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Sudden stops and currency crises

Levan Efremidze
Claremont Institute for Economic Policy Studies and Center for Neuroeconomics Studies, Claremont Graduate University, Claremont, California, USA

Samuel M. Schreyer
Department of Economics, Finance, and Accounting, Fort Hays State University, Hays, Kansas, USA, and

Ozan Sula
Department of Economics, Western Washington University, Bellingham, Washington, USA and Claremont Institute for Economic Policy Studies, Claremont Graduate University, Claremont, California, USA

Abstract

Purpose – The purpose of this paper is to examine empirical characteristics of two commonly mentioned expressions of international financial crisis, "sudden stops" and currency crises.

Design/methodology/approach – Sudden stop and currency crisis events are identified and empirical regularities among them are analyzed based on the annual data of 25 emerging market countries from 1990 to 2003.

Findings – Puzzlingly, these two seemingly close expressions of crises overlap less than 50 percent of the time and sudden stops more frequently precede than follow currency crises. Also the two different sudden stop measures are not strongly correlated with each other.

Research limitations/implications – This shows that it can make a great deal of difference what measure is used and suggests that studies in this area should be sure to check the robustness of their results to different measures.

Practical implications – The authors think that the proper analysis should focus on how to use these different measures to understand the nature of the crises. Thus, sudden stop and currency crisis measures should be used as complements, rather than substitutes.

Social implications – The alarming frequency of the emerging market crises during the last three decades has motivated a large volume of theoretical and empirical literature on the subject. The paper's results advance understanding of these events.

Originality/value – A large body of studies on currency crises coexists with a growing literature on sudden stops yet a majority of the studies that investigate either one of these phenomena do not mention the other. The paper adds value by investigating empirical relationships between them.

Keywords International economics, International finance, International investments, Capital movements, International factor movements, International business, Current account adjustment, Open economy, Macroeconomics, International trade, Financial markets

Paper type Research paper

1. Introduction

The alarming frequency of the emerging market crises during the last three decades has motivated a large volume of theoretical and empirical literature on the subject.

JEL classification – F02, F0, F, F2, F2, F3, F32, F41, F4, G15, G1, G

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The significance of these events is obvious from the sizable output losses the affected countries suffered. Argentina's losses in the early 1980s crisis amounted to 55 percent of its GDP. During the 1997 Asian crises, Thailand, Indonesia, Malaysia and South Korea experienced on average an 11 percent drop in their per capita real GDP (RGDP). Increased volatility of international capital flows and sharp exchange rate movements have been a defining feature of these crises.

A survey of the vast literature on these events leads to a conceptual puzzle. Most of the widely publicized emerging market crises are classified as both sudden stops (SSs) and currency crises (CC). A large body of studies on CC coexists with a growing literature on SSs yet a majority of the studies that investigate either one of these phenomena do not mention the other. Implicitly these two types of events are either assumed to be the same or completely unrelated. Among the small number of studies that do discuss both, Hutchison and Noy (2006) define an SS as the joint occurrence of CC and current account reversal (CAR), and Calvo *et al.* (2004) treats them as separate yet related events. Calvo *et al.* (2004) point out the timing difference between SSs and CC and prefer using SSs to study crises, which are seen as originating from "credit shocks in international markets." The study also argues that a measure that is based on the financial account (FA) would identify more crises episodes than CA deficit-based measures, because some countries have low volatility in CAs.

In addition to the ambiguities of the crisis concepts, there is the measurement issue. The term "sudden stop" was first introduced by Dornbusch *et al.* (1995). It refers to sudden and large drops in capital inflows and the term comes from the banker's adage: "it isn't the speed that kills you, it's the sudden stop." While the essence of this description of SSs is broadly representative of that taken in the literature, there has been less consensus on how to define these events empirically. This is not entirely surprising. A description of SSs – as with many macroeconomic phenomena – does not lend itself to a single, precise mathematical criterion. Similar debates on the appropriate measure to identify CC also exist.

In this study, our goal is to further examine these issues. First, we present a short survey of the measures of SSs used in the recent literature. There are two major alternative empirical approaches. In Section 3, we examine the empirical characteristics of these measures of SSs and their relationships to measures of CC using annual data for 25 emerging market countries from 1990 to 2003. We find that not only do the CC and SSs often fail to overlap but also the two different SS measures are not strongly correlated with each other. This shows that it can make a great deal of difference what measure is used and suggests that studies in this area should be sure to check the robustness of their results to different measures. In Section 4, we discuss several other complications that arise in the crisis literature. We conclude that CC and SSs are neither the same nor unrelated.

2. Measures of SSs

To capture a broad spectrum of conceptual and empirical definitions of SSs, we conducted a keyword search using "sudden stops" in the EconLit database. The search yielded 30 published and working papers since 2004 which are shown in Table I, along with a brief definition and description of the main crisis or SS measures used in each paper. A brief examination of this table reveals that myriad criteria have been used in the recent literature to identify SSs. Nonetheless, there are several facets that many of these definitions have in common.

Table I.
SS definitions in the literature

Author(s)	Brief definition	Description	Sample
Becker and Mauro (2006)	ΔFA/GDP $\leq -5\%$	An SS occurs when the FA balance worsens by more than 5 percentage points of GDP relative to the previous year	1970-2001, annual; all possible countries
Bordo *et al.* (2010)	(1) ΔRGDP <0; (2) ΔFA $\leq \mu - 2\sigma$; and/or (3) ΔFA/GDP $\leq -3\%$	FA is obtained by subtracting the trade balance from changes in reserves. An SS must occur with (1) a decrease in RGDP at time t and/or $t+1$, and either or both of the following conditions: (2) ΔFA be at least two SDs below its mean; (3) the first year that a drop in FA is 3 percent of GDP over a period shorter than four years	1880-1913, annual; 20 emerging markets
Calvo *et al.* (2006a, b)	(1) ΔFA $\leq \mu - 2\sigma$; (2) Δ(spread) $\leq \mu - 2\sigma$	A systemic SS (SSS) – that is, a crisis reflecting shocks to the capital markets – requires that (1) ΔFA is at least two SDs below its mean, and (2) the change in the aggregate bond spread (e.g. J.P. Morgan's Emerging Market Bond Index spread over US Treasury bonds, measured in logs) is at least two SDs 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 one SD below their mean before/after (1) and (2) are satisfied, respectively. An SSS occurs when these windows overlap. The means and SDs in (1) and (2) are measured on a rolling basis (historical), with the first two years of data excluded. Capital flow windows occurring six months or less apart from another are considered the same window	1990-2001, monthly; 15 emerging markets and 17 developed economies
Calvo *et al.* (2004)	(1) ΔFA $\leq \mu - 2\sigma$; (2) ΔGDP <0	A "capital flow window" is constructed as described in Calvo *et al.* (2006) when ΔFA is at least two SDs below its mean. An SS occurs when output drops during the "capital flow window." The mean and SD 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

(*continued*)

Table I.

Author(s)	Brief definition	Description	Sample
Calvo *et al.* (2008)	Calvo *et al.* (2006)	–	1990-2004, monthly; 21 developed and 89 developing economies
Calvo *et al.* (2006)	Calvo *et al.* (2006)	–	1990-2001, monthly; 15 emerging markets and 17 developed economies
Catao (2007)	(1) $\Delta FA \leq -2\sigma$; and/or (2) $\Delta FA/GDP \leq -3\%$	ΔFA represents deviations from a linear trend, rather than year-on-year changes. An SS occurs when (1) ΔFA is at least two SDs below zero, and/or (2) ΔFA is at least 3 percent of GDP. An SS begins when FA attains its peak and ends when FA starts rising relative to trend without falling back to its lowest level within a four-year period	1870-1913, annual; 16 countries
Cavallo (2005)	Cavallo and Frankel (2008)	–	–
Cowan *et al.* (2008)	(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 RGDP and the real exchange rate. After doing this, an SS occurs when (1) the scaled ΔFA is at least one SD below its average, and (2) the scaled ΔFA is at least 5 percent of GDP	1975-2004, annual; 32 emerging markets and 21 developed economies
Deb (2005)	(1) $\Delta FA/GDP \leq -5\%$ (2) CC	An SS occurs when a drop in FA is at least 5 percent of GDP and a CC occurs at time t or $t+1$	1975-1999, annual; all possible countries
Durdu *et al.* (2009)	–	The authors use SSs identified "in various empirical studies, including Calvo *et al.* (2004), Cavallo and Frankel (2008) and Rothenberg and Warnock (2006)"	1985-2004, annual; 17 emerging markets
Edwards (2004)	(1) $FA > \chi$ (2) $\Delta FA/GDP \leq -5\%$	An SS 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 percent of GDP	1970-2001, annual; all possible countries
Edwards (2005)	Edwards (2004)	–	–
Edwards (2006)	Edwards (2004)	–	–

(*continued*)

Table I.

Author(s)	Brief definition	Description	Sample
Edwards (2007)	ΔFA/GDP $\leq -3\%$	Edwards calls this a "capital flow contraction" (CFC) and distinguishes this from an SS since, according to Edwards, the latter must be preceded by net capital inflows	1970-2004, annual; all possible countries
Cavallo and Frankel (2008)	(1) ΔFA $\leq \psi - 2\sigma$; (2) ΔCA ≥ 0; (3) Δ(PCGDP) < 0	An SS occurs when (1) the FA falls at least two SDs below the mean SD (ψ) at time *t* and is preceded by a FA surplus, (2) the CA 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 SD (ψ) is calculated by taking the average of the SDs during the 1970s, 1980s, and 1990s+	1970-2002, annual; all possible countries
Gallego and Jones (2005)	(1) ΔFA $\leq \mu - 2\sigma$	An SS is defined by a "capital flow window" (Calvo *et al.*, 2006) when ΔFA is at least two SDs below its mean	1990-2003, monthly; 14 emerging markets
Guidotti *et al.* (2004)	(1) ΔFA $\leq \mu - \sigma$; (2) ΔFA/GDP $\leq -5\%$	SSs are identified by (1) a reduction in net capital flows by at least one SD below its mean, and (2) the reduction in net capital flows are at least 5 percent of GDP	1974-2002, annual; all possible countries
Honig (2008)	(1) ΔFA $\leq -2\sigma$; (2) ΔCA ≥ 0; (3) Δ(PCGDP) < 0	An SS occurs when (1) the FA falls at least two SDs below zero at time *t* and is preceded by a FA surplus, (2) the CA increases at time *t* or *t + 1* and is preceded by a CA deficit, and (3) PCGDP falls	1982-2004, annual; all possible countries
Hutchison and Noy (2006)	(1) ΔCA/GDP $\geq 3\%$; (2) CC	An SS is defined by the joint occurrence of an increase in the CA by at least 3 percent of GDP and a CC	1975-1997, annual; 24 emerging markets
Hutchison *et al.* (2010)	(1) ΔFA $\leq -2\sigma$; (2) ΔCA ≥ 0	An SS crisis is defined as a year in which (1) the FA decreases by at least two SDs, and (2) the CA 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)	Becker and Mauro (2006)	–	1975-2003, annual; 34 emerging markets

(*continued*)

Table I.

Author(s)	Brief definition	Description	Sample
Joyce and Nabar (2009)	–	Joyce and Nabar use SSs identified by either Frankel and Calvo (2004) or Calvo *et al.* (2004)	1976-2002, annual; 26 emerging markets
Komarek and Melecky (2005)	$\Delta CA/GDP \geq 3\%$	An SS is defined by a CAR that is at least 3 percent of GDP	1993-2001, annual; 59 emerging markets
Komarek *et al.* (2005)	$\Delta CA/GDP \geq 2.5\%$	An SS is defined by a CAR that is at least 2.5 percent of GDP	1993-2000, annual; 23 emerging markets and developing economies
Levchenko and Mauro (2006)	Becker and Mauro (2006)	–	1970-2003, annual; all possible countries
Ortiz *et al.* (2007)	Calvo *et al.* (2006)	–	1990-2006, monthly; 31 emerging markets
Rothenberg and Warnock (2007)	$\Delta FA \leq \mu - 2\sigma$	An SS is defined by a "capital flow window" (Calvo *et al.*, 2006) when ΔFA is at least two SDs below its mean. The mean and SD are calculated on an rolling basis (historical)	1989-2005, monthly; 28 emerging markets
Sula (2010)	(1) $\Delta FA/GDP \leq 4\%$; (2) $FA < 0$	An SS occurs when (1) the reduced capital inflows are at least 4 percent of GDP, and (2) the FA balance is in deficit in the year of the SS	1989-2003, annual; 38 emerging markets and developing economies
Terada-Hagiwara (2005)	(1) $\Delta FA/GDP \leq \mu$; (2) $\Delta FA \leq \sigma$	An SS occurs when (1) reduced net capital flows is less than the sample mean and persists for another two quarters, and (2) reduced FA is larger than the sample SD. The sample mean and SD are not country specific, but are instead taken for the panel of countries	1980-2000, quarterly; eight emerging markets

Notes: Thirty papers are cited above; all information in this table pertains to the construction of the main, or preferred, measure of an SS in the respective paper; multiple conditions listed for an SS 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, 2010; uses non-FDI capital flows)

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 FA from its balance of payments (BOP) statement. A country's net FA represents the sum of purchases/sales of domestic assets by foreigners and 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 in 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 SSs. 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 (Edwards, 2004; Sula, 2010).

Another commonality shared between many of the SS definitions surveyed in Table I is that the change in a country's FA (ΔFA) be negative and less than a particular threshold involving the mean and/or standard deviation of the ΔFA series (Calvo *et al.*, 2004; Bordo *et al.*, 2010; Rothenberg and Warnock, 2007). Specifically, the following type of criterion is used:

$$\Delta FA_t \leq \mu_{\Delta FA} - \beta\sigma_{\Delta FA} \tag{1}$$

which indicates an SS occurs in a country when the change in its capital flows at time t is negative and at least β standard deviations different from its mean, with the choice of β tending to take a value between 1 and 2 (Guidotti *et al.*, 2004; Gallego and Jones, 2005). Yet many variations of equation (1) exist. For example, Catao (2007) simply omits $\mu_{\Delta FA}$; Rothenberg and Warnock (2007) 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 Cavallo and Frankel (2008) replace $\mu_{\Delta FA}$ with the mean of the standard deviation of ΔFA for each decade of their nearly three-decade long sample.

Several SS definitions in Table I follow a different approach. Their defining feature is that a negative ΔFA must be sufficiently large as a percent of GDP. Typically this threshold ranges from 3 to 5 percent of GDP (Bordo *et al.*, 2010; Catao, 2007). In this manner the reduced capital inflows or increased capital outflows during an SS 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 SSs has been favored by some authors, such as Becker and Mauro (2006).

The standard measures of SSs should really be labeled as capital flow reversals. The intuitive concept of SSs involves large capital inflows that suddenly stop while the standard measures would include a large increase in capital flight in their definitions. Thus, Edwards (2007) interprets a 3 percent drop in FA relative to GDP as a capital flow contraction and distinguishes this from an SS since the latter, according to the author, must be preceded by capital inflows. This issue is discussed further in Section 4.

On a related note, some authors require a decline in GDP, as a whole or on a per capita basis, in order for an SS crisis to occur (Cavallo and Frankel, 2008; Calvo *et al.*, 2004). The purpose of this restriction is to rule out terms of trade improvement related FA adjustments which could also look like an SS. This criterion necessarily limits analysis to a subset of costly SSs, rather than considering the broader scenario of a marked reduction of capital inflows (Honig, 2008).

In order to conduct our analysis, we selected one measure from each of the two approaches that we have surveyed above. For standard deviation-based SS measures we adopt the measure used in Calvo *et al.* (2004) as this is one of the first studies to present a statistical procedure to identify SSs and has been highly influential in the literature. Their measure aims to capture the "unexpected" and "large" changes in FA, which at the same time has a large negative effect on a country's output. The authors use the large fall in output as an additional criteria to identify those SSs that have negative economic consequences.

Following this study, we derived annual SS dummies from monthly data. Monthly capital flow series are constructed by netting out monthly exports and imports from changes in monthly reserves. Then, the SS is defined as a phase where year-on-year change in capital flows is at least two standard deviations below its sample mean. The sample is defined as an expanding window with a minimum of 24 months of previous observations. Once the SS phase is detected, it is converted into a dummy variable with annual frequency. We impose the additional restriction of negative GDP growth to identify an SS crisis[1]. We adopt the abbreviation SS1 for this measure in the remainder of this article.

For SS measures that use thresholds based on GDP, we selected the measure used in Edwards (2004), as it captures important features of this approach and it is widely cited in the recent literature. The measure is based on the annual FA balance. An SS is defined as a fall in net capital flows that is at least 5 percent of the current year's GDP. Also the country should have had positive net capital flows in the previous year. We use the abbreviation SS2 for this measure for the remainder of this article.

To identify CC, we use the commonly adopted exchange market pressure (EMP) index. CC dummies are constructed from changes in an index of EMP, defined as a weighted average of monthly real exchange rate changes, monthly reserve losses and interest rate changes. There is disagreement in the literature over whether is better to use equal or precision weights (Willett *et al.*, 2005). This is discussed in Section 4. Precision weights are inversely related to the variance of changes of each component over the sample of each country. We use the latter measure in our comparison. Annual crises dummies take the value of 1 if the change in the pressure index exceeds the mean plus X times the country-specific standard deviation where X usually ranges between 1.5 and 3.0, we use 2.0. We adopt the abbreviation CC for this measure for the remainder of this article.

3. Examination of empirical regularities

In our analysis, we use annual and monthly data for 25 emerging market countries for the period of 1990-2003[2]. To illustrate the relationship between SSs and CC, we present the behaviour of monthly capital flows, EMP index and the CA for Mexico and Thailand, two important emerging market countries which experienced severe crisis in 1994 and 1997, respectively. In Figures 1 and 2, we see that the first signs of stress show up in net capital flows, rather than in the EMP index. Starting with the first months of 1994 in the case of Mexico, there is a significant increase in the volatility of capital flows – our SS indicators identify the beginning of the SS crisis as mid-1994. On the other hand, EMP reaches historically high levels at the end of 1994. Finally, the reversal in the CA follows after mid-1995. Similar patterns are detected in the case of Thailand in Figure 2. Thus, timing of volatility spikes in these economic variables should be examined in a systematic manner.

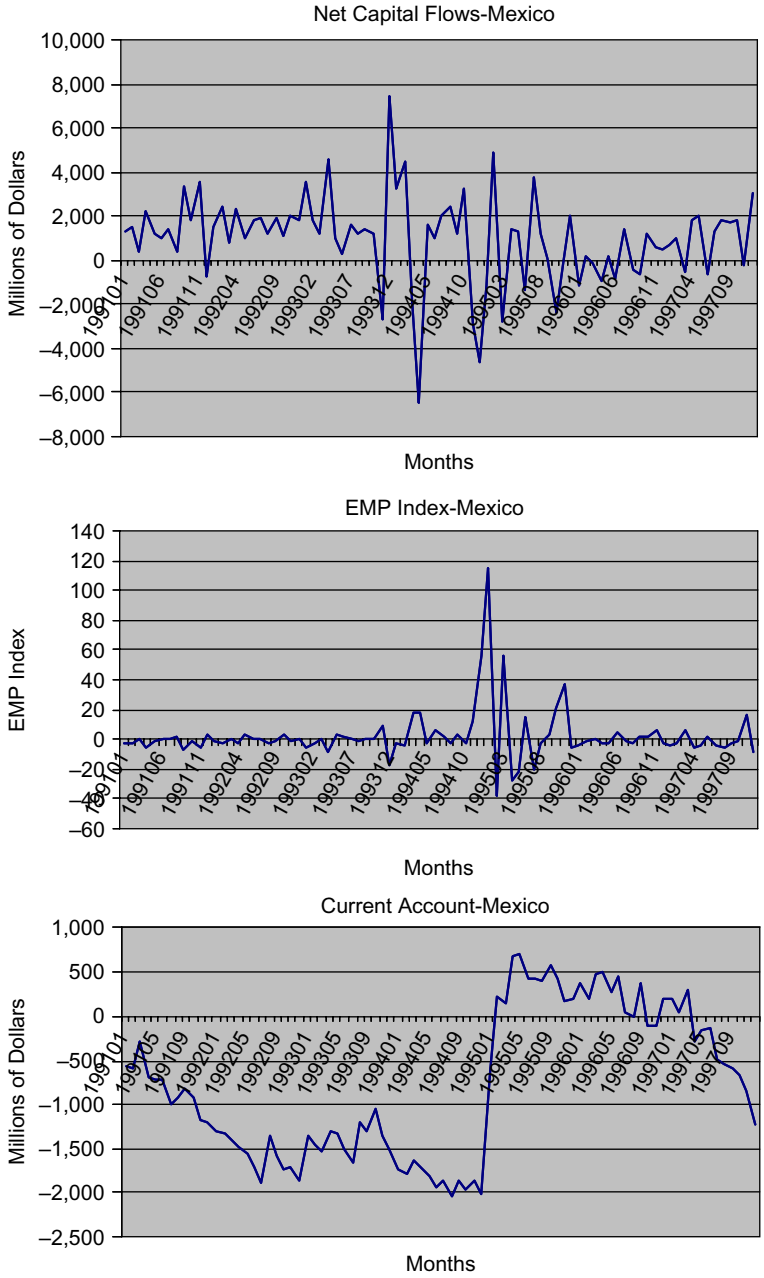

Figure 1.
The 1994 crisis in Mexico

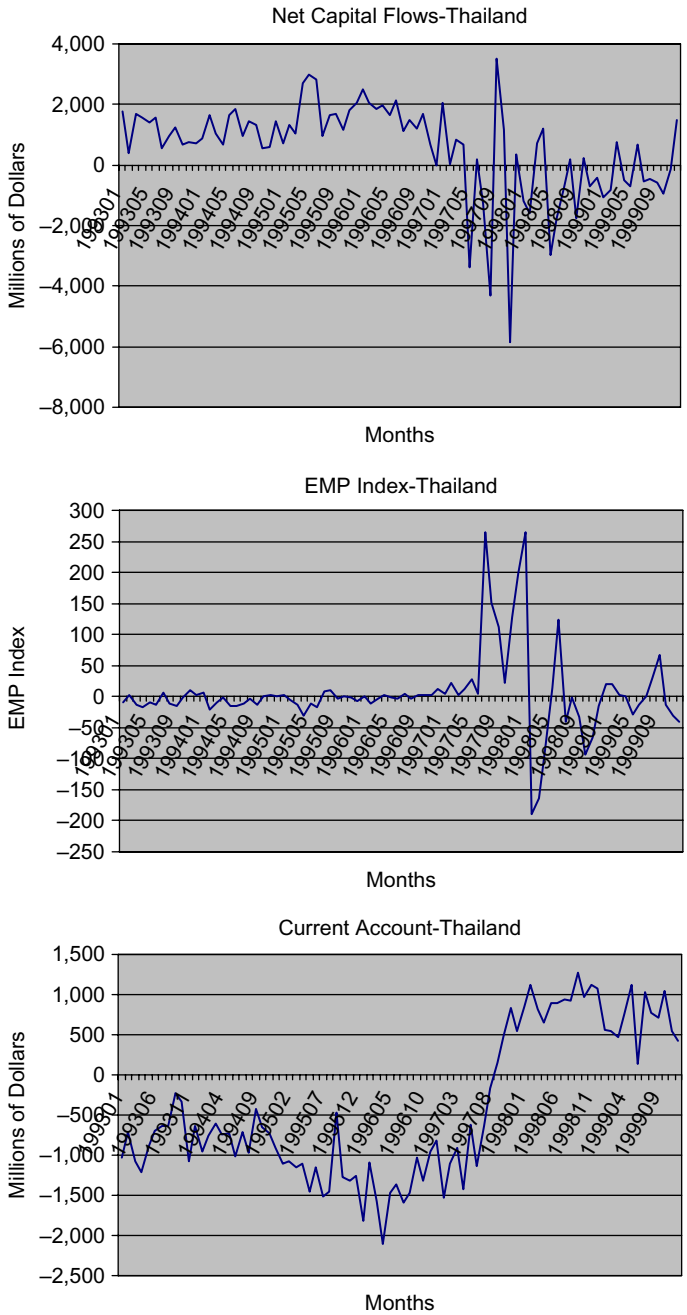

Figure 2.
The 1997 crisis in Thailand

The first section of Table II shows how our measures identify some of the well-known emerging market crises. Both the 1994 Mexican Tequila crisis and the 1997 Asian crisis are identified yet there are minor discrepancies. For example, while all of the measures indicate crisis for Thailand, SS1 covers three years 1996-1998, SS2 shows only 1997 and CC covers 1997 and 1998. For Brazil, Argentina and Russia, disagreement across measures become even greater. The SS measures fail to identify the Brazilian crisis, while the CC measure completely misses the Argentinean crisis.

The second section of Table II lists the crises that are identified by all of the measures. As mentioned in the introduction, this list of 12 observations covers most of the well-publicized crises of the 1990s. But what about all the other crises of the 1990s? The last section of Table II presents the number of years that are identified as crisis by our various measures. Out of 344 observations, SS1 identified 47 incidences and SS2 identified 29 incidences. On the other hand, the number of identified CC is 59. When consecutive crisis years are taken as one episode, SS1 and SS2 produce similar lower numbers (22 and 26). The number of CC episodes also falls but remains greater than the SSs (35). Thus, there are many CC that do not overlap with either type of SSs.

Table III presents the correlation coefficients across the three measures. The correlation coefficients are all very close to 30 percent. While based on earlier analyses, we did not expect very high correlations between the SS and CC measures, we also find that the two SS measures that should be measuring the same events are not highly correlated. We also estimate combinations of bivariate probit regressions where one crisis measure is regressed on the other. There is a 19-41 percent probability to have the other type of crisis (SS1, SS2 or CC) when you have one of them (Table IV). Both Tables III and IV confirm the puzzling nature of SS and CC identification.

The two-way frequencies are presented in Table V. The first panel of Table V reveals that out of 47 crisis observations identified by SS1 only 15 (32 percent) of them are also identified by SS2 and half of the crisis identified by SS2 is also identified

Table II. Measures of emerging market crisis

	SS1	SS2	CC
Major crisis of the 1990s			
Mexico	1994, 1995	1994, 1995	1994, 1995
Thailand	1996-1998	1997	1997, 1998
Korea	1997, 1998	1997	1996, 1997
Philippines	1997, 1998	1997, 1998	1997, 1998
Malaysia	1997, 1998	1997, 1998	1997, 1998
Indonesia	1997, 1998	1997	1997, 1998
Brazil			1998, 1999
Argentina	1998-2002	2001	
Russia	Na	1998	1996-1998
Crisis that all three measures identify	Indonesia 1997, Korea 1997, Malaysia 1997-1998, Mexico 1994-1995, Philippines 1997-1998, Thailand 1997, Turkey 1994, Turkey 2001, Venezuela 1994		
Number of years crisis identified as crisis	47	29	59
Number of episodes identified as crisis	22	26	35

by SS1; 15 out of 29. The next two panels show similar relationships between the SS measures and the CC measure, with the similar levels of overlap.

We also examined timing relationships between SS1, SS2 and CC episodes and found that SS1 starting years more frequently precede CC episodes rather than follow them (Table VI). The relationship is not as strong between SS2 and CC. The temporal ordering finding has important policy implications for early detection of the approaching crises. The SS1 measure has early warning advantages.

4. Additional complications

In this section, we discuss several other complications that arise in the conceptual definitions and identification of SSs and CC. The first is the inclusion of CARs to the analysis. The majority of definitions surveyed in Table I identify SSs based on the FA from a country's BOP. Since BOP identity requires that the CA plus FA plus changes in reserves equals zero, a sharp reduction in the FA must be accompanied by an abrupt improvement in the CA (typically referred to as a CAR), unless offset by a liquidation of international reserves. Furthermore, crisis-related domestic currency

Table III. Correlations of crisis measures

	SS1	SS2	CC
SS1	1.00		
SS2	0.32	1.00	
CC	0.30	0.28	1.00

Table IV. Probit estimation results

SS1 = 1	Then	SS2 = 1 with 25% probability CC = 1 with 33% probability
SS2 = 1	Then	SS1 = 1 with 41% probability CC = 1 with 35% probability
CC = 1	Then	SS1 = 1 with 29% probability SS2 = 1 with 19% probability

Table V. Two-way frequencies

		No	Yes	Total
			SS2	
SS1	No	283	14 (48%)	297
	Yes	32 (68%)	15 (32%) (52%)	47
	Total	315	29	344
			CC	
SS1	No	261	36 (61%)	297
	Yes	24 (51%)	23 (49%) (39%)	47
	Total	285	59	344
			CC	
SS2	No	271	44 (75%)	315
	Yes	14 (48%)	15 (52%) (25%)	29
	Total	285	59	344

depreciations potentially link the FA and the CA. These relationships have led to varying interpretations about how CC and CARs are related to SSs. For instance, Guidotti *et al.* (2004) define a CAR conditional on the occurrence of SSs[3], while Hutchison and Noy (2006) and Komarek and Melecky (2005) define an SS as the joint occurrence of CC and CARs. Calvo *et al.* (2004) argue that measures of crisis should be more closely linked to large and unexpected capital account movements rather than to measures that are based on exchange rate movements and or CARs. They also show that SSs generally precede CARs. Edwards (2004) finds that 46.1 percent of SSs coincide with CARs, and 22.9 percent of countries with CARs also experience an SS in the same year, yet they conclude that these events are not statistically independent. In contrast, in an earlier study Milesi-Ferretti and Razin (2000) find little coincidence or precedence between these CC and CARs and they call these two events "distinct."

A second issue is the source of capital flows. The premise taken in much of the literature on SSs 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) defines an SS 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 SSs. Calvo and Reinhart (2000) 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 SSs 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 SSs (Rothenberg and Warnock, 2007; Cowan *et al.*, 2008; Cowan and De Gregorio, 2007). A non-trivial number of SSs, 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).

A third issue is that SS measures which are based on the net FA will not reflect the changes in the composition of capital flows. This may lead to serious bias in identifying crisis episodes. The concept of an SS, a sharp reduction in capital flows, generally refers to hot money flows like portfolio investment and private loan flows. It has been widely accepted that these types of capital flows are significantly more reversible than foreign

Table VI.
Timing relationship

	Frequency
SS1 precedes CC	7
CC precedes SS1	2
SS2 precedes CC	8
CC precedes SS2	6

Note: Starting years of episodes are no more than two years apart

direct investment (FDI)[4]. For example, during numerous crisis episodes including Mexico 1994, Asia 1997, Russia 1998 and Turkey 2001 portfolio and private loan inflows had sharp falls but FDI continued to flow into these economies. Furthermore, many of the emerging market countries receive loans from the IMF or other national governments during crises. In these instances the decrease in hot money flows will be partially offset by the rise in FDI and official loans, producing a net FA that does not reflect the true impact of SSs on the financial markets[5]. These issues can be easily circumvented in case studies. However, in cross-country analysis they may prevent some of the less known SSs from being identified.

Finally, the measurement of CC is not straightforward either. One important issue is the choice of weights for the components of the EMP index[6]. Theoretically, the weights should be based on the elasticities of demand and supply in the foreign exchange market. Since measuring elasticities is extremely difficult in practice, studies use either equal weights or the so-called precision weights – the inverse of variances of the changes in exchange rates and reserves as weights in the EMP. In addition to the weighting problem, the EMP index is measured with or without the inclusion of interest rates and with replacing the nominal exchange rate by the real exchange rate. Furthermore, there is no clear theoretical basis for choosing standard deviation thresholds. It should also be noted here that there are studies that use only the exchange rate movements to identify crisis. These are labeled currency crashes. The literature on the shortcomings of CC identification is more mature, yet the problems remain.

5. Conclusion

The severity of recent balance-of-payments crises in the emerging markets and developing economies have generated enormous interest in understanding the nature of these crises and for producing appropriate policy recommendations. One of the crucial issues in this area of research is to develop a sound methodology for crisis identification. Prominent emerging market crises such as in Mexico 1994-1995, Thailand 1997-1998, and Argentina 2001-2002 are well known, thus a researcher could use his or her informed knowledge to define these as CC and/or SSs and distinguish crisis periods from non-crisis periods. However, identifying crises based on the researcher's discretion risks incorporating selection bias into the analysis in favor of more severe episodes. Indeed, the three crises that we mention here are well known, at least in part, because of the severe economic recessions and the resulting intense media coverage. In this paper, we examined the empirical regularities among three types of commonly used crisis measures. We show that there is substantial difference among the crisis dates identified by different measures. SSs and CC overlap less than 50 percent of the time and SSs mostly precede CC. Our results suggest that SSs and CC may be different types of events but they are not completely independent of one another. More surprisingly, alternative SS measures show considerable disagreement as well. Since they are all created to measure the same economic phenomena, our results document the sensitivity of these measures and point out potential problems for the researcher.

Although it is tempting to look for the one best measure of crises, we think that the proper analysis should focus on how to use these different measures to understand the nature of the crises. Thus, SS and CC measures should be used as complements, rather than substitutes. Both types of measures could be useful to understand different features of the crisis episodes. Further study of their lead-lag relationships and

possible differences in the determinants of the different types of crises and their effects are important areas for further research. Whether many of these relationships were stable over different decades need to be investigated as well, as for example, the impact of twin deficits on SSs changed over the last 35 years (Efremidze and Tomohara, 2011).

One particularly important area for further research is to focus more on measures of the severity of CC and SSs. Most studies have just used zero-one dummies for the occurrence of SSs and CC but according to Efremidze *et al.* (2011) both the determinants and effects of mild events may differ substantially from those of severe crises.

Notes

1. See Calvo *et al.* (2004) for a more detailed explanation.
2. Our sample period captures a period of frequent crises and high degree of capital mobility. The source of the data is the International Financial Statistics Database produced by International Monetary Fund (IMF). The emerging markets included in the sample are selected based on the *Economist* magazine's classification. They are: China, Hong Kong, India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand, Czech Republic, Hungary, Poland, Russia, Turkey, Egypt, Israel, South Africa, Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.
3. Guidotti *et al.* (2004, p. 79) identify 313 SS observations (of a total of 3,579) using a variant of equation (1). Of these observations, they find 265 occurred with a CAR and 48 did not. "As can be immediately concluded, SSs most likely lead to current account adjustments."
4. For a survey of studies on composition of capital flows (Sula and Willett, 2009) who find that surges in these types of capital flows are more likely to be followed by reversals.
5. One reason for the rise in FDI during crisis is the depreciation of currency and domestic assets, increasing the profitability of some sectors such as FDIs in export industries. Furthermore, if the market value of a firm falls during the crisis, then inflows may increase to take advantage of low prices (Krugman, 2000).
6. See Eichengreen *et al.* (1996) for the application of the EMP index as a crisis indicator and Willett *et al.* (2005) for a detailed discussion of the complications.

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About the authors

Dr Levan Efremidze is an Assistant Professor of Economics at the Economics Department of Claremont Graduate University. He has a PhD in Economics from the Claremont Graduate University and has a Bachelor's degree in Economics and Industrial Engineering from Tbilisi State University. He also works with the Center for Neuroeconomics Studies at Claremont Graduate University and leads its research group in the experimental asset market bubbles. Prior to joining the Claremont Graduate University, he was an Economist at the UCLA Anderson Forecast contributing to the econometric modelling and forecasting of the USA, California, Los Angeles and San Francisco economies. Previously he was also a Lecturer of Economics at Pomona College, worked as a Market Specialist and consulted on the design of trading rules at the Caucasus Stock Exchange, and managed marketing research and operations at ATX and Nissin. His ongoing research focuses on financial crises, trade and budget deficits, global imbalances, asset price bubbles, international capital flows, and flat tax reforms in the transition economies of the former communist countries. He is a recipient of the Benjamin Franklin and Edmund Muskie fellowships (under the Fulbright Scholarship program). Levan Efremidze is the corresponding author and can be contacted at: Levan.Efremidze@gmail.com

Dr Samuel M. Schreyer graduated from Claremont Graduate School in 2009 with a PhD in Economics specializing in the fields of international finance and money and banking. He has taught at universities throughout the USA and is currently an Assistant Professor of Economics at Fort Hays State University. His published research has appeared in journals such as the *Journal of Economic Development* covering topics such as inflation uncertainty, the Taylor Rule, and international capital flows.

Ozan Sula received his PhD from Claremont Graduate University in 2006. Prior to joining Western in the fall of 2006, he was a Lecturer at California State University – Fullerton. He also taught at the University of La Verne and Claremont Graduate University. His current research interests include the behaviour of international capital flows, international reserve policies and the financial crises in emerging markets.

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