array of shocks—including currency, banking, and debt crises, as well as oil price shocks, wars, and natural disasters. These authors calculate the expected costs of these shocks (based on the shocks' frequency, association with an output drop, and the magnitude of the output drop) from 1970 to 2001 and find that sudden stops have the highest expected cost of all the shocks, at 1.5% of GDP annually. Cowan et al. (2007) distinguish sudden stops by whether these crises were primarily the result of increased domestic capital outflows or reduced foreign inflows—the former is referred to as *sudden starts*, while latter is referred to as a *true sudden stop*. Cowan et al. compare data for the 3 years preceding a sudden stop to that of the next three years, and find the average per capital GDP growth for true sudden stops decreases by 1.5% while the same change for sudden starts" is only 0.4%, or about one-fourth as costly. Rothenberg and Warnock (2006) use

[4] A systemic sudden stop requires, in addition to the authors' sudden stop definition that net capital flows fall at least 2 standard deviations below its mean, that the bond spread between JPMorgan's Emerging Market Bond Index and US Treasuries be unusually large. This requirement is intended to capture crises more indicative of contagion and a downturn in foreign investor sentiment.

a similar taxonomy, and find that true sudden stops result in reduced annual real GDP growth of roughly 3%, while sudden starts result in roughly 1.5% loss in output.

Not all empirical papers conclude that sudden stops are costly events in terms of output loss. Kaminsky (2006) uses a regression tree analysis to analyze variations in financial crises over the past 30 years. She finds that sudden stops have a statistically significant result in reducing output (relative to trend) by about 0.2%, which occurs only in the year of the crisis. Joyce and Nabar (2008) examine the impact of sudden stops on investment for 26 emerging markets from 1976-2002, and find that investment only declines when a sudden stop is accompanied by a banking crisis. Edwards (2005) examines the relationship of capital mobility with current account reversals and sudden stops using a sample of 117 countries from 1996-2002. In a sub-section of his paper, he estimates jointly the probability of having a crisis and the effect of the crisis on GDP growth. Edwards concludes that, "countries that experience a sudden stop, but are able—through the use of international reserves—to avoid a current account reversal will not face a significant decline in growth. Moreover, this result suggests that sudden stops have an indirect (negative) effect on growth [via the current account]."[5] Guidotti et al. (2004) also consider sudden stops and current account reversals, employing the rationale that sudden stops with reversals imply domestic adjustments. Using a post-Bretton Woods sample for all countries with available data, the authors find that the average change in GDP (relative to trend) the year following a sudden stop is -1.1% and -0.4% when occurring with and without a current account reversal, respectively.

[5] Edwards (2005), p. 22.

2.3 The empirical literature on sudden stop intensity

Most of the papers listed in the previous section have implicitly treated all sudden stops as if they were identical by analyzing these crises with a dummy variable. There are several exceptions that warrant closer review. As indicated above, Hutchison and Noy (2006) define a sudden stop as the joint occurrence of a currency crisis and current account reversal. In one section of their paper, the authors investigate whether more severe crises result in more output loss. To test this, they differentiate between major and standard currency crises, defining the former when the exchange market pressure index exceeds its mean plus 2 standard deviations and the latter in a similar manner but with 3 standard deviations. Using separate dummy variables to indicate standard and major crises, Hutchison and Noy indicate that the output loss from their subset of major currency crises is *not* more costly than their subset of standard currency crises (the results are not reported). Current account reversals are also distinguished as being either standard or major episodes when the reversal exceeds a 3% and 5% of GDP threshold, respectively, where separate dummy variables are used to indicate each current account reversal subset. However, the more stringent threshold results in *less* output loss relative to the 3% threshold in 4 of the 5 regressions reported.[6]

Hutchison and Noy (2006) examine the robustness of their results by accounting for the magnitude of the currency crisis (measured as the deviation of the exchange market pressure, or EMP, index from the country specific mean during the crisis and zero otherwise), and the magnitude of the current account reversal (defined as the reversal as a fraction of GDP). The magnitude of the currency crisis is insignificant while the crisis

[6] See Hutchison and Noy (2006), p. 238, Table 4.

dummy coefficients remain largely unchanged relative to their earlier results.[7] However, the magnitude of the current account reversal is statistically significant, but economically small, with a reversal of 1% of GDP reducing real GDP growth by 0.2%. The authors state that "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 a unique event that is important above and beyond the actual size of the reversal."[8]

Guidotti et al. (2004) consider the heterogeneity of sudden stops by comparing crises occurring with domestic adjustment (i.e., those occurring with current account reversals) to those without such adjustment. In doing so, the authors ask whether the economy's response depends on the size of the sudden stop (measured as the change in the capital account as a fraction of GDP during the crisis). When they include the sudden stop's magnitude in a set of pooled growth regressions for each type of sudden stop, the magnitude term is not statistically significant towards explaining output loss during sudden stops in *any* of these regressions. In comments on their paper, Jose de Gregorio says a "puzzling result is that the magnitude of the sudden stop does not affect the growth effect. This means that whether the adjustment is 5% or 20% of GDP does not affect the output costs of the sudden stop after controlling for other variables."[9]

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[7] The authors also examine whether the binary specification of currency crises is important by specifying both the binary (dummy) variable and the EMP index for all observations. Although not reported in their paper, the authors indicate the EMP index was statistically insignificant and the coefficient for the binary variable did not change much leading them to the conclusion currency crises are plausibly binary.

[8] Hutchison and Noy (2006), p. 241.

[9] Guidotti et al. (2004), pp. 207-208.

Finally, Edwards (2004a) examines the output costs of current account reversals since 1970 for various regions of the world.[10] Using a Barro-growth equation with a dummy variable to capture current account reversals, Edwards finds reversals to be associated with about a 2.5% loss in real GDP growth. In a sub-section of the paper, he notes that the analysis may be limited since it does not reflect the actual magnitude of the reversal. To this end, the regressions are re-run but with the magnitude of the reversal specified instead of the dummy variable (the reversal's magnitude is measured as a fraction of GDP during the crisis, and zero otherwise). Edwards indicates the magnitude term is not statistically significant in these regressions, leading him to conclude "that once reversals reach a certain level, their effects on growth are similar."[11]

In none of these papers was the intensity of a sudden stop central to the analysis. Furthermore, the relationship between sudden stop magnitude and output loss in these papers is frequently not statistically significant. This point has been interpreted by some authors as justification for specifying crises in a binary fashion. Yet conceptualizing the occurrence of a crisis as an entirely separate phenomenon from its magnitude is precarious since, by definition, the occurrence of a crisis is an event of at least a certain magnitude. It may be the case, as suggested in Edwards (2004a), that after the size of a sudden stop reaches a particular threshold its effect on output is statistically indistinguishable from the effects of other sudden stop magnitudes. This interpretation suggests there is a range such that magnitude does matter, beginning with the threshold used to define the crisis and ending at the threshold where the size of the crisis loses its

[10] Typically sudden stops and current account reversals are not taken to be literally the same phenomena, yet Edwards' analysis here is parallel to that found in the sudden stop literature and is relevant to the discussion at hand.

[11] Edwards (2004a), p. 33.

efficacy to induce contractionary changes in output. Taking these points together clearly suggest the need for a systematic study of the variation in sudden stops' intensities and how this affects output.

3. Measuring the intensity of sudden stops

Attention in this paper focuses on how sudden stop magnitude is measured as an alternative explanation to the literature's general finding that the magnitude of a crisis does not affect the real economy. The general method employed to measure magnitude has been to effectively multiply the crisis dummy with the change in capital flows (or change in capital flows as a percentage of GDP). While this measure is intuitive, it does not reflect the fact that some countries' capital flows are naturally more volatile than other countries. Thus, this measure may indicate a crisis as "very severe" while in fact net capital flows exhibit only a mild deviation from their normal behavior. Note that this concern is also embodied in many of the definitions of sudden stops used in the literature and is addressed by requiring the change in capital flows to be at least β standard deviations below its mean.[12] More generally, since a sudden stop itself is an event of a magnitude beyond some arbitrary threshold, it is logical that the notion of severity follow directly from the sudden stop definition.

The primary definition of a sudden stop employed in this paper closely follows the literature (c.f., Guidotti et al., 2004; Catao, 2006; Cowan et al., 2007). A country experiences a sudden stop when (i) the reduction in net capital flows is at least 1 standard deviation below its mean, and (ii) the reduction in net capital flows is at least 5% of GDP.

[12] There are many variations of this definition, but the basic structure is common. See Schreyer and Sula (2008) for a survey of the sudden stop definitions used in the recent literature.

The first component of this definition captures abnormal net capital outflows relative to their typical behavior; the second component ensures the abnormal outflows are economically meaningful. Net capital flows are measured using the financial account (FA), and the standard deviation and mean are country-specific. The measure of a sudden stop's magnitude is taken directly from the definition of sudden stop's occurrence: a sudden stop's magnitude is the standardized difference between the reduced net capital flows at the time of the crisis and the threshold used to define the crisis. More specifically, a sudden stop's magnitude (SS) is defined as:

$$SS_{it} = \begin{cases} \dfrac{j_{it}}{\sigma_j}, & \text{if } \; j_{it} = -\Delta FA_{it} + \omega^* \geq 0 \;\text{ and }\; \Delta FA_{it}/GDP_{it} \leq 0.05 \\ 0, & \text{otherwise} \end{cases} \qquad (1)$$

where j_{it} is the difference between reduced net capital flows and the crisis threshold ($\omega^* = \mu_{\Delta FA} - \sigma_{\Delta FA}$). Note that j_{it} is then standardized by σ_j, where the latter represents the standard deviation of all crises' j's in the sample. Standardization is done solely to facilitate interpretation.

Equation (1) is applied to a sample of 30 emerging market countries from 1980-2005 (details regarding the sample are reported in the next section). Fifty sudden stop episodes are identified and are shown along with the respective magnitudes in Table 4. According to this table, for example, Mexico's 1982 sudden stop was 7.6 times as intense as the typical sudden stop as defined by the median (7.6 = 2.37 / 0.31), yet this same crisis was only half as intense as the most intense sudden stop in the sample, Thailand 1997 (0.5 = 2.37 / 4.59).

Figure 1 shows the distribution of sudden stop magnitudes and highlights the heterogeneous nature in which these crises have occurred in emerging markets. Not surprisingly, most observations lie to the left indicating that many crisis episodes barely satisfy the definition of a crisis. As the standardized intensity level increases, the number of crises decreases with a noticeable gap in episodes occurring after about 1.8 standard deviations. It is interesting to note that while a traditional examination of distributions such as this might suggest that the values lying to the extreme right are outliers, these values represent some of the most commonly cited examples in research and pedagogy to illustrate what, in fact, constitutes a sudden stop (e.g., Thailand, 1997; Argentina, 2001; Mexico, 1995).

4. Estimating the effects of sudden stop magnitude on real output growth

4.1 The data and the model

The immediate aim of this paper is to see how a sudden stop's magnitude relates to output loss. To this end, I employ an unbalanced panel of annual data from 1980-2005 using a sample of 30 emerging market countries. The set of emerging markets was obtained from the countries used in Joyce and Nabar (2008) and/or Hutchison and Noy (2006), and is listed in Table 4.[13] I concentrate on emerging markets because policy discussions frequently revolve around them and because several studies have indicated that unique factors in these countries make them more susceptible to external crises (c.f.,

[13] Joyce and Nabar (2008) consulted the Standard & Poor's Emerging Market Index, Morgan Stanley Capital International Emerging Market Index, and the IMF's International Capital Markets Department's list of emerging markets to construct their country list. Hutchison and Noy (2006) identify developing countries with real income at least $2000 (PPP adjusted) in 1992. After combining these country lists, I excluded four countries: Hong Kong and Singapore due to their relatively high incomes; and the Slovak Republic and Zimbabwe due to insufficient data.

Cowan, et al., 2007; Glick and Hutchison, 2005; Caballero and Krishnamurthy, 2004; Becker and Mauro, 2006).

To examine the output loss associated with a sudden stop's magnitude, real GDP growth is regressed on its lagged self, sudden stop magnitude, and a set of control variables. Specifically, the model is

$$y_{it} = y_{it-1} + \alpha_i + \delta_t + \gamma_1 SS_{it} + \sum_{j=1}^{n} \beta_j x_{ijt} + \varepsilon_{it} \qquad (2)$$

where time invariant influences specific to country *i* are captured by the fixed effects term α, time specific shocks to all countries is captured by the dummy variable δ at year *t*, *SS* is the crisis magnitude of interest (discussed in the previous section), x_j is the j^{th} element of the vector of control variables, and ε is the disturbance term with a mean of zero and a constant variance.[14]

The basic set of controls variables used here follows closely the papers investigating the costs of external crises, and includes inflation, trade openness, real interest rate, budget deficit, and banking crises. Inflation is controlled for since it may exacerbate uncertainty and a misallocation of resources during a sudden stop crisis, which is particularly relevant here since several countries in the sample experienced particularly high rates of inflation. More generally, inflation can adversely affect output growth even at low and moderate rates (Andres and Hernando, 1997). The degree of trade openness may affect output since less open economies are likely to undergo greater domestic adjustment following a sudden stop (c.f., Cavallo and Frankel, 2004; Frenkel and Razin, 1987; Calvo et al., 2003). Evidence that contractionary monetary and fiscal

[14] Details on all variables used in this paper and their sources can be found in Table 1.

policies have a negative impact on the cost of sudden stops was found by Hutchison, Noy, and Wang (2007) and Ortiz, et al. (2007). For this reason, as well as for the effect on growth by policies initiated prior to a crisis, I control for the real interest rate and the budget deficit. I also control for the occurrence of a banking crisis since there is compelling evidence that the impact of sudden stops on the real economy is transmitted through the banking sector (Joyce and Nabar, 2008). I use dates for banking crises when either Caprio et al. (2005) or Demirguc-Kunt and Detragiache (2005) identify such an occurrence.[15]

The basic set of control variables are augmented in several ways. First, the abrupt loss of foreign capital, as characterized by a sudden stop crisis, may result in the central bank increasing domestic credit through foreign exchange intervention or other methods.[16] Thus, I add domestic credit and, alternatively, international reserves as controls. Separately, high levels of financial dollarization, defined as the holdings by residents of foreign currency assets and liabilities, can seriously weaken the central bank's ability to act as lender of last resort as well as influence the effect of currency fluctuations have on the real economy (c.f., Calvo, 2006; Eichengreen, Gupta, and Mody, 2006). To address this possibility, I include a proxy for financial dollarization obtained from Levy-

[15] Caprio et al. (2005) define banking crises mainly on expert opinions solicited from various sources. Their data distinguishes between systemic and non-systemic crises. I omit this distinction to simplify analysis: Boyd, Kwak, and Smith (2005) estimate output costs of non-systemic and systemic banking crises, and find the latter does not result in greater output loss. Demirguc-Kunt and Detragiache (2005) define a banking crisis when at least one of the following conditions hold: ratio of nonperforming assets to total assets is greater than 2% of GDP; cost of rescue operation was at least 2% of GDP; banking-sector problems resulted in a large-scale nationalization of the banks; and extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis. Arteta and Eichengreen (2002) compare an earlier version of data from Caprio et al. (2005) with that of Demircug-Kunt and Detragiache (2005) and find that their empirical results are unaffected by the data used.

[16] Calvo (2006) cites the behavior of Brazil's central bank in 2002 as an example of an alternative method for ameliorating the loss of foreign credit. Following incoming President Lula's statements that Brazil's public debt might be repudiated, and the inchoate sudden stop, the central bank used its reserves to make loans to the export sector via commercial banks.

Yeyati (2006). Lastly, there is evidence that the degree of capital mobility in an economy affects the impact of a sudden stop crisis. For instance, Edwards (2005) finds the cost of sudden stops in terms of output loss was lower for economies with less financial openness, albeit the effect was still relatively small.[17] Thus, an index of financial openness from Chinn and Ito (2005) in included as a control variable.

Note that the dependent variable in equation (2) also appears with a lag on the right-hand side of the equation. This is due to well-documented evidence of this variable's persistence. However, neither OLS nor fixed effects estimation yield unbiased and consistent estimators with dynamic models—a problem termed *dynamic panel bias*.[18] Moreover, there is likely endogeneity amongst the regressors. I address these concerns by employing a generalized method of moments estimator developed by Arellano and Bond (1991). Related papers that also employ the Arellano and Bond estimation method include Dreher et al. (2005), Hutchison and Noy (2005, 2006), and Joyce and Nabar (2008). This procedure involves first-differencing equation (1) and using second and higher lagged values of the in levels as instruments for the endogenous variables.[19] An appealing feature of this procedure relative to other estimation methods that account for dynamic panel bias is that more moment conditions are utilized to obtain more efficient estimates (c.f., Ahn and Schmidt, 1995; Arellano and Bond, 1991; Blundell and Bond, 1998).

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[17] On the other hand, Joyce and Nabar (2008) find that capital mobility plays no role in explaining investment loss during sudden stops. They indicate that in a regression not reported an interaction term between openness and sudden stops was insignificant, as was the stand-alone sudden stop dummy and banking crisis dummy (fn. 16, p. 15). The authors do, however, find evidence that greater levels of financial openness worsen the impact banking crises have on investment.

[18] See Nickell (1981) for a rigorous formulation of the bias arising from dynamic models with fixed effects.

[19] Arellano and Bover (1995) and Blundell and Bond (1998) extend this methodology to include instruments in first differences in addition to levels.

4.2 Descriptive statistics

Before proceeding to a formal analysis of the relationship between sudden stop magnitude and output loss, I first consider the descriptive evidence. I rank the sudden stops shown in Table 4 by their magnitudes and then categorize all crises above the median intensity as "severe" while all other crises are categorized as "standard". For each of these categories, the median values (i.e., the 25^{th} and 75^{th} percentiles) for real GDP growth and the control variables are obtained before and after a sudden stop crisis occurring at time *t*. As shown in Table 2, output growth starts higher, and drops further, for the typical severe sudden stop (changing by about -4% from *t*-1 to *t*), as compared with their standard counterpart (which changes by approximately -1.5% from *t*-1 to *t*); however, the pre-crisis growth rate is re-attained after about 2 years for both categories. For both standard and severe sudden stops, international reserves decrease (and domestic credit increases) in the year of the crisis, which is consistent with the central bank actions to defend its currency and/or ameliorate a credit crunch. Financial openness decreases in the year of the crisis, with severe sudden stops being associated with relatively more financially open countries. Less discernable are the changes in the budget deficit and the real interest rate during a sudden stop, which may simply be a result of the varied policy responses countries have taken to combat sudden stops.

Table 3 shows the number of years in the sample that occur with sudden stops and banking crises. There are 23 severe sudden stops and 21 standard sudden stops that have corresponding banking crisis data, and constitute about 7% of the sample (= 44 / 654). Nearly 61% of the severe sudden stops (= 14 / 23) are associated with a banking crisis,

which compares to only 43% (= 9 / 21) for standard sudden stops. In addition to the joint frequencies at time *t*, I also consider whether sudden stops tend to precede or follow banking crises (not shown for brevity). About 33% (40%) of severe (standard) sudden stops are preceded 1 year by a banking crisis, while 68% (43%) of banking crises are preceded 1 year by a severe (standard) sudden stop. These results suggest that banking crises and sudden stops are inter-related events, with causality running both ways, and thus the need to control for banking crises and their endogeneity when estimating the effect of sudden stop magnitude on output growth.

4.3 Regression results

I now turn to a formal analysis of the impact of sudden stop magnitudes on real GDP growth. Table 5 shows a series of regressions run when a dummy variable is used to indicate the occurrence of a crisis. Specifications (1) and (2) are obtained using a naïve and fixed effects estimation, respectively, so that results obtained with the IV/GMM estimation can be compared (the latter method is used in all remaining regressions). The occurrence of a sudden stop in these first 2 specifications is statistically significant at the 1% level and results in a 3.4% to 3.8% loss in output growth for that year. Little changes in specification (3) where the sudden stop is assumed to be exogenous. However, a considerable change in the cost of a sudden stop crisis does, occur when this crisis is taken as an endogenous variable, shown in specification (4). This results in a 4.2% contemporaneous loss in output growth. As argued in the previous sections of this paper, using a dummy variable to measure the cost of a sudden stop treats these crises as if their magnitudes were homogenous—a notion clearly not supported by

Figure 1. I begin the investigation into whether sudden stop magnitude helps explain the varied experiences emerging markets have had in terms of output loss by distinguishing "severe" sudden stops from their "standard" counterparts as described in section 4.2, where each category is measured with a dummy variable. Specification (5) shows the results of making this distinction: the occurrence of a severe sudden stop dummy is statistically significant at the 1% level and results in a 4.6% loss in real GDP growth that year. On the other hand, a standard sudden stop fails to exhibit any discernable impact on output whatsoever.

The distinction between "severe" and "standard" in specification (5) is entirely arbitrary. Moreover, it is not evident a priori why a sudden stop's magnitude should manifest itself in a strictly dichotomous manner (i.e., severe versus standard). I avoid these potential shortcomings by applying the measure of magnitude defined by equation (1). Table 6 shows a variety of specifications all showing the magnitude term to be statistically significant at the 1% level: the coefficients range from -2.1 to -2.5 which indicate that a *typical* sudden stop—as defined by the median magnitude of 0.31—would result in a drop of output growth of about 0.7-0.8%. The most intense crisis year in the sample, Thailand in 1997, is estimated to have between 9.4% to 11.5% loss in real GDP growth that year, while the least intense crisis years, such as Uruguay in 1983, have virtually no output loss. The occurrence of a banking crisis is also statistically significant at the 1% level and robust across the different specifications in Table 6. The estimated loss in output growth from banking crises ranges from -1.2% to -1.6%, which is similar to the -1.3% reported by Joyce and Nabar (2008) who estimated the impact of this crisis on

investment.[20] Financial dollarization is added to the basic set of control variables in specification (7), and is statistically significant at the 5% level. To the extent that more dollarized economies suffer greater adverse consequences from a sudden stop crisis, then controlling for this variable should lessen the effect sudden stop magnitude has on output growth, which is indeed the case. A similar interpretation can be applied to specification (10) which adds international reserves to the basic set of control variables. Provided that a country's central bank is able to effectively use its reserves by intervening in its foreign exchange market or increasing credit by more direct operations, then controlling for reserves will increase the impact sudden stop magnitude has on the real economy. And, again, this is the case. Nonetheless, it is important to not overstate the relationships between sudden stop magnitude and the various control variables since the model is not attempting to explain the determinants of sudden stop magnitude.

Thus far, it has been assumed that a sudden stop's magnitude affects real GDP growth in a linear fashion. This may not be the case. Suppose, for example, that a sudden stop results in a wave of the most over-leveraged firms going bankrupt. If this same hypothetical sudden stop were repeated, albeit at a greater magnitude, then the firms surviving the first wave of bankruptcies would benefit from the greater concentration of efforts to mitigate the recessionary effects of the crisis, such as an expansion of credit by the central bank. Thus, there may be diminishing returns, so to speak, with how the magnitude of a sudden stop impacts an economy. To this end, all specifications in Table 6 are re-run, only this time the magnitude term is specified quadratically. The results are reported in Table 7. All quadratic terms in the various

[20] Specifically, the -1.3% value is referring to Table 6 in the appendix of Joyce and Nabar (2008).

specifications are significant at the 5% or 1% levels, and between 88% and 98% of all sudden stop magnitudes occur before the quadratic function attains its minimum. Again using the median intensity level to describe a typical sudden stop, real GDP growth is predicted to decrease between 1.5% and 2.2% contemporaneously with the crisis, which is roughly 1% greater than was found in Table 6. The most intense crisis, on the other hand, is predicted to lead to a drop in output growth between 3.7% and 5.9%, markedly less than the 9.4% to 11.5% range found when magnitude was specified linearly. The least intense crises effectively result in no output loss. The occurrence of a banking crisis is predicted to reduce output growth by 1% to 1.6%, approximately the same bounds found previously, and financial dollarization and international reserves are again statistically significant, while domestic credit and financial openness are not. The quadratic form for sudden stop magnitude is statistically significant and yields reasonable estimates. However, additional robustness tests (not reported) favor the linear specification used in Table 6 and so the quadratic form is abandoned. [21]

Lastly, the robustness of this paper's results is investigated by measuring sudden stop magnitude in a manner analogous to the previous papers who have also investigated the relationship between crisis intensity and output loss, and yet failed to find a compelling relationship (e.g., Guidotti et al., 2004; Edwards, 2005; Hutchison and Noy,

[21] Robustness tests not reported in this paper include using sudden stop definitions from Calvo et al. (2006) and from Frankel and Cavallo (2004). Statistical significance for the quadratic form using these alternative definitions was less conclusive, although the linear specification of sudden stop magnitude remained largely unchanged in its statistical significance and economic impact. Also, additional control variables were added, including the de facto exchange rate, an index of political risk, the terms of trade, and various lags and leads of banking crises and sudden stops. The exchange rate index and political risk index showed no statistical significance, while the terms of trade was occasionally significant but the null hypothesis of the Sargan test for valid instruments was frequently rejected. A 1-year lag for sudden stop magnitude was occasionally significant, but the contemporaneous relationship with output growth was much more compelling. Also considered was the interaction between banking crises and sudden stops, with results largely in-line with Joyce and Nabar (2008). Results available upon request.

2006). These papers effectively multiplied the crisis dummy by the change in the net capital flows. For simplicity, this approach is referred to as the *traditional* measure of sudden stop magnitude. As discussed in section 3, a potential hazard of using the traditional measure of sudden stop magnitude is that it does not reflect the fact that some countries' capital flows are naturally more volatile than other countries, and therefore a sudden stop may be measured as being very severe, while in fact being only mild. The regression results are reported in Table 8 with the traditional measurement of sudden stop intensity indicated by ΔFA/GDP*SS Dummy. The estimated coefficients for the traditional magnitude term are statistically significant at the 10% level in 4 of the 5 regressions, and imply that a reversal of 1% of GDP results in roughly a 0.2% loss in real GDP growth—a figure that is virtually identical to the 0.2% reported by Hutchison and Noy (2006) (see section 2.3). However, the juxtaposition of the regressions in Table 8 with those reported in Table 6 reveals that the traditional magnitude measure is considerably inferior to the one developed in this paper based on statistical significance. These comparative results support the notion that previous papers were unable to find convincing evidence of a relationship between sudden stop magnitude and output loss because their measure of magnitude did not distinguish between the typical and atypical behavior of capital flows.

5. Conclusion

This paper finds that sudden stops have exhibited considerable heterogeneity in their intensities over the last 25 years in emerging markets. Given the wide variety in which these crises manifest themselves, researchers should take caution when treating

these crises as homogenous events. Indeed, real GDP growth loss estimates in the year of a typical sudden stop is less than 1%, yet can range anywhere from about 0% to 11% once the crisis's magnitude has been taken into account. These findings suggest that a reason why the literature has not reached a consensus on the economic cost of sudden stops is because these crises can be very different, despite sharing a common name.

At a broader level, examining these crises' intensities in the context of output loss motivates several important questions about what researchers consider to be crises. Theory and practice clearly suggest sudden stops can have adverse impacts on the real economy. Since the occurrence of a crisis (as manifested by a dummy variable) is by definition an event of a certain magnitude, empirical findings that the occurrence of a crisis matters for output loss—but not its magnitude—is cause for concern. I show evidence that this seemingly incompatible finding arises from the way the intensities of sudden stops are measured (i.e., the traditional measure). Consequently, I argue that measurements of sudden stop magnitude should be a direct extension of how these crises are identified, with these magnitudes being measured relative to the threshold used to indicate the crisis. In this manner, the typical behavior of capital flows is filtered out of the measure thereby allowing the researcher to more accurately quantify the magnitude of the crisis.

As the world becomes ever more financially integrated, it is likely that the spectre of sudden stop crises in emerging markets will not disappear anytime soon. Thus, a nuanced understanding of these crises and the threats they pose is critical for policymaking. The results in this paper indicate that sudden stops of the magnitude that Thailand experienced 1997-98 are rare events: most sudden stops are smaller and not

costly in real terms. This, of course, has many implications for how policymakers choose to implement measures to prevent and mitigate sudden stops. A prominent example is the recent massive accumulation of foreign reserves by central banks in many emerging markets. To the extent that this accumulation was done to insure against sudden stops, the relative infrequency of major crises in recent history suggests the massive collection of foreign reserves by these countries is an especially costly endeavor.

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7. Appendix

Table 1 - Data definitions

Variable	Description	Source
GDP Growth	Real GDP growth	IFS, line 99b
Inflation	Percentage change in the consumer price index	IFS, line 64
Trade Openness	The sum of exports and imports as a percentage of GDP	IFS, lines 90 and 98
Real Interest Rate	Real interest rate defined as the discount rate less inflation	IFS, line 60
Budget Deficit	Fiscal budget deficit (-) / surplus (+) as a percentage of GDP	IFS, line 80
Reserves	Non-gold reserves as a percentage of GDP	IFS, line 11.d
Domestic Credit	Total domestic credit as a percentage of GDP	IFS, line 32
Financial Dollarization	Qualitatively defined as the holdings by residents of foreign currency assets and liabilities. This is the ratio of foreign currency deposits to the total deposits of the banking system.	Levy-Yeyati (2006)
Financial Openness	Capital account liberalization index which ranges from -2 in the most extreme case of capital controls, to 2.5 in the case of most liberalization.	Chinn and Ito (2005)
Banking Crisis	Dummy variable equal to 1 if a crisis occurs. Dates were taken from both sources listed, without making a distinction between systemic and non-systemic crises.	Caprio, et al. (2006) and Demirguc-Kunt and Detragiache (2005)
Sudden Stop	The sudden stop definition is from Guidotti et al. (2004). A sudden stop occurs when the negative change in net capital flows as indicated in a country's financial account which exceeds 5% of GDP in absolute terms, and is also 1 standard deviation below its mean.	IFS, line 78b

Figure 1- Distribution of sudden stop magnitude

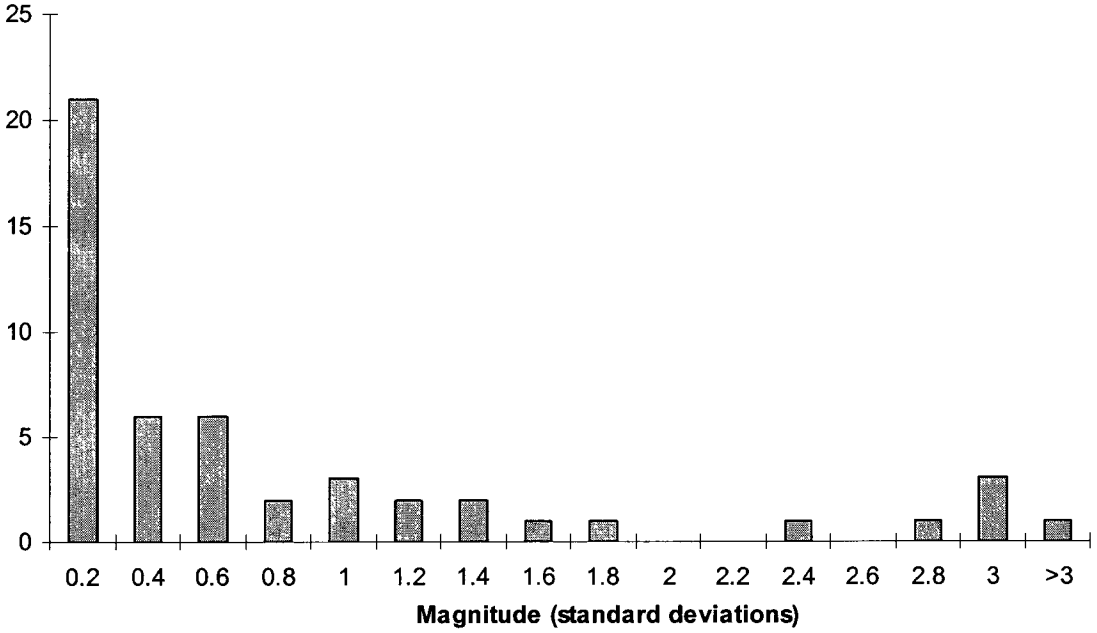


Figure 2 – Median real GDP growth for severe & standard sudden stops

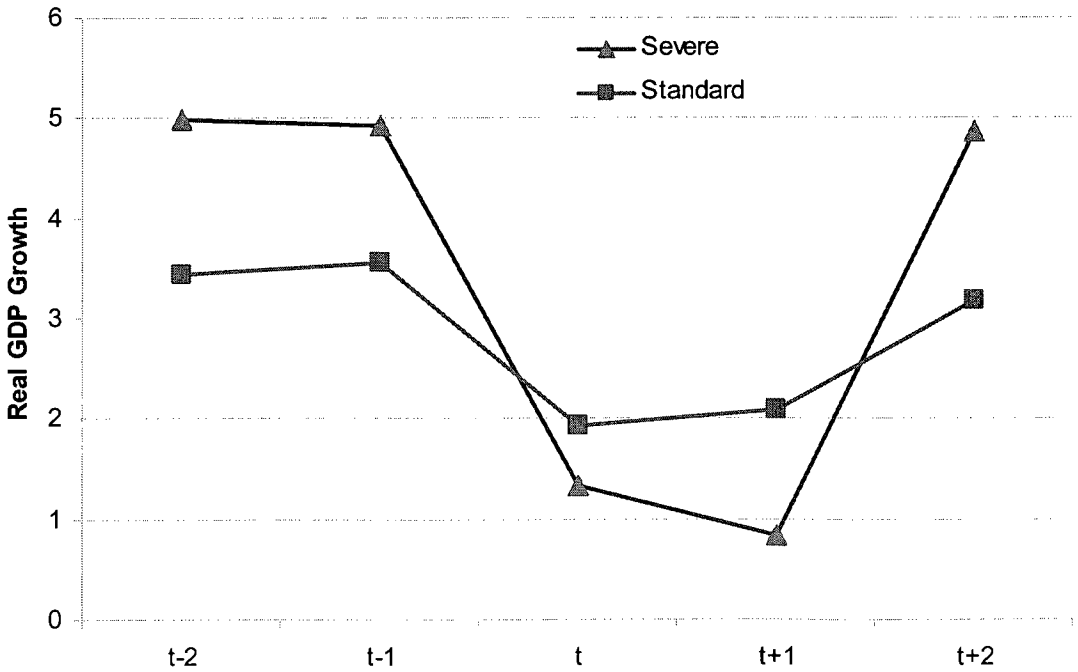


Table 2 - Macroeconomic developments before & after a crisis

	Severe Sudden Stops					*Standard Sudden Stops*				
Variable	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t-2*	*t-1*	*t*	*t+1*	*t+2*
GDP Growth	4.99	4.93	1.32	0.84	4.86	3.43	3.56	1.92	2.09	3.17
Trade Openness	52.26	52.26	55.87	59.05	59.42	103.64	102.26	94.71	99.71	98.91
Reserves / GDP	1.68	1.25	0.55	0.71	0.73	1.97	3.03	2.28	2.10	2.28
Real Interest Rate	4.76	4.96	4.91	2.68	4.78	1.54	2.21	2.99	2.26	2.62
Financial Openness	0.18	0.18	-0.06	-0.03	0.00	-0.06	-0.45	-0.91	-1.10	-0.06
Financial Dollarization	24.70	29.35	32.40	22.20	19.40	12.62	13.48	15.93	15.93	16.88
Budget Deficit / GDP	-1.58	-0.99	-2.01	-1.88	-2.12	-2.90	-4.11	-4.04	-2.97	-2.28
Domestic Credit / GDP	54.02	54.02	65.84	60.93	53.11	65.08	71.47	81.06	74.75	75.78
Inflation	9.77	7.97	9.27	19.75	13.44	8.15	8.15	6.20	3.79	4.25

Note: all values represent the median.

Table 3 - Conditional frequencies of banking crises and sudden stop occurrences

		Banking Crisis		
		Yes	No	Total
Severe SS	Yes	14 (2%)	9 (1%)	23 (4%)
	No	218 (33%)	413 (63%)	631 (96%)
	Total	232 (35%)	422 (65%)	654

		Banking Crisis		
		Yes	No	Total
Standard SS	Yes	9 (1%)	12 (2%)	21 (3%)
	No	223 (34%)	410 63%)	633 (97%)
	Total	232 (35%)	422 (65%)	654

Note: six of the 50 sudden stops identified in Table 4 do not have corresponding banking crisis data, thus the total number of sudden stops shown here is 44.

Table 4 - Sudden stop dates & magnitudes

Country	Year (Magnitude)
Argentina	2001 (2.87)
Brazil	2002 (2.72)
Chile	1982 (0.28), 1983 (0.30), 1998 (0.44)
China	
Colombia	
Costa Rica	1981 (0.02)
Cyprus	1998 (0.10), 2003 (0.07)
Czech Rep.	1996 (0.20), 1997 (0.02)
Egypt	1990 (1.47)
Hungary	1994 (0.12), 1996 (0.77)
India	
Indonesia	1997 (1.36), 1998 (0.90)
Jordan	1992 (0.16), 1993 (0.10), 2003 (0.01)
Malaysia	1994 (0.86), 1997 (0.44), 2005 (1.66)
Malta	1995 (0.05), 2000 (0.01)
Mexico	1982 (2.37), 1994 (1.30), 1995 (2.86)
Morocco	1983 (0.002), 1995 (0.28)
Pakistan	1998 (0.50)
Panama	1980 (0.07), 1987 (0.01), 2000 (0.17), 2002 (0.10)
Peru	1998 (0.47)
Philippines	1983 (0.14), 1997 (0.43), 1998 (0.67)
Poland	1994 (1.18)
Russia	1998 (0.25), 2000 (0.60)
South Africa	
Sri Lanka	
Thailand	1997 (4.59)
Trinidad. & Tobago	1984 (0.04), 1990 (0.01), 1999 (0.03)
Turkey	1994 (1.09), 2001 (2.97)
Uruguay	1983 (0.03), 2002 (0.32)
Venezuela	1994 (0.31), 2002 (0.91)

Note: this table shows 50 sudden stop years for 30 emerging markets from 1980-2005. See text for definitions of sudden stops and their magnitudes. Summary statistics: stdev = 1; mean = 0.73; median = 0.31; max = 4.59 (Thailand, 1997); min = 0.002 (Morocco, 1983).

Table 5 - Sudden stop dummies

	(1)	(2)	(3)	(4)	(5)
Lagged GDP Growth	0.35***	0.19***	0.33***	0.21***	0.34***
	(0.05)	(0.05)	(0.08)	(0.07)	(0.08)
SS Dummy	-3.82***	-3.40***	-3.48***	-4.24***	
	(0.84)	(0.83)	(1.04)	(1.31)	
Banking Crisis	-1.35***	-1.30***	-1.54***	-1.21**	-1.51***
	(0.43)	(0.48)	(0.45)	(0.51)	(0.44)
Inflation	-0.02***	-0.03***	-0.02**	-0.02***	-0.02**
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Trade Openness	-0.01	0.03**	-0.01	-0.00	-0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Real Interest Rate	-0.02***	-0.03**	-0.02**	-0.02***	-0.02**
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Budget Deficit / GDP	0.10	0.19**	0.18**	0.16**	0.17**
	(0.06)	(0.08)	(0.08)	(0.08)	(0.08)
Severe SS Dummy					-4.55***
					(1.13)
Standard SS Dummy					-3.52
					(2.23)
Observations	379	379	379	379	379
Sargan p-value			0.19	0.59	0.26
AR(1) p-value			0.00	0.00	0.00
AR(2) p-value			0.89	0.78	0.81

Note: the dependent variable is real GDP growth. Specification (1) is a naïve estimation; specification (2) is estimated with fixed effects; all other equations use the GMM estimator. The sudden stop dummy in specification (3) is taken as exogenous, while subsequent estimations take this as endogenous. All equations have time dummies (not reported). Robust standard errors in parentheses. *, **, *** significant at 10%, 5%, and 1% respectively.

Table 6 - Sudden stop magnitude

	(6)	(7)	(8)	(9)	(10)
Lagged GDP Growth	0.34***	0.18***	0.34***	0.26***	0.27***
	(0.08)	(0.05)	(0.08)	(0.08)	(0.08)
SS	-2.18***	-2.05***	-2.25***	-2.32***	-2.50***
	(0.59)	(0.62)	(0.59)	(0.65)	(0.61)
Banking Crisis	-1.58***	-1.18**	-1.62***	-1.59***	-1.64***
	(0.45)	(0.52)	(0.45)	(0.47)	(0.47)
Inflation	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
Trade Openness	-0.01	0.00	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Real Interest Rate	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
Budget Deficit / GDP	0.15*	0.21*	0.14*	0.13	0.15
	(0.09)	(0.11)	(0.09)	(0.09)	(0.09)
Financial Dollarization		0.02**			
		(0.01)			
Domestic Credit / GDP			0.00		
			(0.01)		
Financial Openness				0.11	
				(0.14)	
Reserves / GDP					0.00**
					(0.00)
Observations	379	236	376	358	379
Sargan p-value	0.20	0.54	0.20	0.58	0.21
AR(1) p-value	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.87	0.84	0.95	0.89	1.00

Note: the dependent variable is real GDP growth. All estimates obtained using the GMM estimator. All equations have time dummies (not reported). Robust standard errors in parentheses. *, **, *** significant at 10%, 5%, and 1% respectively.

Table 7 - Sudden stop magnitude with diminishing returns

	(11)	(12)	(13)	(14)	(15)
Lagged GDP Growth	0.34***	0.20***	0.35***	0.28***	0.29***
	(0.08)	(0.05)	(0.08)	(0.08)	(0.07)
SS	-5.18***	-5.39***	-5.19***	-6.40***	-7.82***
	(1.63)	(1.67)	(1.61)	(1.64)	(2.80)
SS^2	0.86**	0.92**	0.85**	1.13***	1.88*
	(0.38)	(0.39)	(0.37)	(0.38)	(1.02)
Banking Crisis	-1.51***	-1.01*	-1.54***	-1.50***	-1.62***
	(0.45)	(0.53)	(0.45)	(0.47)	(0.50)
Inflation	-0.02***	-0.03***	-0.02***	-0.02***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Trade Openness	-0.01	0.00	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Real Interest Rate	-0.02***	-0.03***	-0.02***	-0.02***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Budget Deficit / GDP	0.15*	0.19*	0.14*	0.12	0.15*
	(0.08)	(0.11)	(0.08)	(0.08)	(0.08)
Financial Dollarization		0.02**			
		(0.01)			
Domestic Credit / GDP			0.00		
			(0.01)		
Financial Openness				0.12	
				(0.14)	
Reserves / GDP					0.00**
					(0.00)
SS Critical Point	3.01	2.93	3.05	2.83	2.08
Observations	379	236	376	358	379
Sargan p-value	0.16	0.50	0.15	0.57	0.25
AR(1) p-value	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.94	0.97	0.97	0.99	0.59

Note: the dependent variable is real GDP growth. All estimates obtained using the GMM estimator. All equations have time dummies (not reported). Robust standard errors in parentheses. *, **, *** significant at 10%, 5%, and 1% respectively.

Table 8 – Traditional sudden stop magnitude

	(21)	(22)	(23)	(24)	(25)
Lagged GDP Growth	0.33***	0.17***	0.33***	0.26***	0.26***
	(0.08)	(0.05)	(0.08)	(0.08)	(0.08)
Δ FA/GDP*SS Dummy	-0.18*	-0.17*	-0.19*	-0.20*	-0.19
	(0.10)	(0.10)	(0.10)	(0.11)	(0.12)
Banking Crisis	-1.63***	-1.30**	-1.67***	-1.66***	-1.70***
	(0.50)	(0.57)	(0.49)	(0.52)	(0.52)
Inflation	-0.02**	-0.02***	-0.02**	-0.02***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Trade Openness	-0.01	0.00	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Real Interest Rate	-0.02**	-0.02***	-0.02**	-0.02***	-0.02***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Budget Deficit / GDP	0.17**	0.25**	0.17*	0.16*	0.17*
	(0.08)	(0.10)	(0.09)	(0.08)	(0.09)
Financial Dollarization		0.02**			
		(0.01)			
Domestic Credit / GDP			0.00		
			(0.01)		
Financial Openness				0.06	
				(0.14)	
Reserves / GDP					0.00**
					(0.00)
Observations	379	236	376	358	379
Sargan p-value	0.24	0.53	0.24	0.63	0.22
AR(1) p-value	0.00	0.00	0.00	0.00	0.00
AR(2) p-value	0.83	0.97	0.91	0.95	0.95

Note: the dependent variable is real GDP growth. All estimates obtained using the GMM estimator. All equations have time dummies (not reported). Robust standard errors in parentheses. *, **, *** significant at 10%, 5%, and 1% respectively.

CHAPTER III

THE BEHAVIOR OF DOMESTIC CAPITAL FLOWS DURING SUDDEN STOPS

1. Introduction

There are many benefits of international capital flows to emerging market countries, yet experience has shown these benefits are not without potential costs. With greater access to global capital markets comes the possibility that net capital will cease to flow, and may do so in a dramatic fashion. Sudden stops, as these large and abrupt changes in net capital flows are known, are associated with sharp declines in economic activity, substantial enough to lead some prominent academics such as Rodrik (1998) and Stiglitz (2002) to question the merits of financial globalization.

The premise taken in much of the literature on sudden stops is that these crises are motivated by the actions of foreign investors. In some instances, researchers' focus on foreign investors is made explicit. For example, Edwards (2005, p. 14) defines a sudden stop as "an abrupt and major reduction in capital inflows to a country that up to that time had been receiving large volumes of foreign capital." On the other hand, some papers do acknowledge the role of domestic investors during sudden stops. Calvo and Reinhart (1999, p. 4) indicate "... a large negative swing in the capital account can also be due to a surge in [domestic] capital flight." What these papers and much of the empirical literature share in common, however, is that sudden stops are measured using net capital flow data, hence foreign and domestic capital flows are aggregated.

Recently, several papers have argued that domestic investors, as opposed to foreign investors, are the originators of many sudden stops (c.f., Rothenberg and Warnock, 2006; Cowan et al., 2007; Cowan and De Gregorio, 2005). A non-trivial number of sudden stops, these papers contend, are not cases in which an emerging market country is abruptly cut off from global capital markets; rather, it is access to these very markets that serve as the vehicle for domestic capital to take flight. The possibility of a massive exodus of domestic capital is also related to the so-called "capital flight" literature which interprets abnormal domestic capital outflows—often through unrecorded channels and in response to government restrictions and socioeconomic uncertainty—as a drain on a country's resources (Schneider, 2003).

Among the recent papers that have considered gross capital flows include Powell, et al. (2002) who analyze the determinants, consequences, and inter-relationships between domestic and foreign capital flows using a panel vector autoregression. Among their findings, they note inflows and outflows exhibit two-way causality with each other. They find increased domestic outflows are negatively correlated with economic growth after controlling for foreign and official flows; the adverse impact on growth then feeds back to additional domestic outflows, thus creating a vicious circle. While examining capital flows specifically during sudden stops was not the objective of this paper, the authors do note that "...countries hit by crises appear to react quite differently, with sudden stops evident for some in [foreign flows], whereas for others there are increased [domestic] outflows."

Rothenberg and Warnock (2006) comprehensively examine the role of domestic capital flows during sudden stops. They identify 70 sudden stops in 24 emerging markets

occurring between 1989 and 2005 using the Calvo et al. (2004) sudden stop definition (based on net capital flows). These episodes are then classified into being either "domestic flight" or "foreign flight" episodes, where the former type of sudden stop is caused predominantly by domestic investors and the latter by foreign investors.[1] While the details their classification scheme are left for the next section, Rothenberg and Warnock find that of the 70 crises identified using net flows, 31 are true sudden stops, 24 are sudden flights, and insufficient capital flow data existed to identify the remaining 15 episodes. Thus, domestic flight episodes constitute about half of the identifiable sudden stops—these countries are not cut off from global capital markets, but rather domestics make use of these markets by moving their funds abroad. The authors observe that true sudden stops are bunched together between 1997 and 2001, whereas sudden flights are spread more evenly over time, suggesting that contagion plays a role in true sudden stops and domestic conditions motivate sudden flights.

Cowan et al. (2007) compare the behavior of gross capital flows between developed and emerging market economies. They argue sudden stops, as indicated by changes in the financial account, suffer from an identification problem since sudden stops can be precipitated directly by an external financial shock, or indirectly by swings in the current account (which can happen via changes in savings and investment, terms of trade shocks, or exchange-rate misalignments). Insight to the identification problem can be had, according to Cowan et al., by considering whether a sudden stop occurred primarily due to domestic outflow (suggesting a shock to the domestic economy resulted in a current account reversal), or whether the sudden stop occurred primarily due to foreign

[1] Rothenberg and Warnock (2007) term foreign flight episodes as "true sudden stops" and domestic flight episodes as "sudden flights." For consistency, I discuss their paper and all others using my terminology.

capital outflows (in which case the shock to the financial account arose from the external financial market and is more indicative of how economists conceptually think of sudden stop crises). The authors identify 100 sudden stops using annual data on net capital flows from 1975-2004 for 22 developed economies and 31 emerging economies. The authors indicate that of the 100 sudden stop episodes (defined using net flows with a sample of emerging and developed economies), 57 episodes are foreign flight episodes, while 18 episodes are episodes of domestic flight. Cowan et al. go on to say that these numbers change considerably once emerging economies are distinguished from developed economies—65% of the sudden stops in emerging economies are inflow-driven, in contrast to only 40% for developed economies. From this they conclude that inflow-driven sudden stops are not as frequent as suggested in the literature, particularly for developed economies.

The findings in this nascent literature point to a nontrivial role played by domestic investors during sudden stop crises, which is provocative since it runs counter to many economists' notions and suggests different policies to mitigate and prevent these crises. This paper focuses on the taxonomies employed in the previous literature and extends it in a number of important ways. First, I allow for the possibility that domestic and foreign investors respond at different times to the sudden stop shock (due to, for example, asymmetric information) by examining gross capital flows before, during, and after the onset of a sudden stop. Second, I examine instances when the behavior of gross capital flows departs significantly from its typical behavior. The results show that markedly large increases in domestic capital outflows during sudden stops are rare, accounting for about 25% of sudden stops. Furthermore, the percentage of sudden stops occurring

exclusively with domestic flight is about 10%, thus suggesting domestic investors play a minor role in the overwhelming majority of sudden stops. The evidence found in this paper suggest the interesting information obtained by examining gross capital flows during sudden stops is not the non-trivial number of crises that occur because of domestic residents, as indicated in the previous literature; instead, it is that there are so few instances that domestic investors send their funds out in a significant manner.

2. Distinguishing sudden stops by gross capital flows

2.1 Overview of gross capital flow data

This paper examines the behavior of domestic and foreign investors by examining gross capital flows during sudden stops. Gross capital flows are reported in the IFS dataset as assets or liabilities, where both entries can be either negative or positive.[2] Assets (A) represent net purchases/sales of foreign securities by domestic residents. I maintain the BOP convention in reporting a net purchase of foreign securities by domestic residents as a negative value. Liabilities (L) represent net purchases/sales of domestic securities by foreign residents, which take a positive value if a net purchase has occurred. Assets are discussed in terms of "domestic capital flows" and liabilities in terms of "foreign capital flows."

The primary interest of this paper is to examine the effect of a shock on gross capital flows, it is useful to discuss the changes in assets and liabilities over a period of time. The series ΔA and ΔL are measured as annualized changes. Note that it is

[2] Gross capital flow data from the IFS database are gross in the sense that a country's assets are distinguished from its liabilities. However, these assets and liabilities are net of investors' purchases and sales of a security. Clarity on this point is necessary since some papers, for e.g., Dvorak (2003), examine gross capital flows from the latter perspective.

ambiguous whether $\Delta L < 0$ represents an increase in net sales of domestic securities or a decrease in net purchases of domestic securities by foreign investors. For simplicity, I describe this situation as "decreased foreign inflow." Likewise, $\Delta A < 0$ is ambiguous to whether domestic investors are increasing purchases of foreign securities or decreasing sales of foreign securities. For simplicity, this is described as "increased domestic outflow." Table 2 in the appendix summarizes the data and interpretations of gross capital flows.

2.2 Evaluating previous taxonomies

Before constructing a measure to examine the behavior of domestic capital flows during sudden stops, it is useful to review in more detail the criteria used in previous papers closely related to this one. Rothenberg and Warnock (2006), henceforth RW, classify sudden stops as being either foreign flight episodes or domestic flight episodes by comparing the annualized changes in assets and liabilities at the start of the crisis. A sudden stop characterized by foreign flight—that is, a sudden stop owing primarily to the actions of foreign investors—occurs when $\Delta A > \Delta L$, whereas domestic flight episodes, which are dominated by domestic investors moving their money abroad, occur when $\Delta A < \Delta L$. Inequalities employed in this manner do not indicate whether movement in one flow type was substantially larger than the other. For example, a sudden stop with $\Delta A = -5$ and $\Delta L = -4.9$ will be classified as domestic flight as will a sudden stop with $\Delta A = -5$ and $\Delta L = -0.1$. The former scenario is indicative of both foreign and domestic investors fleeing the country, while the latter scenario is more in line with RW's description of a country denied access to the international capital markets.

Cowan et al. (2007), henceforth CEA, incorporate the relative magnitude of changes in gross flows by classifying sudden stops with the following ratio: $S = \Delta L/(\Delta L + \Delta A)$.[3] Domestic flight occurs when $S < 0.25$, while foreign flight occurs when $S > 0.75$.[4] Sudden stops that are mixed—that is, crises where the change in a gross flow is not substantially larger than the other—occur when $S \in [0.25,0.75]$. The values of the S-ratio used to create the tripartite classification are ad hoc: nonetheless distinguishing whether or not the change in a gross flow is markedly different from the other is a refinement of RW's use of simple inequalities. Given CEA's allowance for an additional classification type, it is not surprising domestic flight episodes account for 18% of all sudden stops in their sample, while RW find nearly 37% of sudden stops are domestic flight episodes.[5]

CEA's use of the S-ratio yields a distribution of sudden stops according to the share of the change in foreign capital flows to the change in total capital flows. This is useful since it explicitly shows the degree to which ΔA exceeds ΔL, and vice versa, for the sample of crises. Figure 1 replicates the distribution of this ratio reported in CEA's paper. This figure shows the sudden stops with the highest frequency occur where the S-ratio just exceeds the upper threshold of 0.75, implying that the relative magnitude of decreased domestic capital inflow to increased domestic capital outflow barely avoided being rendered as "mixed" cases. Caution with interpretation is necessary, however, for

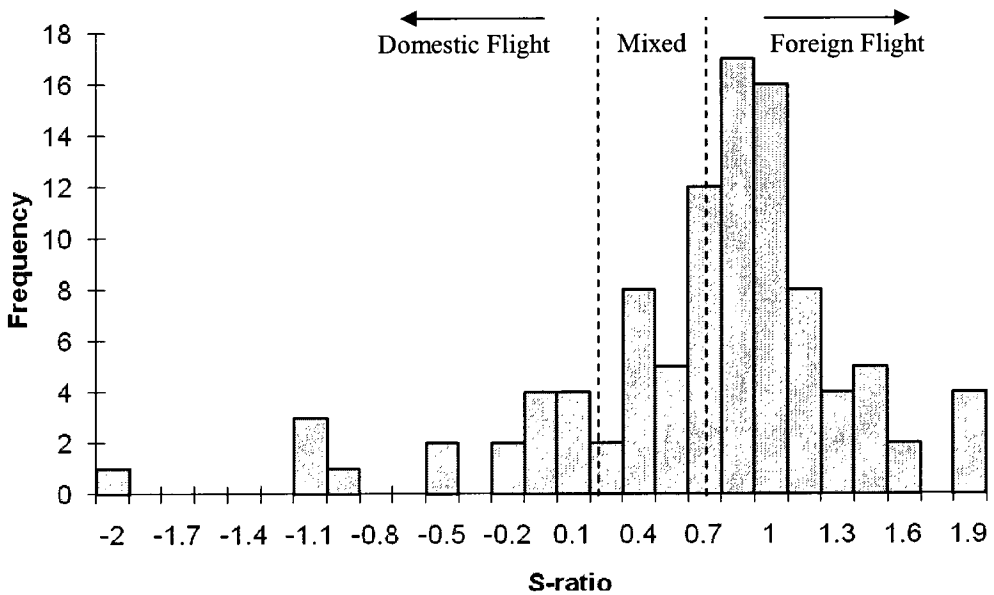
[3] In addition to using this ratio to classify sudden stops based on the contribution of gross capital flows, CEA apply their sudden stop definition to foreign capital flows as a means for classification. I discuss their latter classification in more detail in the following section.

[4] CEA term domestic flight episodes as "sudden starts" and foreign flight episodes as "sudden stops." As with the different terminology used in Rothenberg and Warnock (2006), I avoid CEA's terminology to maintain consistency throughout this paper.

[5] RW identify 70 sudden stops, 65 of which have data on gross capital flows. The percentage cited here is only for the crises which have gross capital flow data.

values of the S-ratio below 0 and above 1 represent either foreign or domestic investors increasing their investment in the country. For example, foreign flight episodes occur for both a sudden stop with $\Delta A = -1$ and $\Delta L = -5$ ($S = 0.83$) and a sudden stop with $\Delta A = +3$ and $\Delta L = -5$ ($S = 2.5$). Thus while both sudden stops in this example are dominated by the actions of foreign investors—and in this sense their classifications as foreign flight episodes seems appropriate—the different directions that domestic flows take suggest very different circumstances behind each of these sudden stops.

Figure 1 – Replica of the distribution of the S-ratio in Cowen et al. (2007)



Foreign or domestic investors increasing their investment position in a country during a sudden stop is not a remote possibility according to the papers discussed here. Of the 55 sudden stops classified by RW as either foreign flight or domestic flight, 23 of these sudden stops experienced decreased domestic outflow while 18 sudden stops had

increased foreign inflow. Similarly, CEA identify a total of 100 sudden stops for developed and emerging market countries. Over half of the foreign flight episodes (31 out of 57) occur with an increase in domestic inflows; and more than two-thirds of the domestic flight episodes (13 out of 18) occur with an increase in foreign inflows. Thus, sudden stops characterized by gross capital flows moving in opposite directions—one fleeing the country while the other is moving toward the country—are aptly described as being the norm here.

An important feature of the taxonomies of RW and CEA is that both compare ΔA to ΔL at time t (i.e., the start of each crisis). However, the relative change in capital flows is unlikely to remain constant for the duration of the crisis, thus it is entirely possible that, for e.g., a sudden stop categorized as domestic flight at time t would be identified as foreign flight at time t+1. The prevalence that RW and CEA find sudden stops occur with increased gross capital inflows may, at least in part, be the result of restricting their comparisons to time t. In the presence of asymmetric information, the onset of a crisis may be characterized by one group of investors behaving normally as they are ignorant of the shock precipitating the crisis. Thus, incorporating the dynamic behavior of foreign and domestic investors during sudden stops is a desirable feature when comparing the contribution of each gross flow type to the crisis.

It is also important to note that the taxonomies employed by RW and CEA do not indicate whether the changes in foreign and domestic capital flows are abnormally large relative to their own histories. It cannot be reasonably assumed, as I demonstrate later in this paper, that abnormally large reductions in net capital flows (i.e., sudden stops) imply abnormally large changes in gross capital flows. Ensuring the change in a gross capital

flows is demonstrably large relative to its own history is important since the alternative implies the respective group of investors did not respond in a meaningful manner to the shock precipitating the crisis. If domestic or foreign investors fail to exhibit atypical behavior during a sudden stop, then the meaningfulness of a classification based on comparing ΔA to ΔL becomes suspect. Distinguishing typical from atypical behavior for gross capital flows is particularly important in the context of emerging markets. As shown in

Figure 2, foreign capital flows are typically much larger than their domestic counterpart—on average, about twice as large as domestic flows in absolute terms. This stylized fact suggests that if a sudden stop were characterized by an atypically large domestic capital outflow and a typical reduction in foreign capital inflow, the former could still smaller in magnitude than the latter. In this case, the RW and CEA taxonomies would classify it as a foreign flight episode despite domestic investors solely reacting to the shock precipitating the sudden stop.

2.3 The direct method

The previous section discussed related papers' taxonomies used to distinguish domestic flight and foreign flight, and indicated these methodologies do not account for the dynamic behavior of gross capital flows, nor distinguish between their typical and atypical behaviors. To develop a measure that incorporates these considerations, I first use net capital flows to define sudden stops in a manner analogous to Guidotti et al. (2004). Specifically, a sudden stop (SS) occurs when the change in the financial account drops at least 1 standard deviation below its mean:

$$\Delta FA \leq \mu_{FA} - \sigma_{FA} \qquad (2)$$

and ΔFA must be at least -5% of GDP. Following Calvo et al. (2004), the country-specific mean and standard deviation are determined on a rolling basis such that at time t all historical data up to, and including, time t is utilized. Two years worth of data for each country is reserved before equation (2) is applied to ensure the rolling mean and standard deviation are not unduly swayed by abnormal values of ΔFA early in the sample. Also, periods which satisfy (2) for a given country are assumed to be of the same episode if the periods occur at most 2 quarters away from each other.

Next, I apply the sudden stop definition above in a parallel manner to each of the gross capital flows to obtain domestic flight (DF) and foreign flight (FF) flight episodes:

$$\Delta A \leq \mu_A - \sigma_A \qquad (3)$$

$$\Delta L \leq \mu_L - \sigma_L \qquad (4)$$

where ΔA and ΔL must fall at least 1 standard deviation below their respective mean to be considered a DF and FF episode, respectively. The means and standard deviations in equations (3) and (4) are also measured on a rolling basis, and episodes occurring no more than 2 periods apart are assumed to be of the same episode. Unlike the sudden stop definition, however, I do not require that ΔA and ΔL fall at least 5% of GDP.

The requirement that ΔA and ΔL must satisfy equations (3) and (4) ensure that only atypical changes in gross capital flows are considered as DF and FF. DF and FF can occur in the absence of sudden stops in net flows, presumably representative of diversification by investors. For this reason, I focus on instances of foreign flight and

domestic flight that overlap with a sudden stop crisis by at least 1 period. The start and end time of each overlapping foreign and domestic flight episode is measured relative to the timing of the respective sudden stop crisis, where the sudden stop begins at time t and ends at time t^*. Thus, for example, a DF episode from 1991Q1-1992Q2 overlapping with a sudden stop from 1991Q3-1992Q2 is given the start date t-2 and end date t^*. In this manner, I avoid restricting the analysis of gross capital flows during sudden stops at a single point in time.

The methodology described here amounts to finding instances when (i) the negative change in a gross capital flow deviates markedly from its normal behavior, and (ii) this deviation coincides with a sudden stop. This methodology can yield four possible outcomes of gross capital behavior during sudden stops. First, significant deviations in both gross capital flows may coincide with a sudden stop (i.e., both foreign investors and domestic investors move their capital abroad in an atypical manner). This possibility corresponds to the presumed scenario most economists have of sudden stops, yet, as I will show in the next section, it is far from the typical case. The second and third possibilities involve only one gross flow type exhibiting a significant change during a sudden stop, thus the sudden stop episode occurs predominantly because of the actions undertaken by either domestic investors or foreign investors. These scenarios loosely correspond with Cowan et al.'s classification scheme requiring the change in one flow type to markedly exceed that of the other to be classified as DF or FF. The last possibility is that neither domestic nor foreign capital flows exhibit a significant deviation during a sudden stop. This case may arise, albeit unlikely, if the correlation between ΔA and ΔL abruptly becomes higher during a sudden stop, despite the changes in the gross

flows being indistinguishable from their normal behaviors. In other words, a sudden stop as defined by equation (2) could occur if the co-movement of the gross capital flows exhibits a marked change despite each individual flow not deviating substantially from its own history.

3. Classification results

An unbalanced panel of capital flow data for a sample of 42 emerging market economies is examined from 1988Q1 to 2005Q4. The country sample corresponds to the samples used by RW and CEA., although data availability makes this correspondence imperfect. A total of 37 sudden stop episodes are identified using equation (2). The direct method is then applied to each sudden stop using data for all types of gross capital flows (foreign direct investment, portfolio debt and equity, derivatives, and a residual category consisting primarily of investments in currency and deposits, loans, and trade credits). All capital flow types are considered here for two reasons. First, the determination of a sudden stop is based on all capital flows since this crisis is defined using the financial account. Thus identifying DF and FF using all types of capital flows enables the sudden stop to be decomposed in its entirety according to the contributions of foreigners and domestics. Second, the differences between these capital flow types can be artificial. For instance, the IMF classifies equity investments in excess of 10% as foreign direct investment (Sula and Willett, 2006).

3.1 Comparing results between taxonomies

Before proceeding to examine in detail the results obtained from the direct method, it is useful to see how this different this method is from the RW and CEA methods. To facilitate comparison, I apply

the RW and CEA classification schemes to the same sample of 42 emerging market economies used for the direct method.[6]

Table 6 shows the classifications for each of the 56 sudden stops using the three methodologies. There are 23 crises—or about 41% of all sudden stops—whose categorization using the direct method differs from either or both taxonomies of RW and CEA: these crises, as well as the changes in liabilities and assets and the *S*-ratio are shown in Table 1 below.[7]

Table 1 – RW & CEA classifications that change using the direct method

Country	SS Date	ΔL	ΔA	*S*	RW	CEA	Direct
Argentina	1995Q1-1995Q1	-13.10	-4.54	0.74	FF	Mixed	FF
Argentina	2001Q1-2001Q1	-9.11	-4.91	0.65	FF	Mixed	FF
Argentina	2001Q3-2002Q3	-23.59	0.23	1.01	FF	FF	Both
Belarus	1999Q3-1999Q3	-0.28	-0.22	0.55	FF	Mixed	Neither
Bolivia	2003Q4-2003Q4	-0.29	-0.32	0.48	DF	Mixed	Both
Costa Rica	2004Q1-2004Q1	-0.48	-0.56	0.46	DF	Mixed	Both
Czech Rep.	1997Q4-1998Q1	-1.04	-2.04	0.34	DF	Mixed	FF
Czech Rep.	2003Q3-2004Q1	-4.94	-2.49	0.66	FF	Mixed	FF
Ecuador	1999Q4-1999Q4	-2.12	-0.67	0.76	FF	FF	Neither
Ecuador	2000Q3-2001Q2	-5.21	-0.92	0.85	FF	FF	Both
Georgia	2002Q4-2002Q4	-0.13	-0.05	0.71	FF	Mixed	FF
Hong Kong	2003Q3-2003Q3	9.82	-28.62	-0.52	DF	DF	Neither
Hungary	2002Q1-2002Q3	-0.88	-2.07	0.30	DF	Mixed	Both
Jordan	2001Q1-2001Q1	-0.39	-0.18	0.69	FF	Mixed	Neither
Jordan	2003Q4-2004Q2	-1.02	0.34	1.51	FF	FF	Both
Mexico	1988Q2-1988Q2	-9.45	-4.13	0.70	FF	Mixed	Neither
Philippines	2001Q1-2001Q3	-5.20	0.82	1.19	FF	FF	Both

[6] In addition to comparing results across the alternative taxonomies, a comparison is made with the results reported in CEA and RW. As shown in Table 3, the results I obtain are different from the results reported in RW and CEA, particularly in the number of DF episodes. RW and CEA report 44% and 18% of all sudden stops are DF, while I find 20% and 9% using their methods, respectively. Identifying the source of this discrepancy is confounded by a number of factors, yet the fact that I identify about one-half as many DF episodes as these authors (as a percentage of all sudden stops) suggests these classifications are sensitive to the particularities in which they are employed.

[7] It is important to emphasize that these are different measures and indicate different information regardless of whether or not they are constructed from the same data. Thus the comparability of their results should be done from the perspective of their (dis)similarities, and not from the perspective of finding the "true" classification.

Portugal	1984Q1-1984Q1	-2.48	-1.01	0.71	FF	Mixed	Neither
Portugal	1991Q2-1991Q2	-1.21	-2.60	0.32	DF	Mixed	Neither
Portugal	1992Q4-1993Q3	-4.47	-1.01	0.82	FF	FF	DF
Russia	2000Q4-2001Q1	-10.92	-5.93	0.65	FF	Mixed	FF
Slovak Rep.	2003Q4-2003Q4	-1.74	-1.83	0.49	DF	Mixed	Neither
Thailand	1997Q2-1998Q3	-20.88	6.69	1.47	FF	FF	Both

For each crisis listed, the change in assets and liabilities at the start of the crisis is given ($US bil.), as well as the S-ratio which incorporates these values.

Juxtaposing the differing classifications obtained using the methods by RW and CEA with the direct measure highlights the difficulties that arise when comparing ΔL with ΔA at the start of a crisis. For example, the last entry in Table 1 shows Thailand's sudden stop during the Asian financial crisis. At the start of this sudden stop in 1997Q2, foreign capital inflow was reduced by $20.88 billion USD, yet domestic capital outflow reduced by $6.69 billion. RW's method categorizes this crisis as FF because at the start of the crisis $\Delta L < \Delta A$; similarly, Cowan's method classifies this crisis as FF because $S = \Delta L/(\Delta L + \Delta A) = 1.47$ exceeds the minimum threshold of $S = 0.75$ to be categorized as such. Despite foreign investors dominating the adverse movement in Thailand's financial account in 1997Q2, attributing the entire crisis solely to these investors may be misleading since it negates the possibility domestic investors reacted at a point in time other than 1997Q2. Indeed, as the direct measure indicates, there was a significant reduction in foreign capital inflow *and* a significant increase in domestic capital outflow during the crisis. Not shown in this table for brevity is that foreign investors actually began a marked reduction in capital inflows in 1996Q4, while substantial domestic capital outflows occurred about a year later, in 1997Q4 (see Table 7 for the dates of each DF and FF episode).

3.2 Results using the direct method

The results from applying the direct taxonomy to gross capital flows are summarized in the first column of Table 4, while the timing for each SS, as well as the timing for each DF and FF episode that overlaps with SS, is provided in Table 7. There are only 5 crises—or about 9% of all sudden stops—where domestic flight occurred exclusively.[8] On the other hand, the direct measure shows the majority of sudden stops occurring exclusively with foreign flight (about 63% of all crises). The low incidence of domestic flight episodes relative to foreign flight episodes may be a result of requiring both ΔA and ΔL be in excess of 2.5% of GDP, particularly given that the typical domestic capital flow for emerging markets is substantially smaller than its foreign counterpart (see

Figure 2). However, this does not appear to be the case, since ΔA satisfied equation (3) 84 times, while ΔL satisfied equation (4) 71 times. In other words, "abnormal" increases in domestic capital outflows are more common in this sample than "abnormal" decreases in foreign capital inflows, yet the latter is vastly more likely to occur during sudden stops.

An interesting result obtained here is the infrequency that both domestic flight and foreign flight occur during sudden stops; only 8 crises (14% of the total) are characterized with both DF and FF. The joint occurrence of substantially reduced foreign capital inflows and increased domestic capital outflows suggests these crises are particularly

[8] This figure is considerably less than the 20% of domestic flight episodes identified using RW's method, and while the percentage equals that found using the CEA method only 3 of the 5 sudden stops are identified as DF by both methods. In their own papers, RW and CEA identify 44% and 18% of sudden stops as DF, respectively.

severe. Indeed, there are several prominent sudden stops in this category—notably Thailand 1997-98 and Argentina 2001-02—but others, including Mexico's 1994-95 Tequila crisis, are not. Lastly, the number of crises where there was not a notable change in either gross capital flow during a sudden stop also (coincidentally) accounts for 8 sudden stops.

The most striking result found using the direct method is the lack of atypical behavior exhibited by domestic investors during sudden stops. If the distinction whether or not DF occurs with FF is not made, then FF is present in 77% percent of sudden stops while DF is present in only 21% of sudden stops. Not only are the number of sudden stops dominated solely by DF a tiny minority, but substantial increases in domestic capital outflows during any sudden stops are a rarity, regardless of foreign capital flows. Thus, the interesting information obtained by examining gross capital flows during sudden stops is not the non-trivial number of crises that occur because of domestic residents, as argued by RW and CEA; instead, it is that there are so few instances that domestic investors send their money out in a significant manner.

To test the robustness of these findings, columns (2) through (5) report the results when the direct method is applied under a variety of different circumstances. First, I exclude foreign direct investment from the set of capital flows used to define DF and FF, although all other criteria used previously are retained—including that ΔA and ΔL satisfy a 2.5% of GDP threshold. As shown in column (2), there is a slight increase in the total number of DF and FF episodes, yet the percentage of DF and FF during SS (irrespective of their joint occurrence) is 25% and 75%, respectively. Column (3) shows the results when portfolio capital flows are used to define DF and FF, whose changes in gross

capital flows must satisfy a 1% of GDP threshold. In addition, a 5-year rolling mean and standard deviation is used in equations (2), (3), and (4) hence there is a slight change in the number of sudden stops identified. Using the first column as the basis for comparison, the total number of DF occurring decreases from 13 instances to just 5. There is also a dramatic increase in the percentage of sudden stops without either DF or FF—changing from 14% to 47%—indicative that non-portfolio capital flows often flee during sudden stops.

Previous research, particularly within the so-called capital flight literature, has indicated that official data on domestic capital flows can be poor in quality. As an alternative, some authors have utilized the errors and omissions in the balance of payments. Column (4) shows results when errors and omissions are used to represent domestic capital flows, while foreign capital flows are captured by non-FDI capital flows. Additionally, the threshold used to define a sudden stop is lowered from 5% to 4% of GDP and the DF / FF threshold is 1.5% of GDP. Given these less stringent thresholds, it is not surprising that there is an increase in the total number of sudden stops identified and the number of FF during these crises. The total number of DF episodes, however, decreases and only 7% of sudden stops occur with DF.

The first three columns have required that capital flows exceed a particular percentage of GDP when defining SS, FF, and DF. While this desirable in that it ensures these events are economically large, the choice of threshold is subjective and is cumbersome when applying to gross capital flows. As an alternative, I employ the sudden stop definition used by Calvo et al. (2004); this method involves two standard deviations instead of one in equations (2) through (4), but does away with the percentage

of GDP requirement.[9] Using non-FDI capital flows for domestic and foreign capital flows, the major change in column (5) is a sharp increase in the number of sudden stops occurring in the absence of either DF or FF, changing from 14% of all sudden stops in column (1) to 42% in column (5). Interestingly, this difference occurs entirely because there are fewer instances of FF during sudden stops. Again using column (1) as the basis for comparison, the percentage of SS occurring with DF actually increases by 1 percentage point to 24%, while the percentage of SS occurring with FF decreases from 77% to just 47%.

4. Conclusions

This paper examines the behavior of domestic capital flows during sudden stops. Recent papers have found increased domestic outflows dominate their foreign counterpart in 18% to 44% of all sudden stops. However, the methods used to distinguish domestic flight and foreign flight in these papers evaluate gross capital flows only at the start of the crisis. Moreover, these methods compare the changes in domestic capital flows to foreign capital flows without distinguishing whether the change in either capital flow was atypical of its own behavior. I address these issues by constructing a taxonomy that yields instances when (i) the negative change in either of the gross capital flows deviates significantly from its normal behavior, and (ii) this change coincides with a sudden stop by at least 1 period. The results show that markedly large increases in domestic capital outflows during sudden stops are rare, accounting for about 25% of sudden stops. Furthermore, the percentage of sudden stops occurring exclusively with domestic flight is

[9] In addition, the sudden stop definition used in Calvo et al. (2004) marks the beginning and ending of each crisis episode when the capital flow series passes and returns to the mean less 1 standard deviation threshold.

about 10%, thus suggesting domestic investors play a minor role in the overwhelming majority of sudden stops. The interesting information obtained by examining gross capital flows during sudden stops is not the non-trivial number of crises that occur because of domestic residents, as argued by RW and CEA; instead, it is that there are so few instances that domestic investors send their money out in a significant manner.

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6. Appendix

Table 2 - Data description

This paper examines gross capital flows for 42 emerging market countries over 1980Q1-2005Q4 using balance of payments data from the IMF's International Financial Statistics (IFS).

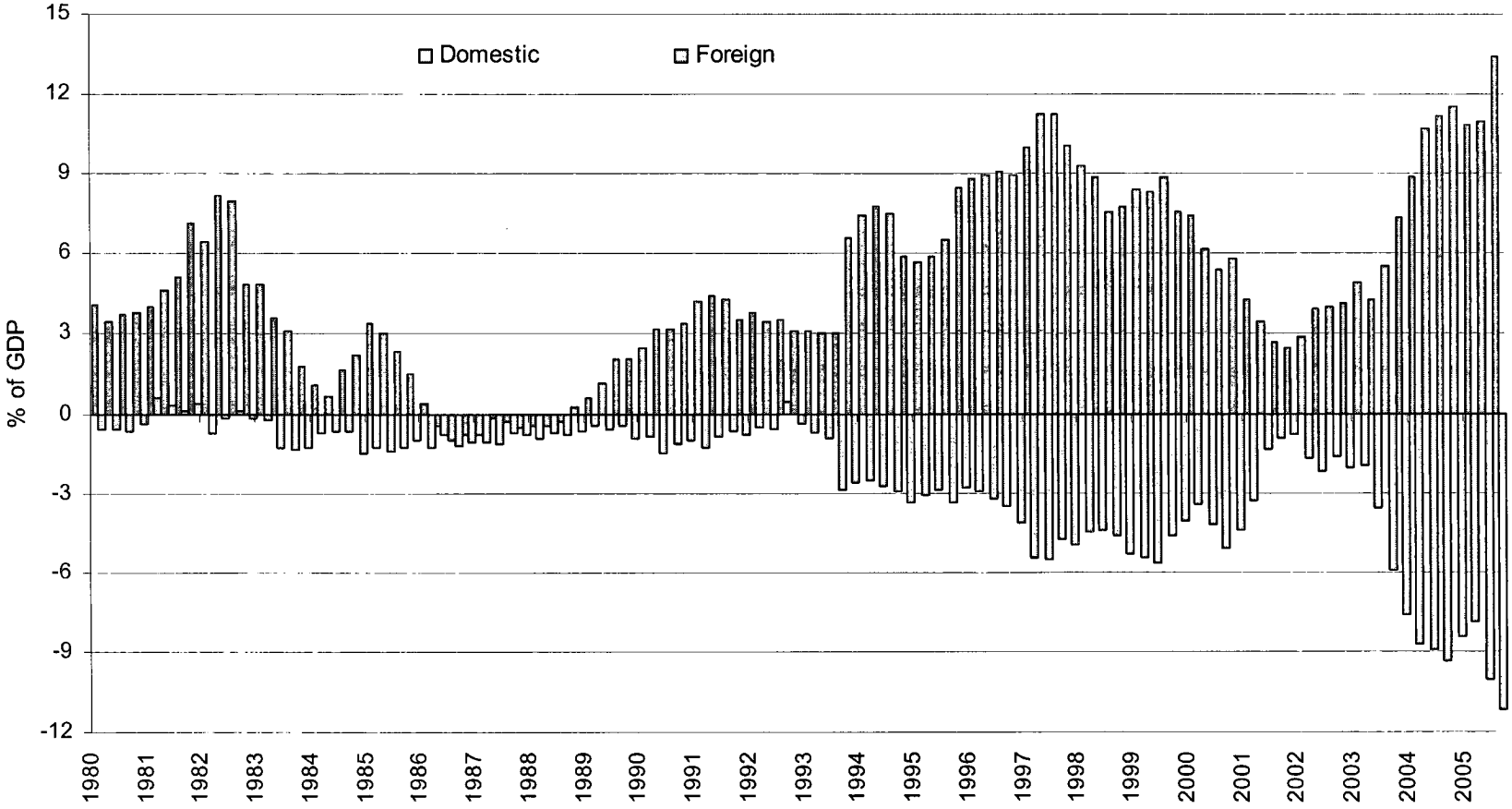
Gross capital flows are reported in the IFS dataset as assets or liabilities, where both entries can be either negative or positive. Assets (A) represent net purchases/sales of foreign securities by domestic residents. I maintain the BOP convention in reporting a net purchase of foreign securities by domestic residents as a negative value. Liabilities (L) represent net purchases/sales of domestic securities by foreign residents, which take a positive value if a net purchase has occurred. Assets are discussed in terms of "domestic flows" and liabilities in terms of "foreign flows."

Unless otherwise indicated, the assets and liabilities are composed of the sum of foreign direct investment (lines 78bdd and 78bed), portfolio debt and equity (lines 78bfd and 78bgd), derivatives (lines 78bxd and 78bwd), and "other" investments (lines 78bhd and 78bid). Major categories in "other" investments are transactions in currency and deposits, loans, and trade credits. Net capital flows represent the financial account balance (line 78bjd).

Each capital flow series is converted to annualized changes. In this form, however, it is ambiguous whether a change in net sales or change in net purchases occurred. For simplicity, the following descriptors for ΔA and ΔL are used:

Sign	*Meaning*	*Descriptor*
$\Delta A > 0$	Increased net sales of foreign securities / decreased net purchases of foreign securities by domestic residents	Decreased domestic outflow
$\Delta A < 0$	Decreased net sales of foreign securities / increased net purchases of foreign securities by domestic residents	Increased domestic outflow
$\Delta L > 0$	Decreased net sales of domestic securities / increased net purchases of domestic securities by foreign investors	Increased foreign inflow
$\Delta L < 0$	Increased net sales of domestic securities / decreased net purchases of domestic securities by foreign investors	Decreased foreign inflow

Figure 2 – Mean gross capital flows in emerging markets 1980Q1 – 2005Q4



Since at least 1980 foreign investors have mostly been net purchasers of domestic securities in emerging markets (i.e., positive value) while and domestic investors have mostly been net purchasers of foreign securities (i.e., negative value). The average foreign and domestic capital flow, measured across time is 5% and -2.5%, respectively.

Table 3 – Domestic and foreign flight episodes using RW and CEA classifications

		RW Methodology		CEA Methodology	
		(1) RW	(2) This paper	(3) CEA	(4) This paper
% of total SS	Total sudden stops (SS)	55 (100%)	56 (100%)	100 (100%)	56 (100%)
	Total domestic flight (DF)	24 (44%)	11 (20%)	18 (18%)	5 (9%)
	DF w/ decreased foreign inflow	7 (13%)	9 (16%)	5 (5%)	2 (4%)
	DF w/ increased foreign inflow	17 (31%)	2 (4%)	13 (13%)	3 (5%)
	Total Foreign Flight (FF)	31 (56%)	45 (80%)	57 (57%)	35 (63%)
	FF w/ increased domestic outflow	25 (20%)	17 (30%)	26 (26%)	8 (14%)
	FF w/ decreased domestic outflow	17 (24%)	28 (50%)	31 (31%)	27 (48%)
	Total Mixed cases	n.a.	n.a.	25 (25%)	15 (27%)

Columns (1) and (2) summarize the results reported in RW (2006) and the results obtained using their classification scheme with my sample of of 42 emerging market economies from 1980Q1 to 2005Q4, respectively. Similarly, columns (3) and (4) summarize the results reported in CEA (2007) and the results obtained using their classification scheme with my sample. Figures in parentheses express the number of episodes for a given category as a percentage of all sudden stops. RW (2006) identify 70 sudden stops, but are able to classify only 55 of these crises due to limited data on gross capital flows: the percentages reported for their paper in this table are based on these 55 classifiable episodes.

Table 4 – Summary classifications using the direct measure

		(1)	(2)	(3)	(4)	(5)
(% of all SS)	Total Sudden Stops (SS)	56 (100%)	56 (100%)	53 (100%)	64 (100%)	43 (100%)
	SS w/ only DF	5 (9%)	4 (7%)	2 (4%)	1 (2%)	5 (12%)
	SS w/ only FF	35 (63%)	29 (52%)	23 (43%)	43 (67%)	15 (35%)
	SS w/ DF & FF	8 (14%)	10 (18%)	3 (6%)	3 (5%)	5 (12%)
	SS w/o DF & FF	8 (14%)	13 (23%)	25 (47%)	17 (27%)	18 (42%)
(% of all DF)	Total Domestic Flight (DF)	84 (100%)	88 (100%)	73 (100%)	56 (100%)	59 (100%)
	DF w/ SS	13 (15%)	14 (16%)	5 (7%)	4 (7%)	10 (17%)
	DF w/o SS	71 (85%)	74 (84%)	68 (93%)	52 (93%)	49 (83%)
(% of all FF)	Total Foreign Flight (FF)	71 (100%)	74 (100%)	79 (100%)	77 (100%)	42 (100%)
	FF w/ SS	43 (61%)	39 (53%)	26 (33%)	46 (60%)	20 (48%)
	FF w/o SS	28 (39%)	35 (47%)	53 (67%)	31 (40%)	22 (52%)

This table summarizes the results from applying the direct taxonomy under a variety of specifications. Column (1) uses data for all capital flow types and is considered the representative case in this paper. Column (2) uses non-FDI capital flows, while column (3) utilizes only portfolio capital flows and a 1% of GDP threshold (instead of 2.5% of GDP). Column (4) shows the results when domestic capital flows are represented with data on the errors and omissions in the BOP. Lastly, column (5) applies the sudden stop definition in Calvo et al. (2004) to net and gross capital flows. See section 3.2 Results using the direct method for more details.

Table 5 – Summary results on the timing of domestic and foreign capital flight

		(1)	(2)	(3)	(4)	(5)
	SS starts at time t					
(% of DF)	DF start < t	2 (15%)	3 (21%)	2 (40%)	0 (0%)	4 (40%)
	DF start at t	5 (38%)	5 (36%)	2 (40%)	0 (0%)	2 (20%)
	DF start > t	6 (46%)	6 (43%)	1 (20%)	4 (100%)	4 (40%)
(% of FF)	FF start < t	13 (30%)	12 (31%)	10 (38%)	12 (26%)	2 (10%)
	FF start at t	26 (60%)	24 (62%)	11 (42%)	28 (61%)	14 (70%)
	FF start > t	4 (9%)	3 (8%)	5 (19%)	6 (13%)	4 (20%)
	SS ends at time t^*					
(% of DF)	DF end < t^*	8 (62%)	7 (50%)	8 (31%)	3 (75%)	2 (20%)
	DF end at t^*	4 (31%)	5 (36%)	11 (42%)	1 (25%)	2 (20%)
	DF end > t^*	1 (8%)	2 (14%)	7 (27%)	0 (0%)	6 (60%)
(% of FF)	FF end < t^*	4 (9%)	8 (21%)	1 (20%)	6 (13%)	3 (15%)
	FF end at t^*	29 (67%)	19 (49%)	1 (20%)	29 (63%)	12 (60%)
	FF end > t^*	10 (23%)	12 (31%)	3 (60%)	11 (24%)	5 (25%)

The table shows the number of domestic and foreign flight episodes that occur before, jointly, or after a sudden stop beginning at time t and ending at time t^*. Column (1) uses data for all capital flow types and is considered the representative case in this paper. Column (2) uses non-FDI capital flows, while column (3) utilizes only portfolio capital flows and a 1% of GDP threshold (instead of 2.5% of GDP). Column (4) shows the results when domestic capital flows are represented with data on the errors and omissions in the BOP. Lastly, column (5) applies the sudden stop definition in Calvo et al. (2004) to net and gross capital flows.

Table 6 – Comparing RW, CEA, and direct classifications

Country	1st Start	RW	CEA	Direct	2nd Start	RW	CEA	Direct	3rd Start	RW	CEA	Direct	4th Start	RW	CEA	Direct
Albania																
Argentina	1995Q1-1995Q1	FF	Mixed	FF	2001Q1-2001Q1	FF	Mixed	FF	2001Q3-2002Q3	FF	FF	Both				
Belarus	1999Q3-1999Q3	FF	Mixed	Neither												
Belize																
Bolivia	2003Q4-2003Q4	DF	Mixed	Both												
Brazil	1999Q1-1999Q2	FF	FF	FF	2002Q3-2003Q2	FF	FF	FF								
Chile	1998Q3-1999Q1	DF	DF	DF												
Colombia	1999Q3-1999Q3	FF	FF	FF												
Costa Rica	2004Q1-2004Q1	DF	Mixed	Both												
Croatia	1998Q4-1998Q4	FF	FF	FF	2000Q3-2000Q4	DF	DF	DF								
Czech Rep.	1996Q4-1996Q4	FF	FF	FF	1997Q4-1998Q1	DF	Mixed	FF	2003Q3-2004Q1	FF	Mixed	FF				
Ecuador	1999Q4-1999Q4	FF	FF	Neither	2000Q3-2001Q2	FF	FF	Both								
Estonia	1998Q4-1999Q3	FF	FF	FF												
Georgia	1999Q4-2000Q1	FF	FF	FF	2002Q4-2002Q4	FF	Mixed	FF								
Greece																
Hong Kong	2002Q1-2002Q2	FF	FF	FF	2003Q3-2003Q3	DF	DF	Neither								

Country	1st Start	RW	CEA	Direct	2nd Start	RW	CEA	Direct	3rd Start	RW	CEA	Direct	4th Start	RW	CEA	Direct
Hungary	1996Q4-1997Q2	FF	FF	FF	2002Q1-2002Q3	DF	Mixed	Both								
India																
Indonesia	1997Q4-1998Q4	FF	FF	FF												
Jordan	1992Q4-1993Q4	FF	FF	FF	2001Q1-2001Q1	FF	Mixed	Neither	2001Q4-2001Q4	FF	FF	FF	2003Q4-2004Q2	FF	FF	Both
Korea	1997Q4-1998Q3	FF	FF	FF	2001Q2-2001Q2	FF	FF	FF								
Latvia																
Lithuania	1999Q3-1999Q3	FF	FF	FF												
Malaysia	2001Q1-2001Q1	FF	FF	FF	2003Q1-2003Q2	DF	DF	DF								
Malta	2000Q2-2000Q2	FF	FF	FF	2000Q4-2001Q3	FF	FF	FF								
Mexico	1982Q4-1983Q3	FF	FF	FF	1988Q2-1988Q2	FF	Mixed	Neither	1995Q1-1995Q4	FF	FF	FF				
Pakistan																
Panama																
Peru	1998Q4-1999Q3	FF	FF	FF												
Philippines	1983Q4-1984Q2	FF	FF	FF	1997Q4-1998Q4	FF	FF	FF	2001Q1-2001Q3	FF	FF	Both				
Poland																
Portugal	1984Q1-1984Q1	FF	Mixed	Neither	1991Q2-1991Q2	DF	Mixed	Neither	1992Q4-1993Q3	FF	FF	DF				
Russia	1998Q4-1999Q3	FF	FF	FF	2000Q4-2001Q1	FF	Mixed	FF								

Country	1st Start	RW	CEA	Direct	2nd Start	RW	CEA	Direct	3rd Start	RW	CEA	Direct	4th Start	RW	CEA	Direct
Singapore																
Slovak Rep.	1999Q2-1999Q3	FF	FF	FF	2003Q4-2003Q4	DF	Mixed	Neither								
South Africa																
Sri Lanka																
Thailand	1997Q2-1998Q3	FF	FF	Both												
Turkey	1994Q3-1995Q1	FF	FF	FF	1998Q3-1998Q3	DF	DF	DF	1999Q1-1999Q2	FF	FF	FF	2001Q2-2002Q1	FF	FF	FF
Uruguay																
Venezuela																
Zimbabwe																

The table shows 56 sudden stops obtained by applying the sudden stop definition of Guidotti et al. (2005). Each sudden stop is classified using the RW, CEA, and direct methods. There are 23 crises whose classification by the direct method differs from either of the other methods and are summarized in Table 1.

Table 7 – Dates for domestic & foreign flight episodes during sudden stops

Country	SS	FF	DF	SS	FF	DF	SS	FF	DF	SS	FF	DF
Albania												
Argentina	1995Q1-1995Q1	1994Q4-1995Q1	--	2001Q1-2001Q1	2000Q4-2002Q3	--	2001Q3-2002Q3	2000Q4-2002Q3	2001Q2-2002Q2			
Belarus	1999Q3-1999Q3	--	--									
Belize												
Bolivia	2003Q4-2003Q4	2003Q4-2003Q4	2003Q4-2004Q1									
Brazil	1999Q1-1999Q2	1999Q1-1999Q4	--	2002Q3-2003Q2	2002Q1-2003Q2	--						
Chile	1998Q3-1999Q1	--	1998Q1-1998Q3									
Colombia	1999Q3-1999Q3	1998Q3-1999Q3	--									
Costa Rica	2004Q1-2004Q1	2004Q1-2004Q1	2004Q1-2004Q1									
Croatia	1998Q4-1998Q4	1998Q4-1998Q4	--	2000Q3-2000Q4	--	2000Q3-2000Q3						
Czech Rep.	1996Q4-1996Q4	1996Q3-1997Q1	--	1997Q4-1998Q1	1998Q1-1998Q1	--	2003Q3-2004Q1	2003Q2-2004Q1	--			
Ecuador	1999Q4-1999Q4	--	--	2000Q3-2001Q2	2000Q3-2001Q2	2000Q1-2000Q3						
Estonia	1998Q4-1999Q3	1998Q4-1999Q3	--									
Georgia	1999Q4-2000Q1	1999Q4-2000Q3	--	2002Q4-2002Q4	2002Q4-2002Q4	--						
Greece												
Hong Kong	2002Q1-2002Q2	2001Q4-2002Q2	--	2003Q3-2003Q3	--	--						
Hungary	1996Q4-1997Q2	1996Q4-1997Q1	--	2002Q1-2002Q3	2002Q2-2002Q4	2001Q4-2002Q1						

Country	SS	FF	DF	SS	FF	DF	SS	FF	DF	SS	FF	DF
India												
Indonesia	1997Q4-1998Q4	1997Q4-1998Q4	--									
Jordan	1992Q4-1993Q4	1992Q4-1993Q4	--	2001Q1-2001Q1	--	--	2001Q4-2001Q4	2001Q4-2001Q4	--	2003Q4-2004Q2	2003Q4-2004Q1	2004Q2-2004Q2
Korea	1997Q4-1998Q3	1997Q4-1998Q4	--	2001Q2-2001Q2	2001Q1-2001Q4	--						
Latvia												
Lithuania	1999Q3-1999Q3	1999Q3-1999Q3	--									
Malaysia	2001Q1-2001Q1	2001Q1-2001Q1	--	2003Q1-2003Q2	--	2003Q1-2003Q2						
Malta	2000Q2-2000Q2	2000Q1-2000Q4	--	2000Q4-2001Q3	2001Q3-2001Q3	--						
Mexico	1982Q4-1983Q3	1982Q4-1983Q3	--	1988Q2-1988Q2	--	--	1995Q1-1995Q4	1994Q4-1995Q4	--			
Pakistan												
Panama												
Peru	1998Q4-1999Q3	1998Q4-1999Q3	--									
Philippines	1983Q4-1984Q2	1983Q4-1984Q2	--	1997Q4-1998Q4	1997Q4-1998Q4	--	2001Q1-2001Q3	2001Q3-2001Q3	2001Q2-2001Q2			
Poland												
Portugal	1984Q1-1984Q1	--	--	1991Q2-1991Q2	--	--	1992Q4-1993Q3	--	1993Q1-1993Q2			
Russia	1998Q4-1999Q3	1998Q4-1999Q3	--	2000Q4-2001Q1	2000Q4-2001Q1	--						
Singapore												
Slovak Rep.	1999Q2-1999Q3	1999Q1-1999Q4	--	2003Q4-2003Q4	--	--						

Country	SS	FF	DF	SS	FF	DF	SS	FF	DF	SS	FF	DF
South Africa												
Sri Lanka												
Thailand	1997Q2-1998Q3	1996Q4-1998Q3	1997Q4-1998Q2									
Turkey	1994Q3-1995Q1	1994Q3-1995Q1	--	1998Q3-1998Q3	--	1998Q3-1998Q3	1999Q1-1999Q2	1999Q1-1999Q2	--	2001Q2-2002Q1	2001Q2-2002Q1	--
Uruguay												
Venezuela												
Zimbabwe												

An unbalanced panel of quarterly data for 42 emerging market countries is examined from 1980Q1-2005Q4. The sudden stop definition applied here is from Guidotti et al. (2005) for all types of capital flows. The start and end dates for domestic flight (DF) and foreign flight (FF) episodes are reported relative to the respective dates of the sudden stop crisis.