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International Capital Flows and Sudden Stops: a global or a domestic issue?

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Abstract

This paper analyses the determinants of sudden stops in capital inflows in developing and developed countries. It aims to reconcile the differences in the new literature which finds that global factors are the key determinants of sudden stops and the earlier literature which finds that domestic factors are key drivers of such episodes. It introduces explanatory variables to the regression analysis used in the new literature such as liability dollarization and trade openness, which have been found as significant in previous studies. The results provide new evidence for the hypothesis that global factors are the key drivers of sudden stops.

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I. Introduction

Sudden stops are episodes of extreme capital outflows from an economy. They were first defined and discussed by Calvo (1998) as an explanation of the crises in developing countries in the 1990's. Calvo's seminal work was the first of many theoretical models and empirical studies on sudden stops. The literature so far suggests that sudden stops largely occur in developing countries and that they can be harmful for the real economy through a variety of channels such as restricted access to credit, bankruptcies, trade, and destruction of human capital (Calvo 1998). The empirical literature so has far focused on domestic factors as causes of sudden stops and has defined sudden stops using net capital flows (Cavallo and Frankel 2008).

In a recent paper Kristin Forbes and Francis Warnock (2012) challenge the existing literature and argue that global factors play a much more important role in increasing the probability of sudden stops episodes. They use a different definition of sudden stop episodes based on gross flows, which allows for differentiation between foreign and domestic investors (Forbes and Warnock 2012). Their empirical results suggest that global and contagion factors are significant while domestic factors play a minor role (Forbes and Warnock 2012). The authors, however, do not control for variables which have been theoretically justified by the earlier literature and have consistently appeared as significant across earlier empirical studies.

This paper aims to reconcile the differences between the earlier and the new empirical literature on sudden stops. In particular, I use the new definition of sudden stops presented by Forbes and Warnock (2012), and I introduce new variables to their empirical analysis such as trade openness and liability dollarization, which have been significant factors in both theoretical models and empirical studies in the earlier literature on sudden stops. I use the new definition of sudden stops and a complementary log log panel data regression with a quarterly data sample of 58 developed and developing countries for the time period from 1985 to 2007 to test the classical theory developed by Calvo et al. (1998, 2004) that domestic liability dollarization and trade openness are in fact significant for sudden stop episodes. I also introduce new control variables, such as credit growth, which new theory suggests might be important for sudden stop episodes (Mendoza et al., 2010).

The debate on external ("push") versus domestic ("pull") causes of crises in the academic literature began in the 1970's and 1980's when numerous developing countries experienced economic and financial crises and "lost decades." Anne Krueger, former chief economists at the World Bank, for example, argued that the domestic political

economy and government policies were a determining factor for the crises (1997). After the Asian financial crisis the literature focused on external factors such as sudden stops as an alternative explanation, but domestic factors were still considered as key drivers of such episodes (Calvo et al. 2004). The recent global financial crisis rekindled the debate on global international flows and economists such as Ben Bernanke (2011) have argued that global capital flows can contribute to a crisis even in a developed economy such as the US.

While this paper does not aim to establish the causes of sudden stops, the results provide additional evidence for the importance of global factors and the limited role of domestic factors in sudden stop episodes. The remainder of the paper is organized as follows. Section II reviews the theoretical and empirical literature on "sudden stops" and discusses the effects of "sudden stops" on the real economy. It explains the theoretical motivation for including liability dollarization and trade openness in empirical studies. Section III describes the new methodology used in the paper to identify sudden stops. Section IV provides descriptive analysis. Section V describes the estimation methodology. Section VI consists of the results and the analysis. Section VII discusses the robustness of the results and contains sensitivity tests. Section VIII concludes.

II. Literature Review:

i. Theory

The theoretical motivation for including liability dollarization and trade openness in an empirical study on sudden stops comes from Calvo et al. (1998, 2004). Calvo (1998) defines a sudden stop as an episode of extreme capital outflows and shows how it can be harmful for the real economy. Calvo (1998) shows this through a simple derivation from the balance of payment accounting identity which states that the current account deficit, CAD, must equal capital inflows, KI[1]:

$$CAD = KI \quad (1)$$

Or CAD equals the aggregate demand, A, less gross national product, GNP:

[1] According to the IMF definition of the balance of payments identity, *KI = FA + KA*. *FA* is the financial account and is the difference between purchases of foreign assets abroad and purchases of domestic assets by foreigners. KA is the capital account and includes transfers such as debt forgiveness and migrant remittances.

$$CAD = A - GNP \quad (2)$$

Or CAD equals demand of tradables, Z, less gross domestic product of tradables, Y, and net factor transfers from abroad, NFTA:

$$CAD = Z - Y - NFTA \quad (3)$$

During a sudden stop KI in (1) exogenously goes down. Since CAD will also have to go down, theoretically Z, the demand for tradables, could decrease to accommodate the stop without a decrease in Y in (3) (Calvo 1998).

However, lower Z is likely to be accompanied by lower demand for nontradable goods, A – Z, and a decline in the relative prices of nontradables with respect to tradables (Calvo 1998). As a result, loans to the nontradable sector given out under the old expected relative prices could default (Calvo 1998). This could lead to bankruptcies across the entire economy (Calvo 1998). Bankruptcies could result in destruction of human capital at the firm level and an overall negative externality on the entire economy since credit channels to firms connected with the bankrupt firms could disappear (Calvo 1998).

It is important to note that sudden stops are not the same as a current account reversal, which is associated with a reversal from a current account deficit towards a surplus (Edwards 2004). Equations (1) – (3) suggest that the current account deficit will decrease, but this does not mean that it will reverse into a surplus once the episode is over. Sudden stops might coincide with a current account reversal, but there are many current account reversals that have been gradual rather than sudden and there have been sudden stops without a reversal in the current account position (Edwards 2004).

Calvo et al. (2004) extend the basic ideas of this model and show how trade openness and liability dollarization, i.e. having foreign currency debt, could respectively improve or worsen a sudden stop episode.

Let the demand function for nontradables be:

$$ln(H) = \alpha + \beta \ln(RER) + \delta \ln(Z) \quad (4)$$
$$h = \alpha + \beta rer + \delta z$$

RER is the real exchange rate, H is the demand for nontradable goods, and Z is the demand for tradable goods as before. The non-capital letters denote the logs of these variables. Following Calvo et al. (2004), α, β, δ are parameters.

CAD is defined as before in (3). Given Y and NFTA, a sudden stop results in:

$$-\Delta Z = CAD \quad (5)$$

Dividing both sides by Z gives:

$$-\frac{\Delta Z}{Z} = \frac{CAD}{Z} \quad (6)$$

Assuming that H, the demand for nontradables, is constant for simplicity, and taking the first difference of (4), we get:

$$-\Delta z = \frac{\beta \Delta rer}{\delta} \quad (7)$$

Approximating $\frac{-\Delta Z}{Z}$ from (6) with the first difference in logs in (7) gives:

$$\Delta rer = \frac{\delta}{\beta}\frac{CAD}{Z} \quad (8)$$

Equation (8) shows the effect on the real exchange rate of a sudden stop rather than the full exchange rate equilibrium. It effectively summarizes Calvo's (1998) proposition on the effect of sudden stops on the relative prices on the nontradable and tradable sectors. The equation suggests that if a sudden stop drives CAD down as was the case in equations (1)-(3), then the real exchange rate, Δrer, falls[2].

This result also has two other implications. First, if the economy has a lot of foreign-currency debt, i.e. it is liability-dollarized, the shock from the falling exchange rate could force a lot of companies (or even the government) into bankruptcy due to the currency

[2] Calvo et al. (2004) extends the model to a monetary economy with central bank reserves. The same results hold once reserves are depleted.

mismatch in their liabilities. This could further deteriorate access to credit across the economy even for companies which do not have debt issued in foreign currencies as discussed in the more simple case in equations (1)-(3). This result is intuitive as the depreciation in the currency from the sudden stop would make repaying the foreign debt more expensive, especially if the company receives a substantial portion of its income in a domestic currency. If the change in the exchange rate is sharp enough, it could force the company into a default.

Second, (8) suggests that the larger the size of the tradable sector is, the smaller, the effect of the sudden stop would be. Rewriting (8) with the definition of CAD from (3) gives:

$$\Delta rer = \frac{\delta}{\beta}\left(\frac{Z - Y - NFTA}{Z}\right) \quad (9)$$

This result suggests that the higher the openness (the supply of tradables, Y), the smaller the financing from abroad (Calvo et al. 2004). The intuition is that the more open the economy is, the less it would depend on foreign capital to fund imports. Hence, a sudden stop would result in a smaller shock.

More recent literature has attempted to incorporate the theoretical propositions discussed above into more sophisticated small open economy models. Chari et al. (2005), for example, study a frictionless small open economy and show that a sudden stop would in fact increase output. Since the empirical observations suggest the opposite, later models such as Durdu et al. (2008) and Mendoza et al. (2010) explore the frictions in the economy and show how a sudden stop can cause a decline in output. Mendoza et al. (2010) build a business cycle model with a collateral constraint which is largely consistent with the empirical observations on the effects of sudden stops on the economy. In general, the results discussed above in Calvo (1998, 2004) still hold.

ii. Earlier Empirical Literature

While the theoretical literature discussed so far provides explanations on how the sudden stops affect the real economy through trade and liability dollarization, it does not provide explanations of sudden stops themselves (Calvo et al. 2004). The empirical literature has focused on establishing the determinants which increase the likelihood of sudden stops.

Most studies have used the definition of sudden stops designed by Calvo et al. (2004). While there is some slight variation in the definitions (e.g. in the time periods used for calculations), sudden stops so far have been measured with net capital flows. Most studies have used the following definition designed by Calvo et al. (2004). First, construct a proxy for monthly net flows. Second, define a sudden stop episode according to the following algorithm:

- The episode begins when the annual year on year change in net capital flows (ΔNCF) falls one standard deviation (σ) below the historical mean (μ)
- A sudden stop occurs when ΔNCF falls at least 2xσ below μ
- The episode ends when ΔNCF exceeds one σ below μ

Calvo et al. (2004) use a probit panel data regression and a sample of 32 countries for the period 1990-2001 to study the determinants of sudden stops. They find that liability dollarization and trade openness increase and decrease respectively the probability of such stops (Calvo et al. 2004). Cavallo and Frankel (2008) use a similar specification as Calvo et al (2004), and include instruments for trade openness to address potential endogeneity of trade openness. Their findings on trade openness are consistent with Calvo et al. (2004), but they do not find that liability dollarization has a significant effect on the probability of a sudden stop (Cavallo and Frankel 2008).

Calvo et al. (2008) study systemic sudden stops. They define systemic sudden stops as episodes which satisfy the conditions listed above and occur when there is a rise in aggregate spreads (Calvo et al. 2008). Using a larger panel data sample than in their previous study and the new definition of stops, the authors find again that liability dollarization and trade openness are significant and robust across different specifications. The theory discussed in the previous section and the empirical findings of the literature suggest that trade openness and liability dollarization should be included in empirical studies. Not controlling for them could lead to omitted variable bias.

- **Ex-Post Effects of Sudden Stops on the Economy**

The second topic of interest in the empirical literature has been the factors which exacerbate or alleviate the effects of a sudden stop on the real economy. Guidotti et al (2004) using Calvo's definition of stops and a pooled growth regression show that higher trade openness is likely to improve the recovery, and higher liability dollarization is likely to decrease growth. Their findings are consistent with the theory described in the previous

section. Edwards (2004) uses a similar approach and also finds that trade openness is likely to alleviate the consequences of a sudden stop. Becker and Mauro (2006) use a probit panel regression to study the effects on output after different types of crises and find that sudden stops are the most costly shocks for developing countries.

iii. New Empirical Literature

- **Determinants of Sudden Stops**

All of the studies discussed so far use net capital flows to identify sudden stops. This method, however, does not allow for the differentiation between domestic and foreign investors (Forbes and Warnock 2012). The two groups of investors might be driven by different factors, and the stops caused by domestic or foreign flows might have different consequences on the real economy. Consider the net flows equation:

$$NFC = Gross\ Inflows_t + Gross\ Outflows_t \quad (10)$$

The standard IMF convention is to record outflows with a negative sign when domestic residents send capital abroad. If gross inflows from abroad, stay the same, but gross outflows rapidly rise, i.e. fall following the IMF convention, then NFC falls. Hence, a sudden rise in outflows by domestic investors would also be considered a sudden stop episode. However, a rapid rise in outflows by domestic residents is unlikely to have the same effect on the economy as a sudden stop in inflows of foreign capital. It is also likely that the decisions of foreign and domestic investors are driven by different factors.

Until the mid-1990s, gross flows roughly mirrored net flows, so their use would not have given very different results (Forbes and Warnock 2012). In the last two decades gross flows have become more volatile (Forbes and Warnock 2012). Fig. 1, for example, shows quarterly gross and net flows in Korea in billions of USD since 1985 until 2009. The graph illustrates that gross inflows and outflows since the mid-1990s have become much more volatile than net flows.

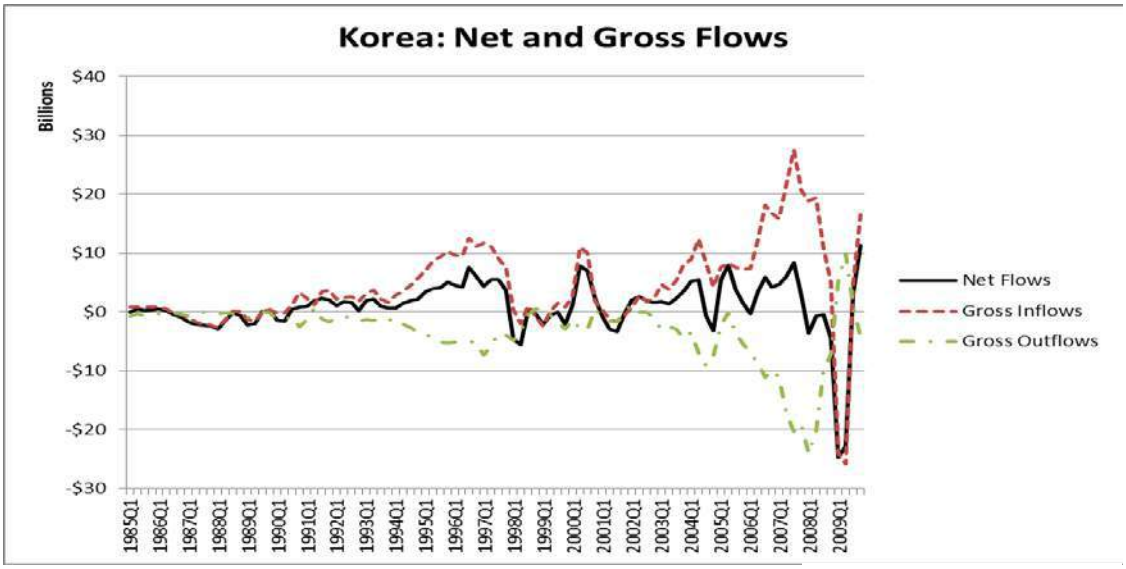

Fig. 1 Source: IFS

The new empirical literature by Cowan et al. (2008), Forbes and Warnock (2012), and Calderon and Kubota (2013) has focused on differentiating sudden stops caused by domestic and foreign investors. Forbes and Warnock (2012) are the only authors who use gross instead of net flows to identify sudden stops. The only other authors that have attempted to differentiate between foreign and domestic driven episodes are Cowan et al. (2008) and Calderon and Kubota (2013). They use net flows to identify the episodes, and simultaneously look at gross flows to identify whether the net change was driven by foreign or domestic investors. The results from all of these empirical studies have shown that global "push" factors play an important role and many of the domestic factors which were previously considered important are insignificant.

The methodology used in this paper follows Forbes and Warnock (2012). The authors find that global factors are significant across different specifications. Forbes and Warnock (2012), however, do not control for trade openness and liability dollarization, the two domestic factors which have been theoretically justified and have consistently appeared as significant in other empirical studies as discussed above. This paper aims to reconcile the earlier theory and empirical literature with the new one. In particular, it extends the analysis of Forbes and Warnock (2012) and combines it with Calvo et al. (2004, 2008).

- **Ex-Post Effects of Sudden Stops on the Economy**

The new empirical literature has shown that sudden stop episodes driven by foreign investors are more detrimental to the economy than stops driven by domestic investors (capital flights). Cavallo et al. (2013) are the only authors who study the effects of sudden stops with the gross flow definition used in this paper. They find that sudden stops in

gross flows are likely to be followed by a fall in output (Cavallo et al. 2013). Developing countries are more susceptible to a fall in output after a sudden stop in gross flows (Cavallo et al. 2013).

In an innovative study Cowan and Raddatz (2013) use micro-level data at the industry level for a set of developed and developing economies to study the ex-post effects of sudden stops on the manufacturing sector. The authors use net flows to identify stops and show that firms which depend on external financing are hurt more from stops than firms which do not rely on such financing (Cowan and Raddataz 2013). The findings in Cowan and Raddatz (2013) are consistent with the theory described in the previous section and provide evidence at the micro level that liability dollarization is indeed a channel through which the real economy is hurt by sudden stops.

III. New Episode Identification Methodology

The traditional way of measuring sudden stops was designed by Calvo et al. (2004) and was described in Section III. I follow the same definition as Calvo et al. (2004) and use quarterly gross inflow data from the International Financial Statistics (IFS) from the IMF instead of monthly proxies for net flows. I define gross inflows following standard balance of payment accounting practice. I define gross private inflows as[3]:

$$Gross\ Inflows_t = FDI_t + Portfolio\ Inflows_t + Other\ Investment\ Inflows_t \quad (11)$$

In order to identify a sudden stop, I follow the time-horizons used in Forbes and Warnock (2012). First, let C_t be the 4-quarter moving sum of gross inflows to the economy in order to eliminate seasonal fluctuations:

$$C_t = \sum_{i=0}^{3} Gross\ Inflows_{t-i} \quad (12)$$

Second, calculate ΔC_t, the annual year-over-year change in C_t:

$$\Delta C_t = C_t - C_{t-4} \quad (13)$$

[3] This definition excludes reserve transactions and derivate transactions. This is the standard approach in the literature and the reason is that I want to study the behaviour of private capital flows. Data on derivative transaction is not included since it is new and scarce for the majority of the sample.

Third, calculate a moving average, μ, and standard deviation for ΔC_t, namely, $\sigma_{\Delta C_t}$ over a 5 year period.[4] Then, calculate four bands with the μ and $\sigma_{\Delta C_t}$:

$$\mu +/- \sigma_{\Delta C_t}$$

$$\mu +/-2 \times \sigma_{\Delta C_t}$$

Fourth, I define a sudden stop as in Calvo et al. (2004):

- The sudden stop episode starts when ΔC_t falls one standard deviation below its mean:

$$\Delta C_t < \mu - \sigma_{\Delta C_t}$$

- There must be at least one quarter during which ΔC_t falls two standard deviations below its mean:

$$\Delta C_t < \mu - 2 \times \sigma_{\Delta C_t} \quad (14)$$

- The sudden stop episode ends when flows return at least above one standard deviation below their mean:

$$\Delta C_t > \mu - \sigma_{\Delta C_t} \quad (15)$$

In addition to the conditions above, Forbes and Warnock (2012) add the condition that the episode lasts more than one quarter.

Fig. 2 illustrates the sudden stop episodes and the identification strategy for Brazil. When the blue line, ΔC_t, falls below the dashed red line, $\mu - \sigma_{\Delta C_t}$, and crosses the dotted line, $\mu - 2 \times \sigma_{\Delta C_t}$, a sudden stop episode occurs. The episode ends when ΔC_t returns above $\mu - \sigma_{\Delta C_t}$. Sudden stops are represented by the red bars on the graph.

Episodes of extreme capital inflows from abroad are known in the literature as surges or bonanzas and are defined as the mirror image of a sudden stop and are represented by the light blue bars on the graph. Bonanzas have also been identified as increasing the risk of a crisis in emerging economies especially due to procyclical fiscal policy during episodes of such surges of foreign capital (Reinhart and Reinhart 2009). Fig. 2 suggests

[4] This filter is known as a Bollinger Band, discovered by John Bollinger in the 1980's, and it is still widely used in financial markets to detect extreme relative price movement.

that surges did precede some of the sudden stop episodes. While this paper focuses on sudden stops, it will also test whether surges of "hot money" could increase the probability of sudden stops.

Fig. 3 illustrates the difference between the net flows and the gross flows approach. Using gross inflows instead of net flows allows us to identify more sudden stop episodes driven by foreign investors and shows that some of the episodes last longer as illustrated in the shaded region on the graph.

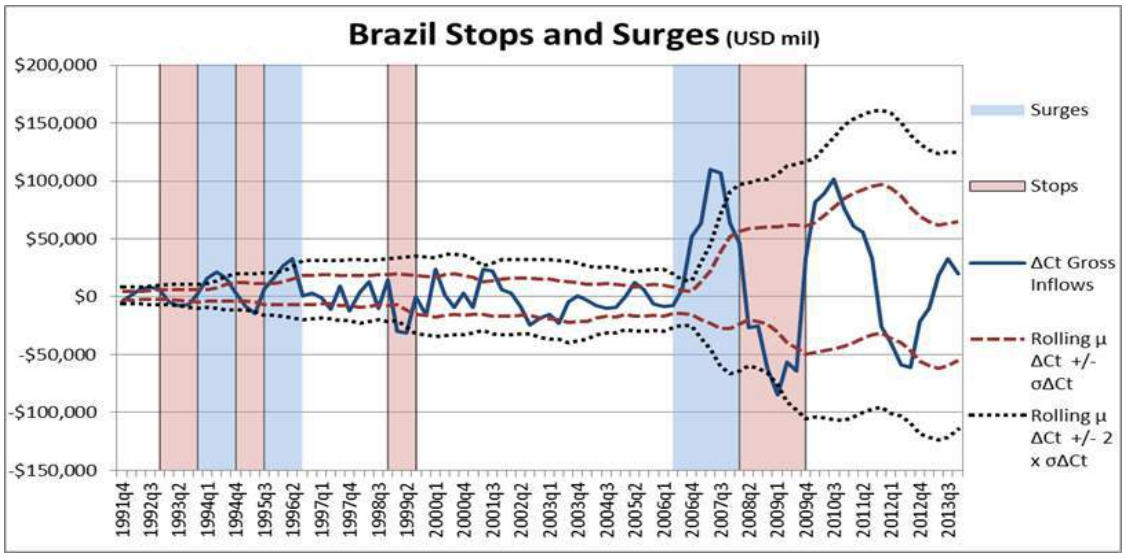

Fig. 2 Source: IFS, Author's Calculations

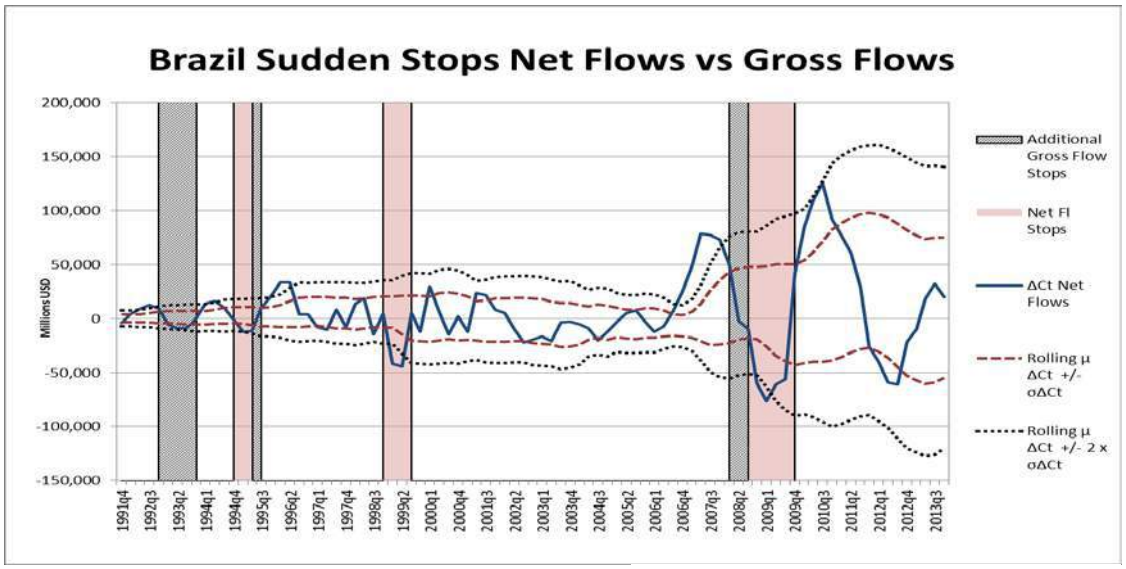

Fig. 3 Source: IFS, Author's Calculations

Two more types of episodes can be defined using the methodology outlined above with gross outflows to study the behaviour of domestic investors. Gross outflows are defined as the sum of direct and portfolio investments by domestic residents abroad and other investments. Let C_t be equal to the sum of gross outflows:

$$C_t = \sum_{i=0}^{3} Gross\ Outflows_{t-i} \quad (16)$$

Using the same algorithm as before, let us define "retrenchments" as episodes when outflows fall sharply and "flights" as episodes when outflows rise sharply (Forbes and Warnock 2012). Defining these episodes and studying their relationship with sudden stops is important since flights can exacerbate a sudden stop episode, and retrenchments can alleviate the effect from the sudden foreign capital withdrawal.

IV. Data and Descriptive Analysis of Episodes

i. Data and Episodes

I use quarterly data from the IFS to calculate gross capital inflows following the procedure described above to identify the sudden stop episodes. I include only countries which have at least ten years of data as in Forbes in Warnock (2012). The full sample of countries for which data is available is 58. I use data until 2009q4. The starting year of data availability varies for each country. I identify 143 sudden stops episodes. Forbes and Warnock (2012) identify 168 sudden stops for that period. This is not surprising since the authors add data from domestic sources to enlarge their database. For example, most of the data for Taiwan and Bangladesh in the IFS is missing. These two countries alone account for 7 of the missing episodes. I use the episodes data set from Forbes and Warnock (2012) since it is more detailed.

ii. Descriptive Analysis

- **Stops and Other Episodes by Income Groups**

Figures 4-10 below illustrate different relationships between sudden stops and other extreme capital flow episodes. I define developing countries using the IMF classification of developed and developing countries from the 2011 World Economic Outlook report. The data set includes 27 developing economies and 31 developed economies[5].

Fig. 4 illustrates the share of developed and developing countries which experienced a sudden stop at the same time. Stops in developing countries are represented by the shaded

[5] China is not included in the sample as it began reporting financial flows only recently. A full list of the countries can be found in the Appendix.

area, and stops in developed countries are represented by the light blue area. The graph suggests that both developing and developed countries often experience sudden stops at the same time. Hence, there could be common global factors which drive sudden stops. It is also worth noting that developed countries appear to experience sudden stops more frequently especially for the period prior to 1995. This is most likely the case due to the poorer data availability in developing countries.

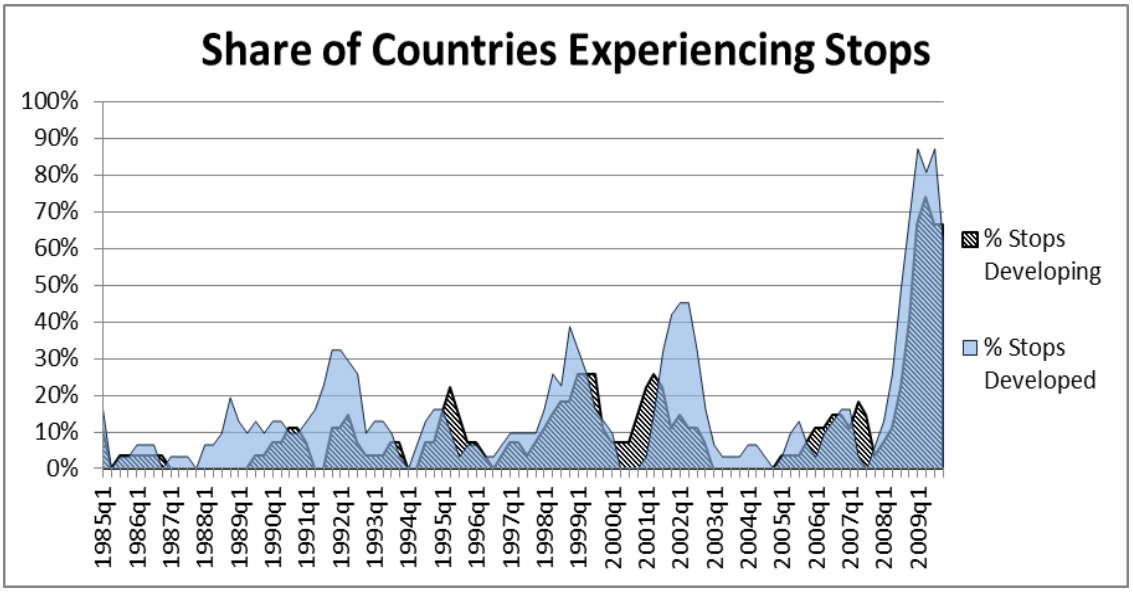

Fig. 4 Source: Forbes and Warnock (2012), Author's Calculations

Figures 5 and 6 illustrate stops and surges for developing and developed countries. Stops are represented by the shaded area, and surges are represented by the light blue area. Fig. 5 suggests that there could be some cyclicality in "hot money" surges and sudden stop episodes in developing countries. Agosin and Huaita (2012) use a probit panel regression to assess the relationship between bonanzas (surges) and sudden stops and find that experiencing a preceding surge episode increases the probability of a sudden stop (Agosin and Huaita 2012). The graph is somewhat consistent with such theories of overreaction. Fig. 6 suggests that there is no relationship between stops and surges for developed countries.

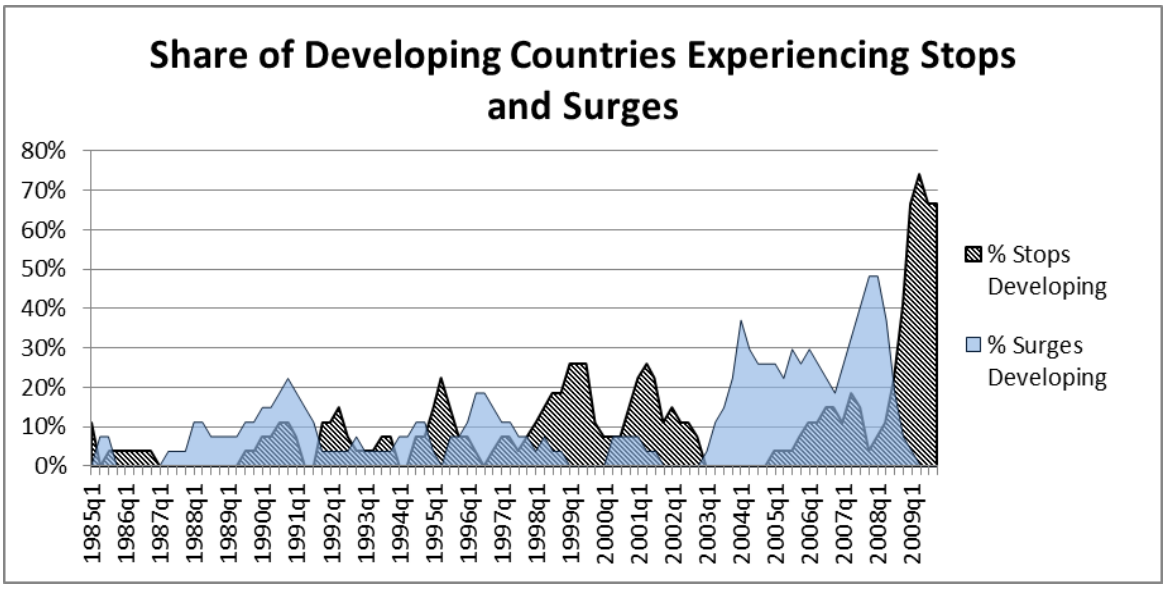

Fig. 5 Source: Forbes and Warnock (2012), Author's Calculations

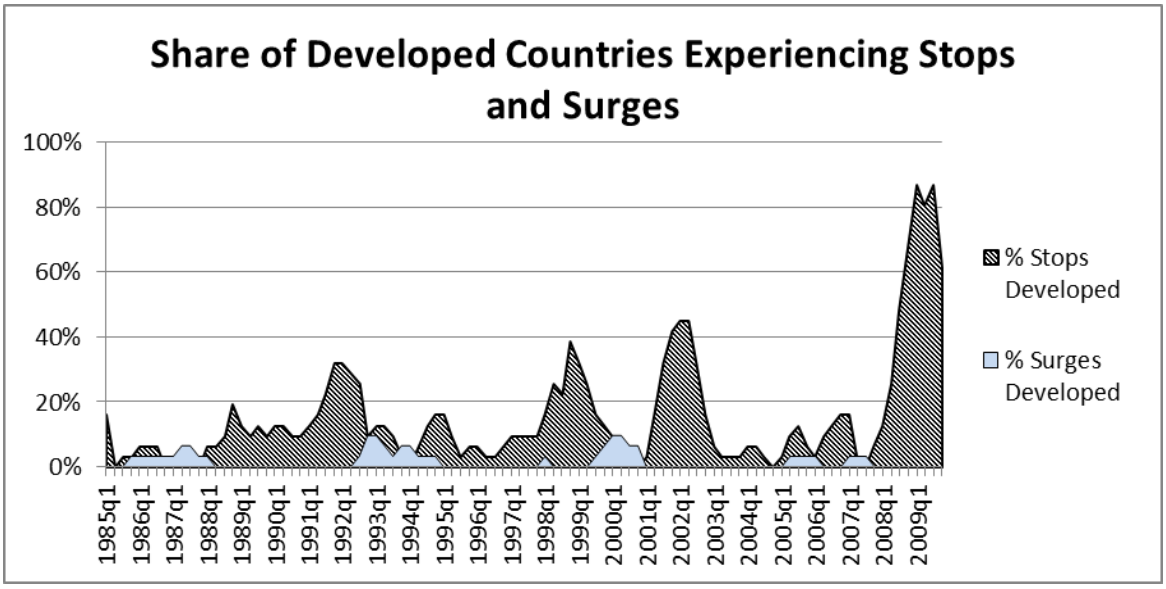

Fig. 6 Source: Forbes and Warnock (2012), Author's Calculations

Figures 7-10 focus on the relationship between sudden stops and episodes caused by domestic investors such as flights and retrenchments. Figures 7 and 8 illustrate stops and flight episodes for developing and developed countries. Both developed and developing countries appear to experience an equal amount of flights which is somewhat surprising since the expectation is that developed countries would be less likely to send capital abroad. The motivation for the flights for the two groups, however, could be different. Whereas in developing countries, domestic residents might be sending money abroad due to fear from a domestic crisis, in the developed world they might be sending it abroad to diversify their portfolio or to look for higher yield.

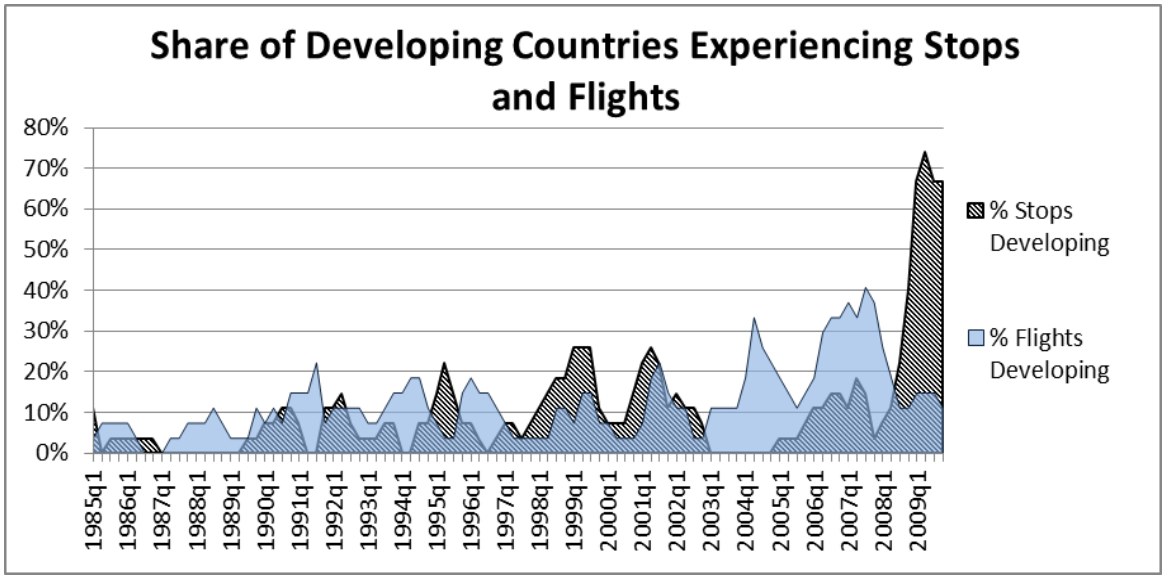

Fig. 7 Source: Forbes and Warnock (2012), Author's Calculations

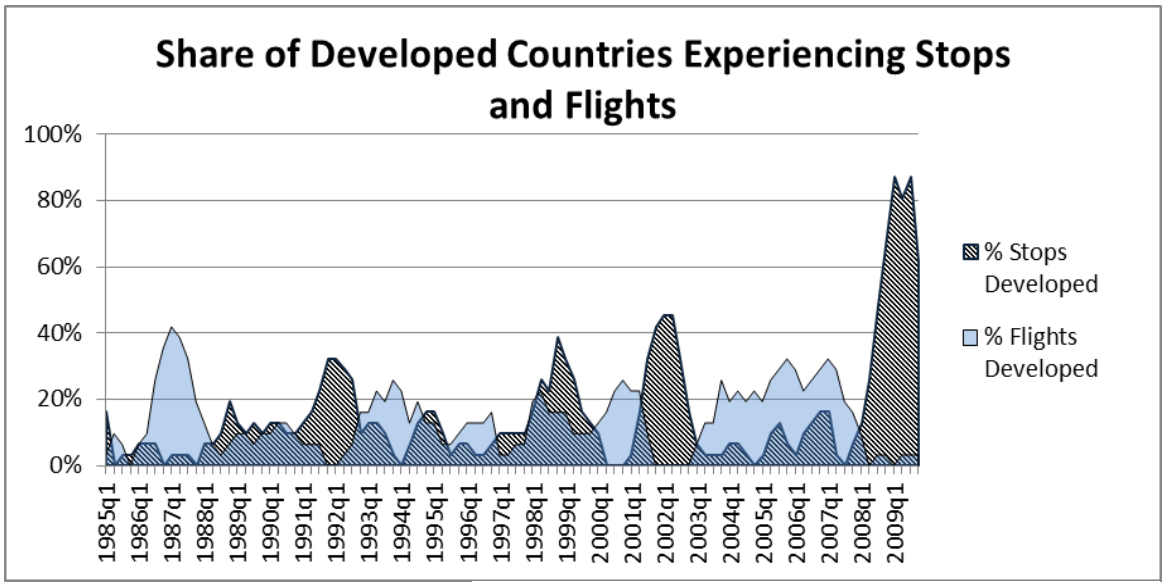

Fig. 8 Source: Forbes and Warnock (2012), Author's Calculations

Figures 9-10 illustrate sudden stop and retrenchment episodes. The relationship between sudden stops and retrenchment episodes is of particular interest since a retrenchment episode could alleviate the net effect of a sudden stop. For example, if a developing country with foreign currency denominated assets experiences a sudden stop, then there could be currency depreciation and a liability mismatch as described in Section II. However, if there is a simultaneous "retrenchment", domestic investors would return capital at home, which should alleviate the pressure on the currency from the outflows abroad. If one assumes that the assets that were withdrawn from foreign accounts are also efficiently reinvested domestically, then the effect of the sudden stop should be negligible.

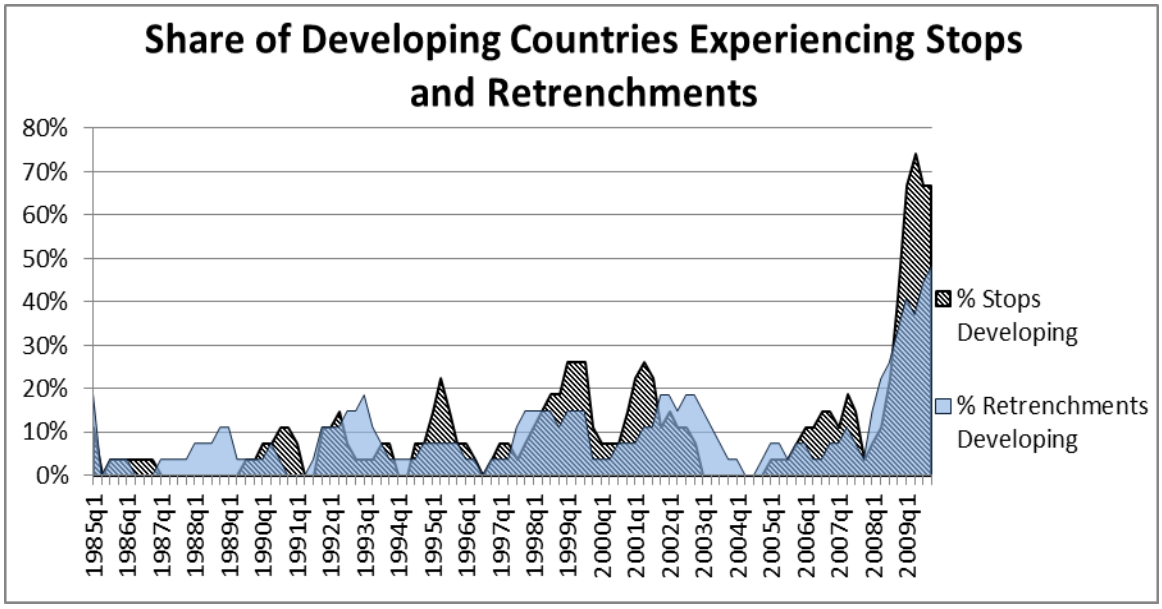

Fig. 9 Source: Forbes and Warnock (2012), Author's Calculations

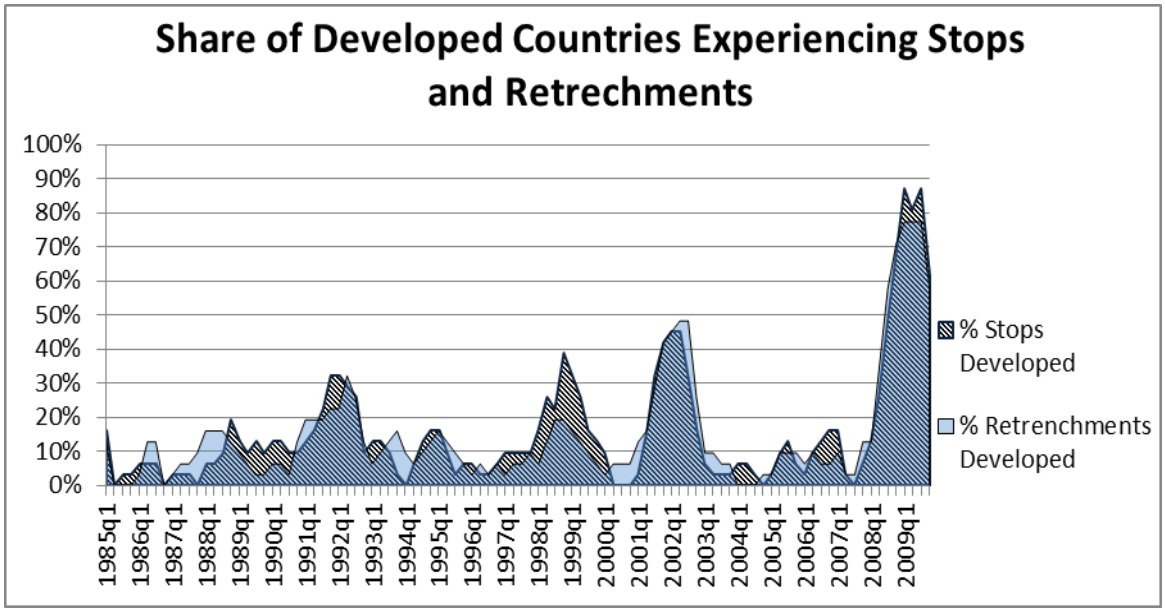

Fig. 10 Source: Forbes and Warnock (2012), Author's Calculations

The following recent example for the US illustrates how a retrenchment episode could alleviate a sudden stop. Let us consider the international financial account of the US for 2008, quarter 4, the quarter after Lehman Brothers filed for bankruptcy. Gross inflows fell by roughly $100 billion (Fig 11). Even though the US is the largest economy of the world, a liquidation of such an amount over the course of a few months, ceteris paribus, would have led to a fall in exchange rate (Obstfeld 2012). However, as Figure 11 illustrates, the dollar actually appreciated. The reason for this is the simultaneous retrenchment which the US experienced. In the same quarter, US residents liquidated roughly $300 billion worth of assets abroad and returned them at home, which put

upward pressure on the dollar (Obstfeld 2012). This real example illustrates how a retrenchment episode alleviates the pressure on the currency from the sudden stop and allows a country to continue financing its current account deficit.

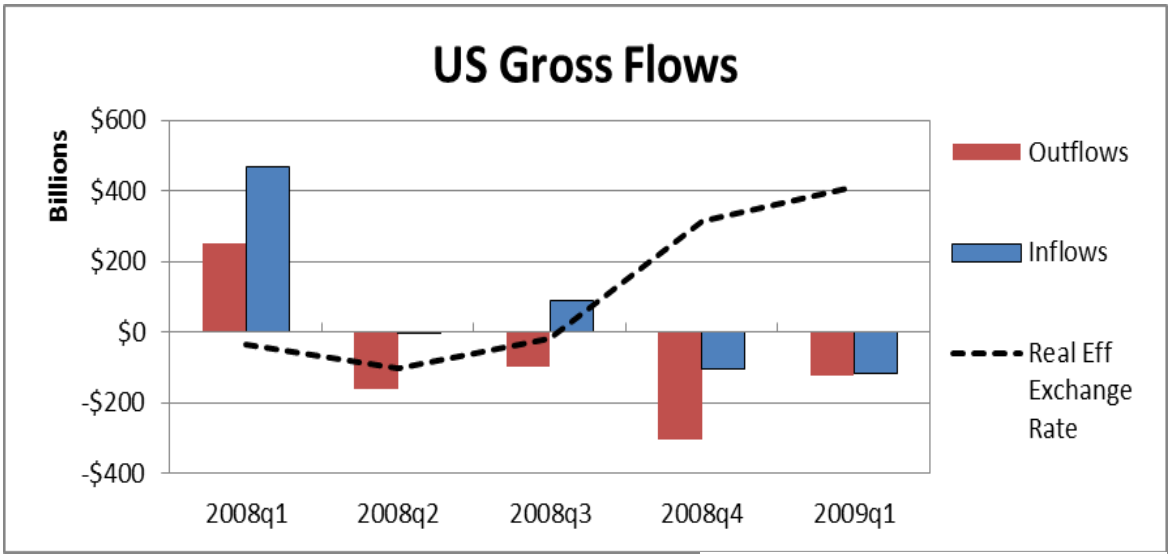

Fig. 11 Source: IFS, Author's Calculations

Under the earlier definition of sudden stop, with net capital flows, if a retrenchment and a sudden stop coincide, the algorithm described in the previous section would not detect anything. The standard IMF convention is to record outflows with a negative sign when domestic residents send capital abroad and with a plus sign when the capital flows back into the economy. Hence, the gross inflows would rapidly fall down due to the sudden stops, but the gross outflows will increase, so net flows would not change by a lot. In the US case, discussed above the change in net capital flows is the following[6]:

$$Net\ Capital\ Flows\ =\ Gross\ Outflows\ +\ Gross\ Inflows\ (10)$$

$$Net\ Capital\ Flows = 300 + (-100)\ (17)$$

$$Net\ Capital\ Flows = 200\ (18)$$

Equation (18) implies that the US successfully maintained its current account deficit during the quarter despite the domestic and global turmoil and financed it through the sales of foreign assets abroad (Obstfeld 2012). From (18) alone one cannot conclude that

[6] The IMF convention for the BoP accounting identity states that CA+NCF+NKA=0 where the CA is the current account, the NCF is the net financial account and NKA is the capital account. Assuming that NKA is negligible, CA = - NCF. Hence the positive number in (19) indicates a surplus in the financial account and a CA deficit, which indicates that the US is a net debtor.

the US experienced a sudden stop and a retrenchment according to our definition. Fig. 12 graphs the sudden stops for the US using the algorithm described in Section III. It shows that with net flows, quarter 4 would not be identified as a sudden stop episode, but it would be detected with the definition used in this paper based on gross flows.

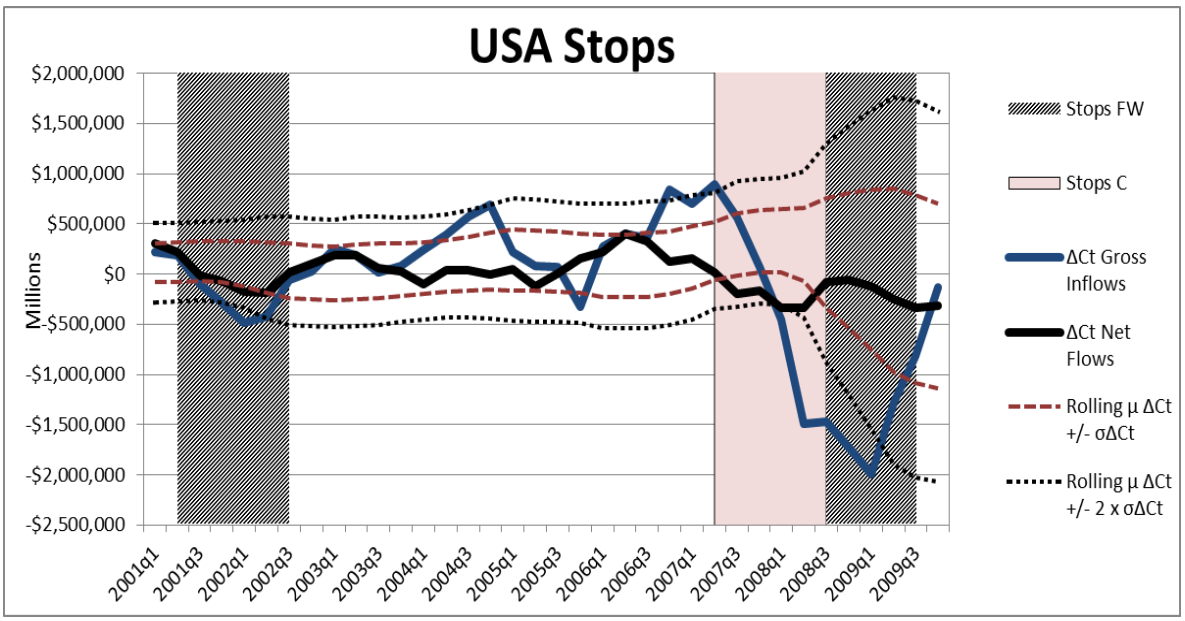

Fig. 12 Source: IFS, Author's Calculations

Figures 9-10 suggest that retrenchment episodes are less frequent in developing countries and much more frequent in the developed world. This observation is confirmed with the correlation coefficients for sudden stops and retrenchments for both groups. For the developed world the coefficient is 0.61 whereas for the sample of developing countries it is 0.27. This is a very interesting insight which Forbes and Warnock (2012) did not notice and discuss. It suggests that the reason why previous authors such as Calvo et al. (2004, 2008) have found that sudden stops are largely a developing country phenomenon is not that developing countries are necessarily more prone to sudden stops. As Fig. 4, the first figure of the section suggests, both groups appear to experience sudden stops, i.e. extreme outflows of foreign capital, at about the same time. However, the developed countries are much more likely to experience a retrenchment at the same time, which alleviates the effects of the sudden stops. If one uses net flows to identify sudden stops, then the sudden stops in the developed world would likely remain undetected. In addition, this finding suggests that sudden stops in developing countries are potentially much more detrimental since they do not experience simultaneous retrenchment episodes frequently.

▪ **Stops and Other Episodes Geographical Distribution**

Fig. 13 illustrates the geographical distribution of the stop episodes since 1990 since data availability is better for the developing world starting that year. Stops appear to be equally distributed across the developed and the developing world unlike in previous studies such as Calvo et al. (2004) in which they have been identified as a largely developing country event. The larger number of episodes is due to the fact that earlier literature based on net flows did not capture numerous stop episodes in the developed world which coincided with retrenchments as discussed in the previous section.

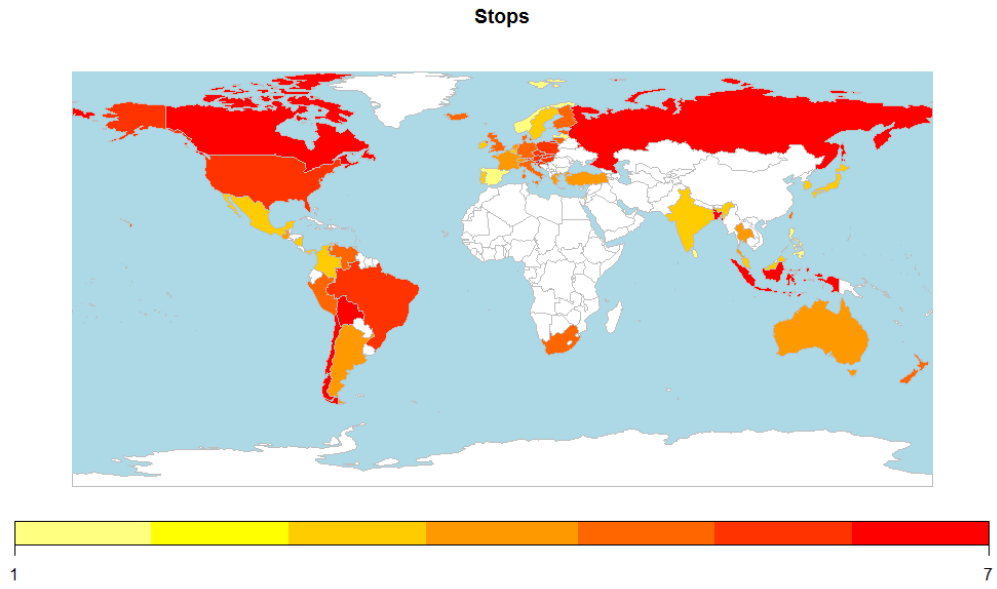

Fig. 13 Source: Forbes and Warnock (2012), Author's Calculations

iii. Stops and Other Crises by Income Group

The earlier literature has identified that stops increase the probability for a variety of crises. Figures 14 and 15 illustrate the incidence of sudden stops and other crises across time for the developed and the developing world. The data on external and domestic defaults and banking crises is from Reinhart and Rogoff (2009). Currency crises are defined as a fall in the nominal exchange rate of at least 25% as in Frankel and Rose (1996). A recession episode is identified as a fall in output for at least 2 subsequent quarters and is calculated using IMF quarterly data on GDP.

Fig. 14 and 15 suggest that sudden stops might occur in the developed world as frequently as they occur in the developing one. However, other crises episodes are less likely to coincide with stops in developed countries.

Fig. 14 and 15 suggest that recessions are likely to coincide, precede, or follow sudden stop episodes. Fig. 14 suggests that developing countries are more likely to

experience a recession and an additional crisis in conjunction with sudden stops. Recessions are the most frequent crisis episode to coincide with sudden stops in both the developed and the developing world. While the graphs alone cannot provide any evidence that there is a causal relationship between the crises and the stops, they do suggest that sudden stops are likely to be accompanied or followed by a recession, which is consistent with new and earlier empirical studies such as Guidotti (2004), Becker and Mauro (2006), and Cavallo et al. (2013).

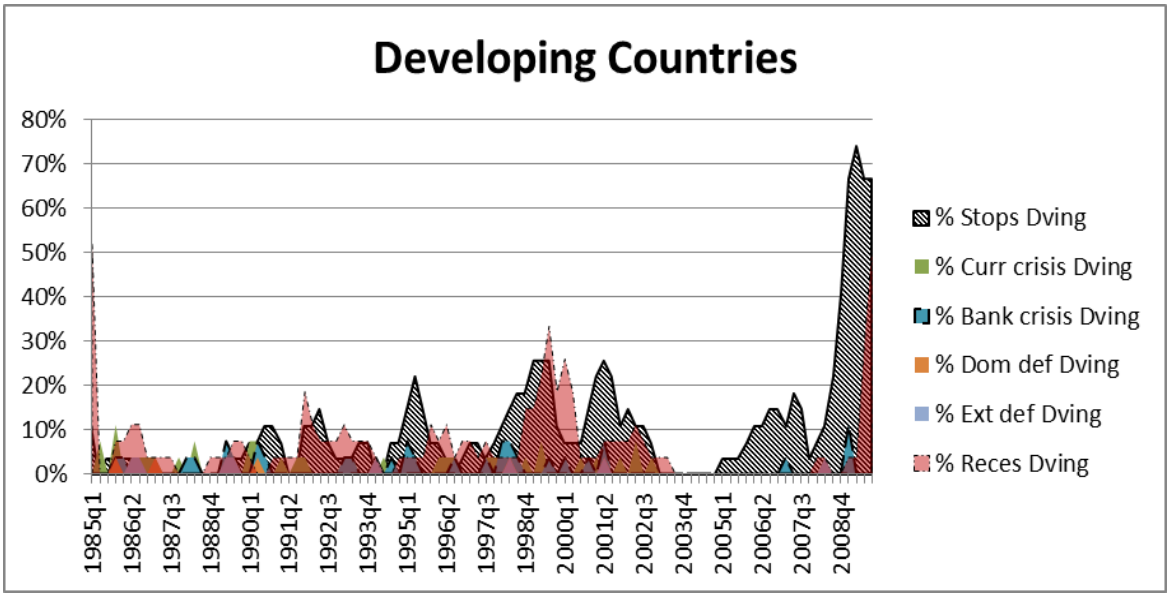

Fig. 14 Sources: IFS, Reinhart and Rogoff, Author's Calculations

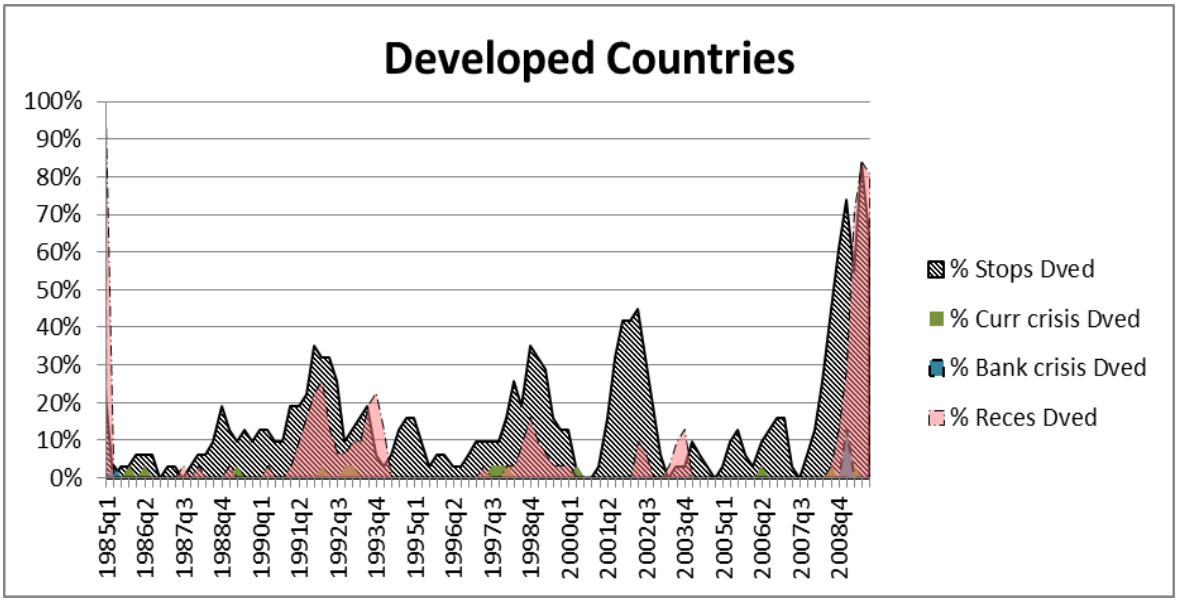

Fig. 15 Sources: IFS, Reinhart and Rogoff, Author's Calculations

Currency crises and banking crises are much less frequent compared to recessions and sudden stops. They appear to be more prevalent in the developing world than in the developed world as expected. External and domestic defaults seem to be very rare in developing countries and non-existent in the developed world.

V. Estimation Strategy

This section describes the baseline empirical methodology and the sources of the data used. I use a complementary logarithmic framework for the baseline regression as in Forbes and Warnock (2012) and perform robustness checks in the following section with other specifications used in the earlier literature. I use the new definition of sudden stops described in Section III, and I test the hypothesis that including new domestic variables, which have been found as significant in the previous literature, would change the results of Forbes and Warnock (2012). In particular, I test whether trade openness and liability dollarization are significant and whether global factors become insignificant once these factors have been accounted for.

i. Baseline Regression Set Up

In order to assess the role of domestic and global variables, I estimate the following model:

$$Prob(SS_{it} = 1) = F\left(X_{t-1}^{Global}\beta_g + X_{t-1}^{Domestic}\beta_d + X_{t-1}^{Contagion}\beta_c\right) (19)$$

Where SS_{it} is a dummy variable which equals one if country *i* experiences a sudden stop episode at time *t*; X_{t-1}^{Global} is a vector containing global variables; $X_{t-1}^{Domestic}$ is a vector containing domestic variables, and $X_{t-1}^{Contagion}$ is a vector containing domestic variables. Sudden stops are defined using the new methodology developed by Forbes and Warnock (2012) discussed in Section III.

In order to estimate (19) I use a complementary logarithmic framework for the baseline regression. The earlier literature has used probit models to estimate (19). Calvo et al. (2004) use a random effects probit model, Cavallo and Frankel (2008) use a fixed effects probit model, and Calderon and Kubota (2013) use a probit model with no fixed effects. These specifications assume the following:

$$P(SS = 1 \mid X) = \Phi(\beta_0 + \beta_1 x_1 \dots \beta_k x_k) \ (20)$$

Where $P(SS = 1 \mid X)$ is the probability of a sudden stop occurring given X, Φ is the probit function, which takes values from 0 to 1, $0 < \Phi(z) < 1$, for all real numbers z, and $\Phi(z)$ is the standard normal cumulative distribution function (cdf) (Wooldridge, 2010, 471-472).

The episodes are rare events, i.e. they occur for only 17% of the sample. Therefore, it is reasonable to assume that $\Phi(.)$ follows the cumulative distribution function of the extreme value distribution (Forbes and Warnock 2012). Robustness checks with the probit models used in the earlier literature are reported in Section VII.

ii. Independent Variables

The literature on sudden stops provides numerous potential causes of sudden stops, which are discussed in Section II. The explanatory variables for (19) follow largely Forbes and Warnock (2012). I also include trade openness and liability dollarization as suggested by both the theory and the empirical evidence discussed in Section II. All explanatory variables are lagged by one quarter to address potential endogeneity. In addition, unlike most of the previous literature, which uses annual data, I use quarterly data for a sample of 58 countries from 1985q1 to 2007q4. This increases the number of observations up to 20 times compared to Calvo et al. (2004). The time period was chosen to ensure that the results are not driven by the recent financial crisis. A sensitivity check with data until 2009 is performed in Section VII.

The domestic variables, $\boldsymbol{X_{t-1}^{Domestic}}$, are as follows:

- **"Real GDP Growth"**. This variable is included as it controls for growth shocks in the previous quarter. In particular, a recession in the previous quarter might drive investors to reduce their exposure to a particular country which would increase the probability of a sudden stop. Hence, the expected sign on the coefficient on this variable is negative. The data comes from the IFS and is augmented with data from national sources from the Economic Intelligence Unit.
- **"Inflation"**. Inflation is measured as the quarterly change of CPI. It serves as a proxy for domestic monetary financial stability (Calderon and Kubota 2013). The expected sign is a positive one as episodes of higher inflation are often associated with domestic economic issues and a loose monetary policy. The data comes from the IFS, which has very detailed records of CPI for most countries and years in the sample.
- **"Trade openness"**. Trade openness is measured as the sum of exports and imports over gross domestic product (Cavallo and Frankel 2008). The expected sign on trade openness is in fact ambiguous. While the earlier theoretical literature by Calvo et al. (1998, 2004) discussed in Section II suggests that higher trade openness is likely to alleviate the ex-post effects on the economy of a sudden stop, it does not necessarily imply that higher trade openness increases the probability of a sudden stop. Larger trade openness also implies a higher integration into the global economic and financial system,

which suggests that it would increase the probability of a sudden stop. Calvo et al (2004, 2008) and Cavallo and Frankel (2008) find that higher trade openness decreases the probability of a sudden stop. Calderon and Kubota (2013) find that it increases the probability of a sudden stop. Quarterly data for exports, imports, and gross domestic product is obtained from the IFS. The data has been augmented with data on imports and exports from the Balance of Payment statistics in USD and Real GDP in USD from the Economic Intelligence Unit.

- **"Liability dollarization"**. Liability dollarization is measured by the sum of the banking sector's local liabilities in foreign currency and foreign borrowing over GDP. The information on liability dollarization reported at the Bank of International Settlements, however, is unavailable for most developing countries and even for some developed countries. Two alternative proxy measures are used in this study. First, the foreign borrowing of the banks as a fraction of the money supply as suggested by Cavallo and Frankel (2008). The data from the IFS and is available for most countries. The second source is a database created by Lane and Shambaugh (2010), who gather data from a variety of national and international sources. The first data set is the preferred one as it contains quarterly data and is more recent. The second one contains annual data up until 2004, and it is used for a sensitivity check. The theory discussed in Section II suggests that liability dollarization is likely to worsen the ex-post effects of a sudden stop on the economy due to potential balance sheet effects and currency mismatches. However, it is not clear whether liability dollarization would increase the probability of a sudden stop ex-ante. In theory, if foreign investors are aware of the liability dollarization of a particular country, then liability dollarization might be a catalyst for a self-fulfilling sudden stop. For example, investors fear that a sudden stop might cause a change in the exchange rate and that a highly dollarized economy might be severely affected by a sudden stop. Therefore, they liquidate their existing positions and/or stop investing in the economy causing a sudden stop. While this is an entirely plausible mechanism, it is not likely that investors actually observe the amount of liability dollarization ex-ante, especially for developing countries. Given the lack of information, it is unlikely that liability dollarization would be a significant factor in determining the probability of a sudden stop occurring. Calvo et al. (2004, 2008) find that liability dollarization is positive and significant. Edwards (2004) and Cavallo and Frankel (2008) do not find any evidence that liability dollarization is a significant factor.

- **"Reserves as a share of imports".** Reserves to imports measures the amount of foreign reserves a country has (excluding IMF reserves) which it could use to defend its

currency in case of a sudden stop or a currency crisis. Hence, the expected sign on reserves is negative. Cavallo and Frankel (2008) find evidence that reserves decrease the probability of a sudden stop. Data on reserves is from the IFS, and data on imports is from the Balance of Payments Statistics.

The following variables are included as controls for global factors, $\boldsymbol{X_{t-1}^{Global}}$:

- **"Global interest rates".** Global interest rates are measured as the average of the nominal interest rates in the US, the core Eurozone interest rates, the UK, and Japan. It is likely that a rise in global interest rates will increase the probability of a sudden stop, especially in emerging markets. The beginning of the lost decade of the 1980's in Latin America was to some extent triggered by the rise in interest rates in the US. Recent studies have found evidence of contagion and spill over effects. Bayoumi and Swiston (2010) study international bond markets and find that changes in inflation expectations in the US interest explain about half of the foreign yields in the developed world. Data on interest rates is from the IFS.

- **"Global liquidity".** Global liquidity is measured as the average change in the money supply of the US, the Eurozone, and Japan. Change in monetary policy in large developed economies could potentially trigger a sudden stop. For example, a recent study by Moore et al. (2013) finds that the Large-Scale-Asset-Purchases by the Fed increased debt flows to emerging markets and lowered long-term yields. A contractionary monetary policy could do the opposite and increase the chance of a sudden stop. Data on the money supply growth is taken from the IFS.

- **"Global growth".** Global growth is included as an additional control for external shocks as in Forbes and Warnock (2012). Data is from the IFS.

- **"VXO".** The VXO is a measure of implied volatility in the markets derived from stock option prices on the S&P 100. A rise of the VXO indicates increasing risk aversion. The expected sign, therefore, is positive. The data is from the Chicago Board of Options.

Finally, contagion $\boldsymbol{X_{t-1}^{Contagion}}$, is defined as a dummy variable, which takes the value of one, if a country has experienced a sudden stop at time *t* and at least one another country in the region has experienced a sudden stop in the previous period *t-1*.[7]

In addition to all variables, a control for previous surges is included. The descriptive analysis suggested that there might be some cyclicality especially in developing countries. Summary statistics are included in the Appendix Table 1.

[7] The contagion variable has been adjusted for the fact that sudden stop episodes last longer than one quarter. For example, Sri Lanka was the only one to experience a sudden stop in Asia in 1994q2-q3. If one does not account for this fact, then an algorithm would detect a contagion episode in 1994q3, which would lead to measurement error.

VI. Results and Analysis

The results from the baseline specification with a complementary logarithmic framework and a sample from 1985q1-2007q4 are summarized in Table 1. Since this a logistic regression, the direction of the signs and not their magnitudes are of interest. Table 1 presents the results for the full sample and developing and developed countries estimated separately as in Calderon and Kubota (2013). All estimations are with robust standard errors clustered by country.

The full sample estimation suggests that global factors remain statistically significant even after controlling for trade openness and liability dollarization. In particular, the VXO, the world interest rate, and contagion are significant and positive. From the domestic variables only domestic GDP growth is significant and negative in all samples. The signs of the variables are consistent with the expectations discussed in the previous section.

For the sample of developing countries, trade openness is significant and positive, and liability dollarization is insignificant. The positive sign of trade openness contradicts most of the earlier empirical literature on sudden stops such as Calvo et al. (2004, 2008) and Cavallo and Frankel (2008). The results, however, are similar to Calderon and Kubota (2013), the closest study to this one. It is intuitive that trade openness would increase the probability of a sudden stop. More trade implies more cross border financial flows such as trade credits. The model described in Section II.i by Calvo (1998) and Calvo et al. (2004) does suggest that trade openness would alleviate the ex-post consequences on the real economy. However, it does not suggest that ex-ante trade openness would decrease the probability of a sudden stop. Reserves and inflation are not significant. This result is consistent with both the earlier and the newer literature on sudden stops. Having a surge of “hot money” is also insignificant for all samples.

Overall, the results are consistent with Forbes and Warnock (2012) and with the hypothesis that sudden stops are highly influenced by global variables and contagion variables and less so by domestic factors. All previous studies have used net flows to define sudden stops. As discussed in Sections III and IV, there is a significant theoretical and empirical difference between net flow and gross flow sudden stops. Therefore, it is not surprising that the results in this paper differ from previous studies.

Table 1: Baseline Results

	Full Sample	Developing	Developed
Domestic Factors			
Domestic GDP Growth	-10.849***	-11.841*	-11.070***
	(-2.41)	(-4.82)	(-3.11)
Inflation	0.009	-0.001	0.746
	(-0.01)	(-0.03)	(-1.52)
Trade Openness	0.012	1.068***	-0.171
	(-0.18)	(-0.27)	(-0.17)
Liability Dollarization	0.005	0.032	0.016
	(-0.06)	(-0.17)	(-0.09)
Reserves to Imports	0.009	0.1	0.021
	(-0.06)	(-0.15)	(-0.06)
Global Factors			
VXO	0.032***	0.02	0.036**
	(-0.01)	(-0.02)	(-0.01)
Global GDP	-1.324	-2.641	-1.309
	(-3.3)	(-4.87)	(-4.21)
World Interest Rate	13.720**	22.493*	12.093*
	(-4.5)	(-10.32)	(-5.04)
World Money Supply	-4.372	-10.004	-3.798
	(-4.1)	(-12.65)	(-4.83)
Contagion and Surges			
Surges	-0.365	-0.197	-0.426
	(-0.21)	(-0.48)	(-0.23)
Contagion	0.745**	0.721	0.748**
	(-0.23)	(-0.49)	(-0.26)
Constant	-2.631***	-3.249**	-2.550***
	(-0.39)	(-1.09)	(-0.43)
Observations	*1,886*	*418*	*1,468*

Notes: The * indicate levels of significance: p<0.05, ** p<0.01,***p<0.001;

Standard errors in parentheses.

VII. Sensitivity Tests and Robustness

i. Alternative Data Sets and Additional Controls

- **Full Sample until 2009**

I include the years of the global financial crisis and perform an estimation of the baseline complimentary log log regression. Results are reported in the Appendix Table 2. The results do not change substantially and global variables such as risk and contagion remain significant. Trade openness is still positive and highly statistically significant for developing countries.

- **Alternative Definition of Dollarization**

I use the data set of Lane and Shambaugh (2010), which contains annual data until 2004. I quarterize the data using a cubic spline interpolation. The results change substantially for the sample of developing countries. In particular, only domestic factors appear to be significant. This test does not necessarily indicate an issue with the previous specifications since it itself might be more problematic. The quarterized data is no substitute for actual data even though this technique is used by Forbes and Warnock (2012). The results do not change for the developed countries and the full samples. This is not surprising since liability dollarization in the developed world traditionally has been negligible. Results are reported in Appendix Table 3.

- **Additional Controls: De Jure Capital Controls and Exchange Rate Peg**

I include controls for de jure financial openness and exchange rate peg. The reason for including a proxy for capital controls is to test whether domestic policies could decrease the probability of sudden stops. The data is from the Chinn and Ito (2006) index on de jure financial openness, updated until 2012. The data for the exchange rate peg is from Ilzetsky et al. (2010), who update the original index by Reinhart and Rogoff (2004). The exchange rate peg is included in the analysis since a pegged currency might make countries more susceptible to a stop through speculative attacks.

The results are reported in Appendix Table 4. The results do not change. The global variables remain significant across all samples as in Table 1. Trade openness remains positive and significant for the developing country sample even after controlling for de jure financial openness. This suggests that domestic policies on limiting international financial transactions do not decrease the probability of a sudden stop.

- **Additional Controls: Credit Growth and Debt**

Finally, I control for domestic credit growth and the fraction of debt liabilities in the foreign international position account. Domestic credit growth has been found as a significant predictor for a variety of crises episodes by Gourinchas and Obstfeld (2012)

and Schularick and Taylor (2012). The fraction of debt liabilities is included since it is likely that having a higher composition of debt relative to portfolio equity or FDI would increase the chance of a sudden stop. Levchenko and Mauro (2007) use the earlier definition of sudden stops based on net flows and find that debt is the most volatile form of international financing and accounts for a large share of the fall in flows during sudden stop episodes. The data on credit growth is from the IFS, and it is very poor even for the developed world. The data for total international debt is from the IFS, and it is also very scarce, especially for the developing world. The results do not change.

ii. Alternative Estimation Methodologies

The typical approach to estimating the model (19) has been a probit model. Calvo et al. (2004, 2008) use a random effects probit model with time dummy variables. Cavallo and Frankel (2008) use a probit with fixed effects and time dummy variables. Calderon and Kubota (2013) use a probit model with no fixed effects or time variables. I perform all three specifications for (19). In addition, I introduce yearly time controls to the original complementary log log estimation. The results for the original sample for all countries until 2007q4 are in Table 2.

The only domestic variable which remains significant across all specifications is domestic GDP growth. The results in table 2 suggest that global variables are very sensitive to the inclusion of time controls. In particular, in almost every specification with a time dummy, the global variables become insignificant. This suggests that the models with yearly fixed effects suffer from high multicollinearity. High multicollinearity would make the standard errors higher and hence, the t-statistics would be unreliable (Wooldridge 2009, 97). This is intuitive since the global factors by definition control for common trends for all countries across time. One way to check if multicollinearity is present is to calculate the variance inflation factors. Appendix Tables 5 and 6 show that including time controls does introduce multicollinearity. The variance inflation factors of most of the global variables become much higher than the acceptable level of 10 (Wooldridge 2009, 98).

Table 2: Alternative Estimations

	Cloglog	Cloglog_Y	Probit FE	Probit FE_Y	RE
Domestic Factors					
Domestic GDP Growth	-10.849***	-9.883***	-8.091***	-7.438***	-6.364***
	(-2.41)	(-2.14)	(-2.01)	(-1.94)	(-1.3)
Inflation	0.009	-0.001	0.021	0.018	0.007
	(-0.01)	(-0.02)	(-0.01)	(-0.01)	(-0.02)
Trade Openness	0.012	-0.062	0.922	0.509	-0.01
	(-0.18)	(-0.2)	(-0.67)	(-0.72)	(-0.1)
Liability Dollarization	0.005	0.003	-0.031	-0.021	-0.004
	(-0.06)	(-0.07)	(-0.11)	(-0.12)	(-0.05)
Reserves to Imports	0.009	-0.003	0	0.009	0.014
	(-0.06)	(-0.07)	(-0.07)	(-0.08)	(-0.04)
Global Factors					
VXO	0.032***	-0.007	0.019**	-0.005	-0.004
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Global GDP	-1.324	-30.512	-1.618	-21.066	-21.01
	(-3.3)	(-21.16)	(-2.34)	(-13.75)	(-13.15)
World Interest Rate	13.720**	31.034	12.952***	24.104	22.019
	(-4.5)	(-22.15)	(-3.77)	(-14.93)	(-18.22)
World Money Supply	-4.372	-8.732	-3.334	-5.796	-5.403
	(-4.1)	(-6.89)	(-2.84)	(-4.48)	(-4.76)
Contagion and Surges					
Surges	-0.365	-0.438	-0.235	-0.246	-0.244
	(-0.21)	(-0.23)	(-0.12)	(-0.15)	(-0.14)
Contagion	0.745**	0.402	0.509**	0.261	0.256*
	(-0.23)	(-0.23)	(-0.19)	(-0.2)	(-0.13)
Constant	-2.631***	-2.175	-1.745***	-1.39	-1.424
	(-0.39)	(-1.88)	(-0.43)	(-1.28)	(-1.49)
Observations	1,886	1,886	1,826	1,826	1,886
Country Fixed Effects	No	No	No	Yes	No
Yearly Fixed Effects	No	Yes	Yes	Yes	Yes

Notes: The * levels of significance: * p<0.05, ** p<0.01,***p<0.001;

Standard errors in parentheses

Results for developing countries and for developed ones are included in Appendix Tables 7 and 8. The only notable change in results is that for developing countries the world interest rate becomes insignificant and the world money supply becomes significant with a negative sign. The implication of this result is similar to the previous result for the world interest rate. A fall in the world's money supply is typically associated with a rise in interest rates. However, the world interest rate is influenced by other factors than the money supply; it is not controlled by central banks, especially in the long-run. Trade openness remains positive and significant. For developed countries, the results largely remain the same. The only notable change is that trade openness becomes positive and significant in some of the specifications.

iii. Robustness

There are two key issues which are common for most of the empirical literature on crises using maximum likelihood estimations. First, there is an issue with the estimation methodology itself. In particular, when using fixed effects probit, there is an incidental parameters problem (Wooldridge, 2010, 611-612). Due to the nature of the panel data and the characteristics of the probit model, the estimation of the coefficients becomes biased (Wooldridge 2010, 612). The incidental parameters problem is not resolved theoretically (Greene 2012 659). A number of authors have performed Monte Carlo simulations in attempt to estimate the bias, but there is still no general consensus as to how serious this issue is (Greene 2012, 659). Not controlling for country fixed effects, however, may lead to omitted variable bias. Cavallo and Frankel (2008) use the probit fixed effects estimation and claim that the incidental parameter problem is an asymptotic problem. An alternative estimation technique used by Calvo et al. (2004, 2008) is the random effects probit. However, it requires additional strong assumptions about the relationship between the unobserved effects and the other explanatory variables (Wooldridge 2010, 612). Finally, there is the issue of the rare occurrence of the sudden stops as discussed by Forbes and Warnock (2012). Overall, no model is an obvious choice and there are trade-offs associated with each estimation technique (Wooldridge 2010, 624).

The issues with the estimation techniques discussed above are potentially serious, but the sensitivity checks performed show that the results are consistent across different specifications of the model (19). Another serious issue which cannot be solved through choosing a different estimation technique is endogeneity. While, I lag the variables to alleviate endogeneity concerns, there is still a place for concern that a few of the

explanatory variables are endogenous especially for developing countries. First, the level of trade openness and reserves could be endogenous. In particular, a previous sudden stop might have led to an IMF program which would have caused countries to become more open. Alternatively, countries could have decided to become less open after a crisis episode. Calvo et al. (2004) suggest performing a Rivers and Vuong test by using a second lag of trade openness as an instrument of trade openness. I follow Calvo et al. (2004) and do the same test for trade openness. The results are presented in Appendix Table 9. The new variable "uhat" in the table contains the residuals obtained from an OLS regression of trade openness on its instruments. The insignificance of the residuals in the probit regression suggests that endogeneity is not an issue (Wooldridge 2010, 632). This test is not entirely convincing as it is not clear whether a second lag would be exogenous itself[8]. Theoretically, endogeneity should not be of such concern in this paper as it is in the literature which uses the previous definition of sudden stops. The new definition, which is used for this study, as discussed in Section IV is less correlated with currency, financial and other crises and is less likely to be endogenous.

Other factors that could be endogenous are the level of reserves and surges. The level of reserves has risen tremendously after the Asian financial crisis (Obsfteld et al. 2010). Reserves, however, are typically not accumulated to protect from sudden stops. They could be used for domestic crises or for currency manipulation. It is still not clear why central banks have accumulated such amounts of reserves over the last two decades (Obsfteld et al. 2010). Additional estimations are performed without the potentially endogenous variables, and the results are reported in Appendix Table 10. The results do not change.

VIII. Conclusions

This paper contributes to the overall literature on sudden stops and fills part of the gap between the new and earlier literature. It provides additional evidence for the importance of using gross flows instead of net flows when studying sudden stops. The regression analysis provides additional evidence for the hypothesis that global factors play a key role in driving sudden stops.

First, the descriptive analysis suggests that sudden stops are not a developing world phenomenon but also occur frequently in the developed world. The key finding is that in developed countries sudden stops coincide very often with episodes of

[8] An alternative instrument is a gravity model suggested by Cavallo and Frankel (2008). Since the quarterly data for trade is not as detailed as annual data, it would be a difficult task to create quarterly instruments without making strong assumptions about the behaviour of trade across time.

retrenchments during which domestic residents bring back money from abroad. As a result, a sudden stop in a developed country is much less likely to lead to a fall in the exchange rate and a loss in output. In developing countries retrenchments coincide much less frequently with sudden stops and the consequences for the real economy might be much more severe. This is a very valuable insight which no one in the literature so far has observed and discussed. It suggests that further research should focus on the determinants of such retrenchment episodes and the reasons why they occur in developed countries in conjunction with sudden stops but not in the developing world. It also illustrates the importance of disaggregating net flows into gross flows as the behaviour of domestic and foreign investors is very different in the developed and the developing world.

The regression analysis in this paper provides further evidence for the importance of global factors in sudden stops. In particular, the global interest rate, the global risk, and the global money supply appear to be key drivers in such episodes. The only consistently significant domestic factor is domestic growth. Liability dollarization, which was considered an important factor for sudden stops in the past literature, appears to be insignificant. The results also suggest that trade openness does not decrease the probability of a sudden stop ex-ante but in fact increases it especially for developing countries. Domestic capital controls and the choice of exchange rate appear to be insignificant across different specifications.

The results have significant policy implications. They suggest that the concerns which government officials from developing countries have for economic policies in the developed world are well grounded. Raghuram Rajun, the current central banker of India and a former chief economist at the IMF, recently voiced his concerns about the potential withdrawals from emerging markets after a rise in interest rates in the US and the EU and has asked for more global policy cooperation (2014). The reply from the president of the New York Federal Reserve, William Dudley has been that developing countries have accumulated large enough reserves to prevent potential crises and now have more sound macroeconomic policies (2014). However, the regression analysis in this paper suggests that domestic policies cannot prevent a sudden stop. The theory in Section I suggests that reserves in a developing country can counteract a sudden stop by in effect substituting for the retrenchments which occur in developing countries. Holding reserves and investing them abroad comes at high social cost. Rodrik (2006) estimates that this cost can be as high as 1% of GDP. This appears to be an unnecessary burden on developing economies.

New empirical and theoretical research on the causes and the effects of sudden stops is needed given the record inflows and borrowing from abroad by developing

countries after the Great Recession. Developing countries withstood the global financial crisis, but it is not clear whether they will be able to withstand a new potential wave of sudden stops in the coming years.

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Appendix

Appendix Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
stops	4370	0.176888	0.381617	0	1
surge	4367	0.160751	0.367343	0	1
st_calvo	5600	0.002321	0.04813	0	1
currcrisis	5600	0.01125	0.105477	0	1
bankcrisis	5600	0.010357	0.101251	0	1
domdef	5600	0.00125	0.035336	0	1
extdef	5600	0.001429	0.037773	0	1
reces	5684	0.071429	0.257562	0	1
tr_op	4314	0.828908	0.59692	0	4.34
gdp_g	4461	0.033076	0.044566	-0.42	0.36
cpi	5400	0.803274	9.685932	-0.06	356.81
dom_cr_g_pc	1114	0.051463	0.200654	-1	5.04
dld1	4743	0.828775	3.164689	0	59.66
dld2	4484	0.381494	0.686969	0	7.638027
ra_im	5512	1.328471	1.112499	0	8.67
contagion	5400	0.101667	0.302237	0	1
global_gdp	5800	0.029285	0.020681	-0.0327	0.0541
vxo	5796	20.50711	8.996621	0	53.8633
world_r	5800	0.056653	0.019652	0.0286	0.097
world_m	5800	0.075882	0.025939	0.0172	0.1218

Developing Countries	Developed Countries
Argentina, Bangladesh, Bolivia,	Australia, Austria, Belgium, Canada,
Brazil, Chile, Colombia,	Czech Republic, Denmark, Estonia,
Croatia, Guatemala, Hungary,	Finland, France, Germany,
India, Indonesia, Latvia,	Greece, Hong Kong, Iceland,
Lithuania, Malaysia, Mexico,	Ireland, Israel, Italy,
Nicaragua, Panama, Peru,	Japan, Korea, Netherlands,
Philippines, Poland, Romania,	New Zealand, Norway, Portugal,
Russia, South Africa, Sri Lanka,	Singapore, Slovak Rep, Slovenia,
Thailand, Turkey, Venezuela	Spain, Sweden, Switzerland,
	Taiwan, UK, US

Appendix Table 2: Full Sample 2009 Baseline Specification

	Full Sample	Developing	Developed
Domestic Factors			
Domestic GDP Growth	-11.015***	-9.423*	-13.851***
	(-2.05)	(-3.6)	(-2.2)
Inflation	0.021**	0.008	1.562
	(-0.01)	(-0.01)	(-1.17)
Trade Openness	0.177*	0.918***	0.113*
	(-0.08)	(-1.12)	(-0.06)
Liability Dollarization	-0.028	-0.116	-0.027
	(-0.05)	(-0.09)	(-0.06)
Reserves to Imports	0.039	0.159*	0.011
	(-0.03)	(-0.21)	(-0.04)
Global Factors			
VXO	0.043***	0.029*	0.048***
	(-0.01)	(-0.01)	(-0.01)
Global GDP	-3.087	-8.393	-0.22
	(-3.22)	(-3.56)	(-3.92)
Wolrd Interest Rate	4.814	13.983	3.807
	(-4)	(-8.07)	(-4.38)
World Money Supply	4.703	3.562	3.909
	(-3.63)	(-4.36)	(-4.25)
Contagion and Surges			
Surges	-0.291	-0.12	-0.348
	(-0.19)	(-0.26)	(-0.23)
Contagion	0.665***	0.899*	0.536**
	(-0.18)	(-0.35)	(-0.19)
constant	-2.981***	-3.550***	-2.938***
	(-0.32)	(-0.84)	(-0.35)
Observations	2,113	474	1,639

Appendix Table 3: Alternative Liability Dollarization Baseline Specification			
	Full Sample	**Developing**	**Developed**
Domestic Factors			
Domestic GDP Growth	-10.432***	-10.877***	-11.020***
	(-1.83)	(-2.47)	(-3.04)
Inflation	0.531	0.687	0.894
	(-0.34)	(-0.43)	(-0.87)
Trade Openness	-0.108	0.315	-0.184
	(-0.17)	(-0.44)	(-0.17)
Alternative LDL	0.082	-0.498	0.043
	(-0.08)	(-1.19)	(-0.08)
Reserves to Imports	-0.025	0.012	0.029
	(-0.07)	(-0.16)	(-0.07)
Global Factors			
VXO	0.025*	0.002	0.035***
	(-0.01)	(-0.03)	(-0.01)
Global GDP	-2.659	-5.389	-1.372
	(-3.56)	(-7.94)	(-4.22)
World Interest Rate	14.108**	14.614	12.283*
	(-3.57)	(-8.78)	(-5.23)
World Money Supply	0.148	13.738	-3.514
	(-4.21)	(-9.11)	(-4.77)
Contagion and Surges			
Surges	-0.325	-0.136	-0.422
	(-0.21)	(-0.44)	(-0.23)
Contagion	0.762**	0.671	0.755**
	(-0.23)	(-0.49)	(-0.26)
constant	-2.777***	-3.490***	-2.584***
	(-0.41)	(-1)	(-0.46)
Observations	1,975	507	1,468

Notes: The * indicate different levels of significance, in particular * p<0.05, ** p<0.01,***p<0.001;

Standard Errors Reported in Parentheses

Appendix Table 4: Peg and Financial Openness Baseline Specification

	Full Sample	Developing	Developed
Domestic Factors			
Domestic GDP Growth	-11.243***	-12.681**	-11.680***
	(-2.47)	(-4.89)	(-3.04)
Inflation	0.007	0.008	0.749
	(-0.01)	(-0.03)	(-1.84)
Trade Openness	0.093	0.794*	-0.058
	(-0.21)	(-0.36)	(-0.23)
Liability Dollarization	-0.024	0.035	-0.01
	(-0.07)	(-0.23)	(-0.1)
Reserves to Imports	0.001	0.03	-0.004
	(-0.06)	(-0.14)	(-0.06)
Global Factors			
VXO	0.031***	0.007	0.035***
	(-0.01)	(-0.02)	(-0.01)
Global GDP	-1.838	-3.322	-1.67
	(-3.44)	(-5.8)	(-4.44)
World Interest Rate	13.686**	0	11.443*
	(-4.73)	((.))	(-5.41)
World Money Supply	-3.541	-7.057	-3.011
	(-4.16)	(-14.09)	(-4.94)
Contagion and Surges			
Surges	-0.31	-0.193	-0.351
	(-0.21)	(-0.47)	(-0.23)
Contagion	0.761**	0.654	0.777**
	(-0.23)	(-0.42)	(-0.27)
Capital Openness	0.033	-0.313	-0.107
	-0.21	(-0.41)	(-0.33)
Peg	0.095	-0.006	0.126
	-0.06	-0.19	-0.07
Constant	-1.549405	-1.549	-2.792***
	0.834568	-0.83	-0.72
Observations	1,794	418	1,376

Notes: The * indicate different levels of significance, in particular * p<0.05, ** p<0.01,***p<0.001;

Standard Errors Reported in Parentheses

Appendix Table 5: No Yearly Fixed Effects

No Yearly Fixed Effects

Variable	VIF	R-VIF	Tolerance	Squared
l_gdp_g	1.16	1.08	0.8648	0.1352
l_cpi	1.06	1.03	0.9411	0.0589
l_tr_op	1.12	1.06	0.8934	0.1066
l_dld1	1.08	1.04	0.9257	0.0743
l_ra_im	1.09	1.05	0.9140	0.0860
l_sur	1.02	1.01	0.9768	0.0232
l_vxo	1.23	1.11	0.8099	0.1901
l_global_gdp	1.39	1.18	0.7206	0.2794
l_contagion	1.03	1.02	0.9700	0.0300
l_world_m	1.54	1.24	0.6486	0.3514
l_world_r	1.25	1.12	0.8029	0.1971

Mean VIF 1.18

Appendix Table 6: Yearly Fixed Effects

Collinearity Diagnostics

Variable	VIF	VIF	Tolerance	R-Squared
l_gdp_g	1.23	1.11	0.8143	0.1857
l_cpi	1.08	1.04	0.9254	0.0746
l_tr_op	1.13	1.06	0.8862	0.1138
l_dld1	1.09	1.04	0.9192	0.0808
l_ra_im	1.10	1.05	0.9088	0.0912
l_sur	1.05	1.02	0.9549	0.0451
l_vxo	4.49	2.12	0.2229	0.7771
l_global_gdp	50.33	7.09	0.0199	0.9801
l_contagion	1.11	1.05	0.9024	0.0976
l_world_m	8.37	2.89	0.1195	0.8805
l_world_r	62.64	7.91	0.0160	0.9840

Mean VIF 3.17e+12 Yearly Controls Not Reported

Appendix Table 7 Developing Alternative Estimations 07

	Cloglog	Cloglog Year	Probit FE	Probit FE Y	Probit RE Y
Domestic Factors					
Domestic GDP Growth	-11.841*	-11.085*	-7.510*	-7.076	-7.247**
	(-4.82)	(-5.24)	(-3.71)	(-3.64)	(-2.24)
Inflation	-0.001	-0.054	0.004	-0.083	-0.042
	(-0.03)	(-0.07)	(-0.02)	(-0.05)	(-0.03)
Trade Openness	1.068***	1.104***	0.481	3.294*	0.795*
	(-0.27)	(-0.33)	(-1.42)	(-1.52)	(-0.31)
Liability Dollarization	0.032	0.081	0.179	0.302	0.139
	(-0.17)	(-0.35)	(-0.13)	(-0.21)	(-0.15)
Reserves to Imports	0.1	0.242	-0.055	0.545	0.189
	(-0.15)	(-0.22)	(-0.29)	(-0.46)	(-0.11)
Global Factors					
VXO	0.02	0.054*	0.008	0.046*	0.032
	(-0.02)	(-0.03)	(-0.01)	(-0.02)	(-0.03)
Global GDP	-2.641	12.075	0.967	36.947	12.87
	(-4.87)	(-46.71)	(-3.19)	(-32.01)	(-35.96)
World Interest Rate	22.493*	-31.366	12.071	-26.878	-21.338
	(-10.32)	(-66.18)	(-6.48)	(-48.84)	(-41.17)
World Money Supply	-10.004	-40.872**	-8.29	-35.033**	-28.540*
	(-12.65)	(-14.51)	(-7.9)	(-10.88)	(-11.39)
Contagion and Surges					
Surges	-0.197	-0.251	-0.261	-0.45	-0.267
	(-0.48)	(-0.4)	(-0.26)	(-0.23)	(-0.38)
Contagion	0.721	0.777	0.461	0.83	0.547
	(-0.49)	(-0.49)	(-0.43)	(-0.43)	(-0.34)
constant	-3.249**	3.331	-1.126	0.799	2.31
	(-1.09)	(-6.85)	(-1.18)	(-4.57)	(-3.29)
Observations	418	326	400	311	418
Country Fixed Effects	No	No	Yes	Yes	No
Yearly Fixed Effects	No	Yes	No	Yes	Yes

Notes: The * indicate different levels of significance, in particular * p<0.05, ** p<0.01,***p<0.001;

Standard Errors Reported in Parentheses

	Appendix Table 8 Developed Alternative Estimations 07				
	Cloglog	**Cloglog Year**	**Probit FE**	**Probit FE Y**	**Probit RE Y**
Domestic Factors					
Domestic GDP Growth	-11.070***	-10.899***	-10.955***	-8.818***	-7.642***
	(-3.11)	(-1.96)	(-2.07)	(-2.35)	(-1.59)
Inflation	0.746	1.648	1.119	0.934	1.217
	(-1.52)	(-1.38)	(-1.08)	(-1.34)	(-0.89)
Trade Openness	-0.171	-0.041	1.824***	0.405	-0.033
	(-0.17)	(-0.07)	(-0.53)	(-0.68)	(-0.08)
Liability Dollarization	0.016	-0.018	-0.180*	-0.123	-0.018
	(-0.09)	(-0.07)	(-0.08)	(-0.07)	(-0.05)
Reserves to Imports	0.021	0.033	-0.028	-0.001	0.031
	(-0.06)	(-0.04)	(-0.06)	(-0.06)	(-0.04)
Global Factors					
VXO	0.036**	0.023*	0.033***	0.024***	0.022*
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Global GDP	-1.309	-58.833***	-2.217	-49.025***	-47.832***
	(-4.21)	(-13.36)	(-3.05)	(-10.47)	(-11.27)
World Interest Rate	12.093*	67.566***	10.211**	54.384***	52.042**
	(-5.04)	(-19.6)	(-3.49)	(-12.63)	(-19.72)
World Money Supply	-3.798	13.585*	0.665	9.103*	8.798
	(-4.83)	(-5.77)	(-2.95)	(-4.17)	(-4.95)
Contagion and Surges					
Surges	-0.426	-0.339	-0.19	-0.165	-0.19
	(-0.23)	(-0.27)	(-0.13)	(-0.17)	(-0.16)
Contagion	0.748**	0.053	0.351	0.043	0.075
	(-0.26)	(-0.24)	(-0.18)	(-0.21)	(-0.13)
constant	-2.550***	-7.601***	-2.334***	-5.063***	-5.116**
	(-0.43)	(-1.55)	(-0.35)	(-1.02)	(-1.68)
Observations	*1,468*	1,563	1,639	1,563	1,639
Country Fixed Effects	No	No	Yes	Yes	No
Yearly Fixed Effects	No	Yes	No	Yes	Yes

Appendix Table 9: Rivers and Vuong

	Rivers and Vuong	Rivers and Vuong Bootsraped
U_hat	**0.025**	**0.025**
	(-1.25)	(-1.13)
Domestic Factors		
Domestic GDP Growth	-5.644***	-5.644**
	(-1.59)	(-1.82)
Inflation	0.003	0.003
	(-0.03)	(-0.31)
Trade Openness	-0.036	-0.036
	(-0.12)	(-0.17)
Liability Dollarization	-0.002	-0.002
	(-0.06)	(-0.07)
Reserves to Imports	0.006	0.006
	(-0.05)	(-0.04)
Global Factors		
VXO	-0.001	-0.001
	(-0.02)	(-0.01)
Global GDP	-8.011	-8.011
	(-26.85)	(-27)
World Interest Rate	0	0
	(0)	(0)
World Money Supply	-8.885	-8.885
	(-7.28)	(-5.4)
Contagion and Surges		
Surges	-0.117	-0.117
	(-0.17)	(-0.16)
Contagion	0.222	0.222
	(-0.16)	(-0.19)
Constant	-0.126	-0.126
	-1.26	-1.31
Observations	1,262	1,262

Notes: The * indicate different levels of significance, in particular * p<0.05, ** p<0.01,***p<0.001;
Standard Errors Reported in Parentheses

Appendix Table 10 Baseline Estimation Full Sample 07

	1	2	3	4	5
Domestic GDP Growth	-8.630***	-8.671***	-8.573***	-11.535***	-10.849***
	(-1.84)	(-2.28)	(-2.41)	(-2.48)	(-2.41)
Inflation	0.001	0.004	0.003	0.008	0.009
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)
VXO	0.023*	0.027**	0.026*	0.029**	0.032***
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Global GDP	-2.329	-0.879	-1.082	-1.287	-1.324
	(-3.56)	(-3.43)	(-3.37)	(-3.32)	(-3.3)
Contagion	0.770***	0.761**	0.791***	0.752***	0.745**
	(-0.23)	(-0.24)	(-0.24)	(-0.23)	(-0.23)
World Money Supply	-1.958	-4.641	-4.149	-4.006	-4.372
	(-4.26)	(-4.2)	(-4.24)	(-4.29)	(-4.1)
World Interest Rate	12.933**	13.734**	14.060**	13.871**	13.720**
	(-4.31)	(-4.34)	(-4.42)	(-4.45)	(-4.5)
Liability Dollarization		-0.014	-0.007	-0.018	0.005
		(-0.04)	(-0.04)	(-0.05)	(-0.06)
Trade Openness			-0.027	0.007	0.012
			(-0.17)	(-0.18)	(-0.18)
Reserves to Imports				0.014	0.009
				(-0.06)	(-0.06)
Surges					-0.365
					(-0.21)
constant	-2.640***	-2.588***	-2.593***	-2.616***	-2.631***
	(-0.32)	(-0.35)	(-0.35)	(-0.38)	(-0.39)
Observations	2,313	2,007	1,959	1,934	1,886

Notes: The * indicate different levels of significance, in particular * p<0.05, ** p<0.01,***p<0.001;
Standard Errors Reported in Parentheses