Trade Openness Effect in Sudden Stops*

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Abstract

Using data for 53 developed and emerging economies from 1970 to 2006, this article investigates empirically the impact of trade openness on the real exchange rate devaluations that result from a large and unexpected fall in capital inflows.

1 Introduction

The abrupt interruption of capital inflows and its impact on the economy have been intensively debated since the Mexican crisis in 1994, and, later, the Asian crises, in 1997. This phenomenon is named sudden stop and it was first coined by Dornbusch, Goldfajn and Valdés (1995). Commonly, sudden stops are coped initially with losses of international reserves, followed by a reversion of the current account's net result.

Initially, governments try to accommodate the impact of sudden stops in the balance of payments by spending international reserves, but this strategy fails to succeed since the episode, in most cases, persists for a longer period than the one in which current account deficits can be financed by the total stock of international reserves. The balance of payments deficit is, then, eliminated by a reversal of the current account's net result, specifically by a reversal of the trade balance's net result; since we do not consider the hypothesis of default of existing obligations and liabilities. The growth mechanism of the trade balance, in most cases, is related to a real devaluation of the domestic currency.

It remains necessary to understand why does a real devaluation in the domestic currency happen? The answer brings us back to the famous debate between John Maynard Keynes and Bertil Ohlin over the payment of war debts in Germany during the 20's, which became widely known as the "Transfer Problem".

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Keynes argued that, in order to pay for the war damages in foreign currency, Germany would have to raise the resources through surpluses in the trade balance. Hence, tradable goods' prices would have to fall; that is, the terms of trade would have to deteriorate and the deustche mark would have to devalue. Ohlin disagreed with this argument by considering the benefits related to the trade balance surplus. The reparation payments to the Allies would reduce the purchasing power of the Germans, reducing their expenditure in both domestic and imported goods. Besides, domestic goods that were not sold in Germany could be exported. Demand of non-tradable goods would also be reduced and, as a consequence, non-tradable goods' prices would fall as well (real currency devaluation). Then, the resources allocated to their production would migrate to the production of exported goods and to the substitution of imported goods. On the other hand, the beneficiaries countries' purchasing power would increase, raising imports and the consumption of exportable and non-tradable goods. Therefore, the production of tradable goods would fall while the production of non-tradable goods would rise.

Ohlin's argument was qualitatively similar to Keynes' with respect to the behavior of the real exchange rate; that is, it would appreciate in the countries that receive capital and it would depreciate in those countries that transfer capital. However, according to Ohlin, the magnitude of the currency devaluation would depend on the local expenditure adjustment. Nevertheless, the terms of trade behavior did not necessarily coincide in the two arguments. Keynes believed that the deterioration of the terms of trade would be unavoidable while Ohlin conditioned their behavior to the expenditure adjustment that would occur in the two set of countries - the debtors and creditors of capital.

Economies that suffer sudden stops are often receivers of foreign capital and, thus, present an overvalued exchange rate. At the moment of capital inflow contraction, these economies start to behave as those which transfer capital and, in such a new situation, they must generate a trade balance surplus within the dynamics offered by Ohlin, implying a real devaluation of the exchange rate.

The power of the economy to generate the necessary trade balance surplus as to reach equilibrium in the balance of payments without incurring in large real exchange rate devaluations determines the extension of the social losses resulted from the abrupt liquidity restrictions related to sudden stops. In fact, the magnitude of the currency devaluation may be inflated or mitigated by factors that cannot be controlled by local actions (exogenous factors) as economic growth and/or more world trade openness. Yet, the ability to generate trade balance surpluses without incurring in large currency devaluations is a feature that can be developed by public policies independently of international conjectures. This is the reason why we consider important to investigate which institutional framework guarantees the development of this ability in an economy.

The greater is the intensity of the trade balance response to the real exchange rate devaluation, the least necessary is the need for large devaluations in order to reach an equilibrium in the balance of payments. Currency devaluations are particularly harmful to the economies which present the "original sin" as defined by Eichengreen et all (2003). The "original sin" is the lack of capacity to issue debt denominated in local currency, a characteristic that distinguishes emerging and developed economies. Economies that commit this sin suffer sudden stops more frequently[1] while the severity of the related damages are greater since the associated currency devaluation raises the cost of the foreign exchange rate denominated debt. Indeed, it constitutes another reason why we consider important the relationship between the behavior of the trade balance and the currency devaluation.

In this article, we verify that the weight of international trade in the economy is the variable that determines the capacity to generate large trade balance surpluses without incurring in a significant devaluation of the domestic currency. The empirical evidence found in this article shows that, in economies with a greater international trade flow, the growth response of the trade balance surplus for a given currency devaluation tends to be larger. In general terms, the reason behind this behavior is that the real exchange rate devaluation has a greater impact in the trade balance in absolute terms for a larger total volume of exports and imports. For example, suppose that a 1% devaluation in the currency leads to a 1% increase of total exports and a 1% reduction of total imports in an emerging economy. In this respect, the trade balance surplus is proportional to the total volume of exports and imports of an economy before the devaluation.

In the example above, we consider that a real devaluation in the domestic currency has a symmetric effect in exports (+1%) and imports (-1%). However, the results of the empirical analysis carried out in Terra and Vasconcelos (2005) shows an asymmetrical effect, that is, exports are more sensitive than imports to real exchange rate devaluations.

This article is organized as follows: in section 2, we show a description of a relationship between the degree of trade openness and power of real exchange rate devaluations on achieving trade balance surplus; in section 3 and 4, we construct an empirical test for the model and analyze the results. Finally, in section 5, we present our conclusion with respect to the importance of trade openness in countries subject to sudden stops shocks.

2 Trade Openness Effect

In this section we present a simple rationale that explains the greater ability of more open economies to generate large trade balance surpluses without incurring in a significant devaluation of the domestic currency.

Consider the trade balance as a function of the real exchange rate

$$TB(q) = P_X(q)X(q) - P_M(q)M(q),$$

where X and M are the exports and imports, respectively, and P_X and P_M are their respective price indexes.

We can rewrite this relation in terms of semi-elasticities and elasticities

[1] Calvo et ali (2004) find empirical evidence that support the idea that less trade openness and greater domestic debt dollarization determine the increase in the probability of occurrence of a sudden stop.

$$\frac{\partial TB(q)/Y}{\partial q/q} = \frac{P_X(q)X(q)}{Y}\left\{\frac{\partial\left[P_X(q)X(q)\right]/\left[P_X(q)X(q)\right]}{\partial q/q}\right\} - \frac{P_M(q)M(q)}{Y}\left\{\frac{\partial\left[P_M(q)M(q)\right]/\left[P_M(q)M(q)\right]}{\partial q/q}\right\}$$

or equivalently

$$\epsilon_{TB/Y,q} = \eta_X \epsilon_{P_X X,q} - \eta_M \epsilon_{P_M M,q},$$

where $\epsilon_{TB/Y,q}$ is the change of the shares of balance trade with respect to GDP in response to percentage changes in the real exchange rate, while $\epsilon_{P_X X,q}$ and $\epsilon_{P_M M,q}$ are the percentage changes of exports income and imports expenditure in response to percentage changes in the real exchange rate, respectively. As we know, $\epsilon_{TB/Y,q}$, $\epsilon_{P_X X,q} > 0$ and $\epsilon_{P_M M,q} < 0$. η_X and η_M are the shares of exports income and imports expenditure with respect to GDP.

Now, for the sake of comparison, consider two countries i and j that share the same economic features except for the level of trade openness, i.e., they share the same $\epsilon_{P_X X,q}$ and $\epsilon_{P_M M,q}$, but the country i differ from j about their shares of exports income and imports expenditure with respect to GDP. Consequently, the more open country i will have greater η_X and η_M than the closer country j. It's clear that $\epsilon^i_{TB/Y,q} > \epsilon^j_{TB/Y,q}$ and this effect is a direct consequence from the greater volume of trade experienced in the more open economy. We denote this phenomenon as "*openness effect*" and it is caused by both export and import volumes as showed below:

$$\frac{\partial \epsilon_{TB/Y,q}}{\partial \eta_X} = \epsilon_{P_X X,q} > 0$$

and

$$\frac{\partial \epsilon_{TB/Y,q}}{\partial \eta_M} = -\epsilon_{P_M M,q} > 0.$$

3 Data Description

We use quarterly data for 53 countries from 1970 to 2006 extracted from the IFS-IMF database. Not all countries have data available for all periods, hence we may have not been able to identify all the sudden stop episodes which effectively occurred over the period. Moreover, the lack of monthly data reduces the accuracy of the identification of the start and the end of each sudden stop episode.

Next we present the variables that are used in empirical tests of the openness effect.

As a proxy for capital flow, we use the difference between the current account and the international reserves variation. We do not use directly the capital flow data because, for most countries, it is presented only on an annual basis, which does not allow the identification of sudden stops that were initiated and finished in the same calendar year.

The real exchange rate series are bilateral rates, using the CPI indexes for the US and each domestic economy. The trade volume is the sum of exports and imports as a fraction of the size of the economy, proxied by the GDP.

As discussed in the introduction, the extent of financial dollarization affects the costs of an exchange rate depreciation. Therefore, in economies presenting large currency mismatches, the government may resist exchange rate devaluation by implementing policies such as selling international reserves or increasing the domestic interest rates. As a measure of debt dollarization, we use the currency mismatch in the government's balance sheet. It is calculated as the ratio between net liability of the monetary authority denominated in the foreign currency and the amount of (fiat) money in circulation[2].

It is clear that the intensity of the liquidity shock caused by the sudden stop is also crucial for explaining the magnitude of the variation of real exchange rate. Hence, we create a variable to measure the intensity of the shock, given by the annual capital flow variation as a share of the GDP[3].

We add annual growth of world exports as another exogenous variable in our model. This variable captures the trading conjuncture at the moment of the occurrence of sudden stop episodes. We believe that in a context of higher growth of world exports, the growth of exports respond with more intensity to exchange rate devaluations and, therefore, there is a lower need for large currency devaluations during sudden stop episodes.

Finally, the yearly variation of the terms of trade is also added as another explaining variable for the real exchange rate depreciation. As already mentioned in the introduction, the terms of trade affect the dynamics of the sudden stop, and their variation should have a strong influence on the trade balance.

The interest rate variation would be another important variable that we should use as a control when assessing the openness effect, but when the exchange rate regime is fixed, the monetary policy becomes a hostage of the exchange rate behavior. Then it would serve as a control only when sudden stops occur during floating exchange rate regimes. However, using the *de facto* classification of exchange rate regimes of Levi-YeYati and Sturzenegger (2002), we find that the number of episodes identified under this regime is very low and not enough to allow reasonable tests.

Identifying Sudden Stops Our criteria to identify sudden stop episodes is based on that of Calvo et al. (2004), but adapted to our quarterly data. A sudden stop episode happens when there is at least one quarter in which the capital flow change[4] is at least two standard deviations lower than the

[2] Alesina e Wagner (2003) used the same ratio to measure the debt dollarization level.

[3] Yearly changes are used to avoid seasonal effects.

[4] A negative variation means that a country transfers more or receives less capital than before.

average change[5], or when there are at least two consecutive quarters in which the capital flow change is at least one standard deviation below its average. We do not require persistence for a drop of capital flows greater than two standard deviations because we would risk missing the identification of sudden stops that lasted for less than six months. On the other hand, we do not allow two episodes separated by only one quarter, so that in such situation we consider them both as only one by merging them.

Differently from Calvo et al. (2004), we do not require a GDP contraction to characterize a sudden stop event, since we also want to capture episodes of capital flow contraction in economies that were able to adjust to the shock less costly. In particular, we are interested in investigating whether more open economies are better tailored to promote larger increases in trade balance with relatively lower exchange rate devaluation. As large unexpected swings in the real exchange rate are a source of cost for the economy, more open economies could cope less costly with sudden stops.

It is true that, by not excluding events that did not present a GDP contraction, we risk capturing large changes in capital flows due to positive shocks, such as a positive shock of terms of trade. We have to keep that in mind when interpreting our results.

Using our procedure, we identify 215 sudden stop episodes: 100 of them occurred in OECD countries and 115 in emerging economies. Note, though, that data is not available for the 70's and 80's for the majority of the emerging economies. Restricting to the period between 1990 and 2006, there were 48 episodes in developed economies and 84 in emerging ones. Hence, sudden stops seem to be a much more commonly emerging markets phenomenon.

In Figure 1 we observe that a significant number of episodes in the OECD countries occurred during the European Monetary System crises (1990 and 1992) and the Asian crisis (1998), while, in emerging economies, the episodes are concentrated around the Mexican crisis (1994 to 1995), Asian and the Russian crises (1998), Argentinean crisis (2001), and 2003 to 2004. The bunching of crises seems to indicate that the incidence of the episode within a subgroup (developed or emerging) has contagion effect features. Nevertheless, Calvo et al. (2006) find that more closed economies or those with a higher degree of dollar denominated debt have a higher probability of experiencing a sudden stop episode.

[5] Both the average and the standart deviations are calculated in a three year window preceding the current quarter.

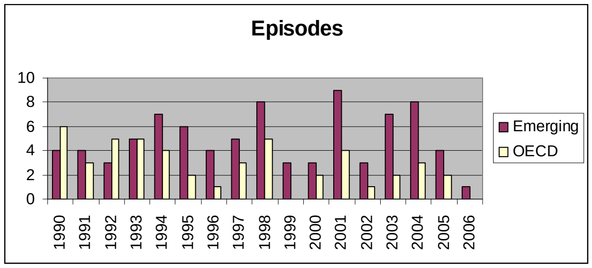

Figure 1

4 Empirical Tests

Once we have identified the episodes, we proceed with two empirical tests for identification of the openness effect. The first one uses cross-section data, while the second uses time-series-cross-section (TSCS) data. We use these both tests because they complement each other with respect to the advantages and drawbacks of their specifications. While the first has trouble with endogeneity issues, the second treats this problem using instruments in order to mitigate the problem. On the other hand, the specification of the second is very much impacted by the lack of accuracy of the identification algorithm with respect to the exact moment of the episode, while the specification of the first test is not much sensitive to this problem.

The both tests confirm very soundly the existence of the openness effect. The first test finds clear evidence that higher share of debt denominated in foreign currencies motivates governments to procrastinate a definite solution to the crisis, while the second test indicates that behavior with less confidence. In the both tests, we have weak evidences that the openness effect is stronger in emerging countries.

4.1 Cross-Section Analysis

In order to identify the relationship between the openness effect and the real exchange rate variation, while avoiding endogeneity problems among the two variables, we build a window called pre-episode. This window comprises the three years before the year which the sudden stop occurred. We also build an episode window that comprises the years in which the sudden stop occurs and the subsequent year. From the episode window, we extract the dependent variable, **real exchange rate variation**, and two explicative variables, **world exports variation** and **terms of trade variation**, calculated as the averages of the annual percentage variation of the real exchange rate, of the world exports, and of the terms of trade, respectively. From the pre-episode window, we extract the **trade openness** and **dollarization**, calculated respectively as the averages of trade openness index and dollarization index. Since the data used to calculate trade openness and dollarization are lagged to the data used to calculate real exchange rate variation, then there is no endogeneity problem between these variables. With respect to world exports variation, there are also no endogeneity problems since this variable belongs to a global context that is not significantly affected by the episode. On the contrary, terms of trade variation is subject to endogeneity issues, which we consider a serious drawback of this specification.

Figure 1 and 2 show the pre-episode and episode windows for the cases in which the episode begins and ends in the same year and for the cases in which it begins and ends in different years.

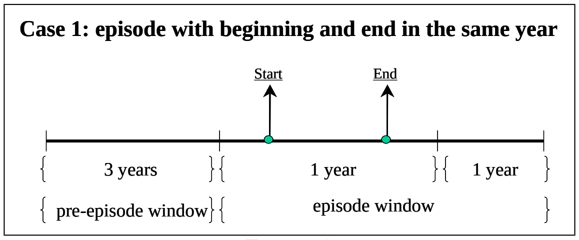

Figure 2

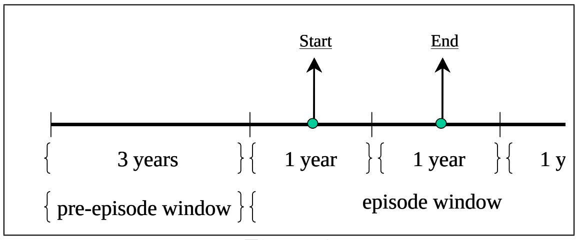

Figure 3

The reason for the existence of an one-year period after the year the sudden stop episode ends is to capture any late variation of the real exchange rate that occurs in those cases which governments initially attempt to equilibrate the balance of payments using international reserves in order to avoid the costs associated with currency devaluations. Even though this strategy is applied in most cases, it uses to fail because sudden stop episodes normally have a higher persistence exactly in those cases where the currency takes a longer time to devalue. Besides, the end of the episode usually coincides with the currency devaluation[6]. In Figure 3, we show that some episodes confirm these stylized facts.

[6] This fact is more appropriate to emerging economies, but it is also valid for developed countries.

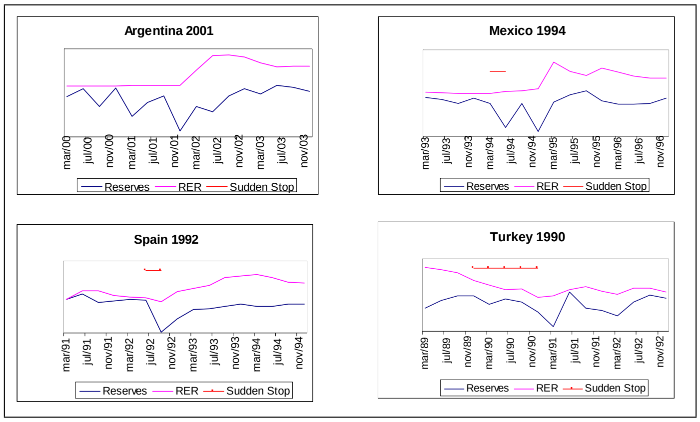

Figure 4

4.1.1 Results

Since we use a cross-section where the observations occur in distinct periods, we cannot assume that the observations are identically distributed. Then, we calculate dispersion measures using the White methodology and, thus, we present confidence measures (p-values) for the coefficients estimation that are robust to the presence of heteroskesdacity.

In table 1 we find empirical evidence that openness effect is present in sudden stop episodes. The coefficient of openness is negative and significant around 1% level of confidence in all regressions. As expected the coefficients of terms of trade shocks, the level of dollarization of debt, and the level of world openness are all negative and statistically significant in all regressions. It indicates that, when there is more trade in the world and/or a country experiences positive shocks in its terms of trade, it needs a lower currency devaluation to generate the necessary trade balance surplus as to reach equilibrium in the balance of payments. The negative coefficient of the level of debt dollarization indicates that countries which have higher share of their debt denominated in foreign currencies, refrain more to devaluate their currencies during these crises.

Table 1. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	(1)	(2)	(3)	(4)
constant	0.0246 **	0.0173	0.0395 ***	0.0747 ***
	(0.0500)	(0.1779)	(0.0044)	(0.0002)
openness	-0.0985 ***	-0.0873 **	-0.1178 ***	- 0.1187 ***
	(0.0039)	(0.0176)	(0.0021)	(0.0015)
sudden stop intensity	0.1298	0.1567	0.1480	0.1933 *
	(0.1994)	(0.1483)	(0.2017)	(0.0934)
terms of trade variation	—–	-0.2501 *	-0.5485 ***	-0.5243 ***
		(0.0846)	(0.0010)	(0.0014)
dollarization	—–	—–	-0.0318 ***	-0.0283 ***
			(0.0009)	(0.0026)
world export variation	—–	—–	—–	-1.5365 **
				(0.0159)
Observations	179	136	115	115
Adjusted R^2	0.0375	0.0444	0.1561	0.1928
F statistics	4.4710	3.0902	6.2719	6.4452

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Table 2 presents a weak evidence that openness effect is stronger in emerging countries than in OECD ones. Despite the fact that the coefficient of interaction between the dummy d_emerging with openness is negative in all regressions, it is not very significant. In the regressions (3) and (4), those which the fit is reasonable, the level of confidence of this coefficient is between 10% and 13%.

Table 2. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	(1)	(2)	(3)	(4)
constant	0.0056	0.0057	0.0164	0.0532 **
	(0.6819)	(0.6691)	(0.2481)	(0.0153)
d_emerging	0.0333	0.0237	0.0541	0.0600 *
	(0.1895)	(0.4576)	(0.1344)	(0.0992)
openness	-0.0528	-0.0604	-0.0719 *	-0.0738 *
	(0.1638)	(0.1216)	(0.0793)	(0.0772)
d_emerging * openness	-0.0799	-0.0740	-0.1175	-0.1062
	(0.1127)	(0.2696)	(0.1061)	(0.1246)
Sudden Stop Intensity	0.1376	0.1869 **	0.1920 *	0.2174 **
	(0.1120)	(0.0410)	(0.0704)	(0.0371)
Terms of Trade Variation		-0.2664	-0.5847 ***	-0.5432 ***
		(0.1364)	(0.0000)	(0.0000)
Dollarization			-0.0391 ***	-0.0365 ***
			(0.0000)	(0.0000)
World Export Variation				-1.6663 **
				(0.0319)
Observations	179	136	115	115
Adjusted R^2	0.0385	0.0411	0.1727	0.2149
F statistics	2.7824	2.1567	4.9660	5.4583

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

4.2 Time-Series-Cross-Section Analysis

We run a two-stage least squares (TSLS) regression in a time-series-cross-section (TSCS) data controlling for fixed effects on both time and cross section dimensions. Yearly real exchange rate logarithmic variation is the dependent variable whereas the explanatory variables are the share of trade volume on gdp denoted by openness, sudden stop intensity, debt dollarization and yearly terms of trade logarithmic variation. The basic specifications is

$$\begin{aligned}\Delta_{t,t-4}\log(\text{rer})= \quad & \alpha + \delta_0\ d\_episode + \gamma_0\ d\_sudden\_stop + \\ & \beta_0\ \log\left(openness_{t-4}\right) + \beta_1\ d\_episode\ \log\left(openness_{t-4}\right) + \\ & \lambda_0\ \log\left(intensity_t\right) + \lambda_1\ d\_sudden\_stop\ \log\left(intensity_t\right) + \\ & \theta_0\ \log\left(dollarization_t\right) + \\ & \theta_1\ d\_sudden\_stop\ \log\left(dollarization_t\right) + \\ & \pi_0\ \Delta_{t,t-4}\log\left(terms\_of\_trade\right) + \\ & \pi_1\ d\_episode\ \Delta_{t,t-4}\log\left(terms\_of\_trade\right) + \varepsilon_t.\end{aligned} \tag{1}$$

The openness is lagged one year in order to avoid endogeneity problems with the real exchange rate variation. The dummy variable d_sudden_stop is valued one on the quarters when a sudden stop happened while *d_ episode* is valued one on a window that comprises the quarters where *d_ sudden_ stop* is valued one and a number of subsequent quarters (2, 4 or 6 depending on the specification). The existence of *d_ episode* is meant to capture any late real exchange rate changes that occur when governments initially attempt to avoid the real exchange rate devaluation by using international reserves to equilibrate the balance of payments.

Notice in the regressions specification that the trade volume share with respect to gdp and terms of trade shocks are interacted with *d_ episode* while *sudden stop intensity* and *dollarization* are interacted with *d_ sudden_ stop*. Intensity of the yearly variation of capital flows is a defining property of the crisis, so we cannot analyze its effect on real exchange rate devaluation out of the period of crisis without hurting the crisis' concept. The financial dollarization is a variable that motivates governments to delay and/or mitigate at a first moment the real exchange rate devaluation, so its effects are better estimated on the period of crisis.

Finally, we control all the effects for terms of trade shocks. Terms of trade shocks variation may be subject to endogeneity issues, so we use such variable one-quarter lagged as instrument in a two-stage least square regression in order to mitigate such problem.

4.2.1 Results

We run a TSLS regression in a time-series-cross-section (TSCS) data. We expurgate from our estimates the fixed effects on both time and cross section dimensions in order to take into account not only countries' idiosyncrasies but also the world context for each period which is common to all countries[7]. Since we use a time-series-cross-section (TSCS), where the episodes occur in distinct periods for distinct countries, we cannot assume that the observations are identically distributed in any of both dimensions. Hence, heteroskedastic robust confidence intervals are computed using the Panel Corrected Standard Error (PCSE) methodology introduced by Beck and Katz (1995).

Table 3 presents four regressions' results for samples with 2093 observations which are different only because of the definition of d_episode window. In the second column, the dummies *d_ sudden_ stop* and *d_ episode* are equal valued whereas the episode window comprises the sudden stop window and the 2, 4 and 6 subsequent quarters in the third, fourth, and fifth columns, respectively. Based on the results, we conclude that there is not strong evidence that openness influences the exchange rate devaluation magnitude on the episode period, but they do when this period is extended by encompassing subsequent quarters.

Notice that for the cases where *d_ episode* window encompasses the *d_ sudden_ stop* window and some subsequent quarters, the coefficients of *d_ episode* dummy are always positive (at 10% or 1% levels of confidence) whereas the coefficients of

[7] We have executed the Haussman test in order to compare fixed effect specification with random effect specification. We have concluded that the fixed effect specification is the appropriate one.

Table 3. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	no quarters	2 quarters	4 quarters	6 quarters
Constant	0.5548 ***	0.5404 ***	0.4995 ***	0.5030 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
d_episode	−0.0168	0.0448 *	0.0788 ***	0.0618 ***
	(0.5858)	(0.0708)	(0.0002)	(0.0023)
d_sudden_stop	—	−0.0308 ***	−0.0369 ***	−0.0351 ***
	—	(0.0067)	(0.0004)	(0.0004)
log($openness_{t-4}$)	−0.1676 ***	−0.1632 ***	−0.1512 ***	−0.1525 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0041	−0.0147 **	−0.0232 ***	−0.0177 ***
	(0.6752)	(0.0274)	(0.0001)	(0.0013)
log(intensity$_t$)	−0.1324 ***	−0.1327 ***	−0.1371 ***	−0.1356 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)	0.2744 ***	0.3268 ***	0.3504 ***	0.3093 ***
	(0.0074)	(0.0004)	(0.0001)	(0.0005)
log(dollarization$_t$)	0.1259 ***	0.1248 ***	0.1212 ***	0.1226 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(dollarization$_t$)	−0.0673	−0.0703	−0.0704	−0.0726
	(0.1443)	(0.1238)	(0.1253)	(0.1153)
$\Delta_{t,t-4}$log(terms of trade)	−0.3049 ***	−0.3236 ***	−0.3330 ***	−0.3147 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
d_episode * $\Delta_{t-4,t-8}$log(terms of trade)	0.2187	0.1700	0.1377	0.0626
	(0.1969)	(0.1316)	(0.1836)	(0.5137)
Observations	2093	2093	2093	2093
Adjusted R^2	0.4599	0.4624	0.4652	0.4630

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

d_ sudden_ stop dummy are always negative (at 1% level of confidence). It means that the *d_ sudden_ stop* window does not capture a considerable part of the real exchange rate devaluation that occurs in sudden stop episodes. Moreover, the negative coefficients (around 12% to 14% levels of confidence) of the interaction between the dummy *d_ sudden_ stop* and the logarithm of degree of debt dollarization indicates that governments refrain more at a first moment to devaluate domestic currency the higher is the degree of liabilities denominated in foreign currencies. This evidence confirms that governments attempts to not devaluate domestic currency when it means a very high rise in the cost of the debt. That is the reason why the influence of trade openness on exchange rate devaluation during sudden stop episodes is not well verified in the second column.

The regressions results presented in third, fourth, and fifth columns show negative and significant (at 1% level) coefficients for the interaction between the dummy *d_ episode* and the logarithm of openness, which means that the real exchange rate devaluation in sudden stop episodes is smaller in more open economies. This result is controlled for the intensity of the sudden stop, for the degree of dollarization of liabilities when the episode occurs, and for the terms of trade shocks. As expected, higher intensity of a sudden stop leads to higher real exchange rate devaluation.

Table 4 presents weak evidence that openness effect has stronger impact in emerging economies during sudden stop episodes than in OECD countries. The coefficients of the interaction among log($openness_{t-4}$), d_episode, and d_emerging are negative in all regressions, but significant at 10% level only in the specification where episode window comprises the sudden stop and the

Table 4. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	2 quarters	4 quarters	6 quarters
Constant	0.5393 ***	0.4918 ***	0.4973 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0314	0.0480 ***	0.0409 **
	(0.1616)	(0.0132)	(0.0269)
d_sudden_stop	−0.0258 **	−0.0324 ***	−0.0320 ***
	(0.0183)	(0.0012)	(0.0009)
d_episode * d_emerging	0.0409	0.0911 *	0.0625
	(0.4928)	(0.0736)	(0.2097)
d_sudden_stop * d_emerging	−0.0150	−0.0137	−0.0100
	(0.4764)	(0.4649)	(0.5777)
log($openness_{t-4}$)	−0.1628 ***	−0.1489 ***	−0.1508 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0120 *	−0.0151 ***	−0.0121 **
	(0.0593)	(0.0063)	(0.0228)
d_episode * d_emerging * log($openness_{t-4}$)	−0.0088	−0.0239 *	−0.0167
	(0.5750)	(0.0805)	(0.2126)
log(intensity$_t$)	−0.1327 ***	−0.1369 ***	−0.1359 ***
	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)	0.3355 ***	0.3619 ***	0.3179 ***
	(0.0004)	(0.0001)	(0.0006)
log(dollarization$_t$)	0.1245 ***	0.1196 ***	0.1218 ***
	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(dollarization$_t$)	−0.0689	−0.0708	−0.0714
	(0.1462)	(0.1397)	(0.1377)
$\Delta_{t,t-4}$log(terms of trade)	−0.3225 ***	−0.3291 ***	−0.3111 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * $\Delta_{t,t-4}$log(terms of trade)	0.1738	0.1295	0.0540
	(0.1293)	(0.2192)	(0.5785)
Observations	2093	2093	2093
Adjusted R^2	0.4621	0.4665	0.4631

Heteroskedastic robust p-value in parentesis
* 10% significative; ** 5% significative; *** 1% significative

subsequent year.

In appendix, we show regressions which change the specification (1) in order to check the robustness of results obtained in tables 3 and 4. Tables 5, 6, and 7 confirm the robustness of the existence of the openness effect during sudden stops episodes. On the other hand, the stronger impact of the effect in emerging countries is only confirmed at 10% level of significance when the episode window comprises the sudden stop and 6 subsequent quarters (table 10). Despite that weak robustness, the coefficient of the interaction among the dummies *d_ episode*, *d_ emerging*, and the variable log($openness_{t-4}$) is negative in all regressions in tables (8) and (9).

We run the same specifications of tables (3) and (4) in tables (11) and (12), but in a subsample where the time dimension starts in 1990 and ends in 2006. It aims to check if the structural changes which occurred in world economy between the 70's and 90's impacts the strength (or existence) of the openness effect during sudden stops. The results confirm again the robustness of the existence of the openness effect during sudden stops. In this subsample the effect is stronger for all countries, but it is not stronger for emerging countries than for OECD ones.

5 Conclusion

The empirical exercises carried out in this paper aim to understand the behavior of the balance of payments during sudden stop episodes, particularly, the process of reversion of the net results of the current account. The episode's mechanism may be represented by the classical "Transfer Problem" discussed between Keynes and Ohlin during the 20's. In the case of sudden stops, economies play the same role of the First World War's winners as receptors of capital.

Using this metaphor, we can compare sudden stop episodes to a hypothetical and non-declared default by Germany. In this case, the Allies, receptors of capital, taking for granted the regular inflow of resources and, hence, dependent on them to finance their liabilities; have to search for new solutions to reach equilibrium in the Balance of Payments. A possible solution is to increase the trade balance surplus which can be driven by a real exchange rate devaluation and/or by a strong recession of the domestic economy.

We have verified that more open economies can achieve the equilibrium in the Balance of Payments through smaller domestic currency devaluations, which confirms the existence of an openness effect, i.e., the elasticity of trade balance surplus with relation to real exchange rate is higher, the higher is the trade volume experienced by an economy. The results seem to indicate that such effect is greater in emerging economies. We also have found evidences that higher share of debt denominated in foreign currencies motivates governments to procrastinate a definite solution to the crisis.

Real exchange rate devaluations represent a social cost and, therefore, it is desirable that, when necessary, they should be small with a strong real effect. The most important result of these empirical exercises reveal that trade openness is the economic feature, under exclusive control of the country policymaker, that provides the most powerful effect in the trade balance given currency devaluations. Considering this result and the one from Calvo et all (2004), which identifies broader trade openness and lower domestic debt dollarization as characteristics that reduce the probability of sudden stop occurrence, we emphasize the importance of public policies that encourage international trade in emerging economies.

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6 Appendix

Episode window comprising the sudden stop and 2 subsequent quarters

Table 5. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	Specifications		
	I	II	III
Constant	0.4980 ***	0.6559 ***	0.6572 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0275	0.0144	0.0170
	(0.2507)	(0.5712)	(0.0500)
d_sudden_stop	−0.0318 ***	−0.0348 ***	−0.0348 ***
	(0.0002)	(0.0013)	(0.0026)
log($openness_{t-4}$)	−0.1380 ***	−0.1854 ***	−0.1916 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0071	−0.0040	−0.0048
	(0.2644)	(0.5562)	(0.4830)
log(intensity$_t$)		−0.1933 ***	−0.1909 ***
		(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)		0.2993 ***	0.3486 ***
		(0.0005)	(0.0002)
log(dollarization$_t$)			0.0678 ***
			(0.0000)
d_sudden_stop * log(dollarization$_t$)			−0.0297
			(0.1262)
$\Delta_{t,t-4}$log(terms of trade)			
d_episode * $\Delta_{t,t-4}$log(terms of trade)			
Observations	4027	3422	3142
Adjusted R^2	0.2340	0.3179	0.4652

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Episode window comprising the sudden stop and 4 subsequent quarters

Table 6. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	Specifications		
	I	II	III
Constant	0.4760 ***	0.6260 ***	0.6290 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0804 ***	0.0699 ***	0.0663 ***
	(0.0001)	(0.0014)	(0.0020)
d_sudden_stop	−0.0393 ***	−0.0441 ***	−0.0434 ***
	(0.0000)	(0.0000)	(0.0000)
log($openness_{t-4}$)	−0.1325 ***	−0.1774 ***	−0.1839 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0196 ***	−0.0182 ***	−0.0174 ***
	(0.0005)	(0.0021)	(0.0031)
log(intensity$_t$)		−0.1927 ***	−0.1905 ***
		(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)		0.3524 ***	0.3978 ***
		(0.0000)	(0.0000)
log(dollarization$_t$)			0.0666 ***
			(0.0000)
d_sudden_stop * log(dollarization$_t$)			−0.0299
			(0.1218)
$\Delta_{t,t-4}$log(terms of trade)			
d_episode * $\Delta_{t,t-4}$log(terms of trade)			
Observations	4027	3422	3142
Adjusted R^2	0.2340	0.3179	0.4652

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Episode window comprising the sudden stop and 6 subsequent quarters

Table 7. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	Specifications		
	I	II	III
Constant	0.4699 ***	0.6160 ***	0.6191 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0843 ***	0.0747 ***	0.0698 ***
	(0.0000)	(0.0003)	(0.0006)
d_sudden_stop	−0.0380 ***	−0.0442 ***	−0.0440 ***
	(0.0000)	(0.0000)	(0.0000)
log($openness_{t-4}$)	−0.1311 ***	−0.1749 ***	−0.1815 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0207 ***	−0.0190 ***	−0.0174 ***
	(0.0001)	(0.0007)	(0.0018)
log(intensity$_t$)		−0.1924 ***	−0.1898 ***
		(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)		0.3435 ***	0.3855 ***
		(0.0000)	(0.0000)
log(dollarization$_t$)			0.0667 ***
			(0.0000)
d_sudden_stop * log(dollarization$_t$)			−0.0300
			(0.1211)
$\Delta_{t,t-4}$log(terms of trade)			
d_episode * $\Delta_{t,t-4}$log(terms of trade)			
Observations	4027	3422	3142
Adjusted R^2	0.2348	0.3189	0.3137

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Episode window comprising the sudden stop and 2 subsequent quarters

Table 8. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	I	II	III
Constant	0.4989 ***	0.6568 ***	0.6561 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0319	0.0222	0.0258
	(0.1805)	(0.3586)	(0.2920)
d_sudden_stop	−0.0157 *	−0.0207 **	−0.0226 **
	(0.0790)	(0.0442)	(0.0435)
d_episode * d_emerging	−0.0116	-0.0143	−0.0170
	(0.8212)	(0.7839)	(0.7388)
d_sudden_stop * d_emerging	−0.0342 *	−0.0354 **	−0.0274
	(0.0537)	(0.0485)	(0.1487)
log($openness_{t-4}$)	−0.1383 ***	−0.1857 ***	−0.1912 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0100	−0.0079	−0.0100
	(0.1300)	(0.2352)	(0.1462)
d_episode * d_emerging * log($openness_{t-4}$)	−0.0065	0.0079	0.0097
	(0.6306)	(0.5891)	(0.4749)
log(intensity$_t$)		−0.1931 ***	−0.1910 ***
		(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)		0.3313 ***	0.3609 ***
		(0.0002)	(0.0003)
log(dollarization$_t$)			0.0674 ***
			(0.0000)
d_sudden_stop * log(dollarization$_t$)			−0.0248
			(0.2197)
$\Delta_{t,t-4}$log(terms of trade)			
d_episode * $\Delta_{t,t-4}$log(terms of trade)			
Observations	4027	3422	3142
Adjusted R^2	0.2304	0.3153	0.3100

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Episode window comprising the sudden stop and 4 subsequent quarters

Table 9. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	I	II	III
Constant	0.4732 ***	0.6217 ***	0.6223 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0482 **	0.0405 *	0.0413 *
	(0.0208)	(0.0539)	(0.0530)
d_sudden_stop	−0.0221 ***	−0.0296 ***	−0.0313 ***
	(0.0054)	(0.0015)	(0.0020)
d_episode * d_emerging	0.0737 *	0.0723	0.0635
	(0.0923)	(0.1062)	(0.1455)
d_sudden_stop * d_emerging	−0.0366 **	−0.0382 **	−0.0297 *
	(0.0193)	(0.0166)	(0.0814)
log($openness_{t-4}$)	−0.1317 ***	−0.1762 ***	−0.1819 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0124 **	−0.0116 *	−0.0130 **
	(0.0339)	(0.0468)	(0.0322)
d_episode * d_emerging * log($openness_{t-4}$)	−0.0166	−0.0165	−0.0126
	(0.1573)	(0.1677)	(0.2821)
log(intensity$_t$)		−0.1917 ***	−0.1899 ***
		(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)		0.3945 ***	0.4248 ***
		(0.0000)	(0.0000)
log(dollarization$_t$)			0.0655 ***
			(0.0000)
d_sudden_stop * log(dollarization$_t$)			−0.0252
			(0.2102)
$\Delta_{t,t-4}$log(terms of trade)			
d_episode * $\Delta_{t,t-4}$log(terms of trade)			
Observations	4027	3422	3142
Adjusted R^2	0.2349	0.3192	0.3136

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Episode window comprising the sudden stop and 6 subsequent quarters

Table 10. Dependent Variable: $\Delta_{t,t-4}$log(rer)

Variables	I	II	III
Constant	0.4655 ***	0.6093 ***	0.6105 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0457 **	0.0372 *	0.0358 *
	(0.0216)	(0.0630)	(0.0785)
d_sudden_stop	−0.0214 ***	−0.0304 ***	−0.0334 ***
	(0.0047)	(0.0007)	(0.0006)
d_episode * d_emerging	0.0892 **	0.0913 **	0.0842 **
	(0.0318)	(0.0321)	(0.0429)
d_sudden_stop * d_emerging	−0.0354 **	−0.0365 **	−0.0268
	(0.0179)	(0.0167)	(0.1012)
log($openness_{t-4}$)	−0.1298 ***	−0.1730 ***	−0.1789 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	−0.0117 **	−0.0100 *	−0.0101 *
	(0.0359)	(0.0743)	(0.0815)
d_episode * d_emerging * log($openness_{t-4}$)	−0.0209 *	−0.0220 *	−0.0191 *
	(0.0599)	(0.0534)	(0.0895)
log(intensity$_t$)		−0.1915 ***	−0.1894 ***
		(0.0000)	(0.0000)
d_sudden_stop * log(intensity$_t$)		0.3857 ***	0.4135 ***
		(0.0000)	(0.0000)
log(dollarization$_t$)			0.0654 ***
			(0.0000)
d_sudden_stop * log(dollarization$_t$)			−0.0254
			(0.2087)
$\Delta_{t,t-4}$log(terms of trade)			
d_episode * $\Delta_{t,t-4}$log(terms of trade)			
Observations	4027	3422	3142
Adjusted R^2	0.2364	0.3209	0.3151

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Sample: 1990 to 2006

Table 11. Dependent Variable: $\Delta_{t,t-4}$log(rer). Period: 1990 to 2006.

Variables	2 quarters	4 quarters	6 quarters
Constant	0.7151 ***	0.6361 ***	0.6248 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0811 **	0.1381 ***	0.1342 ***
	(0.0212)	(0.0000)	(0.0000)
d_sudden_stop	-0.0261	-0.0331 **	-0.0313 **
	(0.1193)	(0.0298)	(0.0341)
log($openness_{t-4}$)	-0.2131 ***	-0.1906 ***	-0.1883 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	-0.0221 **	-0.03748 ***	-0.0350 ***
	(0.0188)	(0.0000)	(0.0000)
log(intensity_t)	-0.1683 ***	-0.1721 ***	-0.1687 ***
	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(intensity_t)	0.3006 ***	0.3457 ***	0.2988 ***
	(0.0121)	(0.0028)	(0.0085)
log(dollarization_t)	0.1407 ***	0.1343 ***	0.1368 ***
	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(dollarization_t)	-0.0956 **	-0.0935 *	-0.0956 *
	(0.0516)	(0.0596)	(0.0557)
$\Delta_{t,t-4}$log(terms of trade)	-0.3461 ***	-0.3668 ***	-0.3398 ***
	(0.0087)	(0.0047)	(0.0138)
d_episode * $\Delta_{t,t-4}$log(terms of trade)	0.1774	0.1806	0.0800
	(0.3979)	(0.3937)	(0.7003)
Observations	1239	1239	1239
Adjusted R^2	0.3773	0.3896	0.3901

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative

Table 12. Dependent Variable: $\Delta_{t,t-4}$log(rer). Period: 1990 to 2006.

Variables	2 quarters	4 quarters	6 quarters
Constant	0.7076 ***	0.6174 ***	0.6214 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode	0.0858 ***	0.1349 ***	0.1567 ***
	(0.0089)	(0.0000)	(0.0000)
d_sudden_stop	-0.0250	-0.0340 **	-0.0334 **
	(0.1211)	(0.0195)	(0.0164)
d_episode * d_emerging	-0.0053	0.0151	-0.0391
	(0.9434)	(0.8072)	(0.5187)
d_sudden_stop * d_emerging	0.0036	0.0092	0.0100
	(0.8968)	(0.7180)	(0.6843)
log($openness_{t-4}$)	-0.2110 ***	-0.1852 ***	-0.1874 ***
	(0.0000)	(0.0000)	(0.0000)
d_episode * log($openness_{t-4}$)	-0.0266 ***	-0.0396 ***	-0.0446 ***
	(0.0040)	(0.0000)	(0.0000)
d_episode * d_emerging * log($openness_{t-4}$)	0.0084	0.0023	0.0175
	(0.6677)	(0.8897)	(0.2841)
log(intensity_t)	-0.1695 ***	-0.1757 ***	-0.1715 ***
	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(intensity_t)	0.2917 ***	0.3378 ***	0.2974 ***
	(0.0150)	(0.0037)	(0.0094)
log(dollarization_t)	0.1425 ***	0.1353 ***	0.1396 ***
	(0.0000)	(0.0000)	(0.0000)
d_sudden_stop * log(dollarization_t)	-0.1102 **	-0.1103 **	-0.1092 **
	(0.0393)	(0.0417)	(0.0451)
$\Delta_{t,t-4}$log(terms of trade)	-0.3510 ***	-0.3676 ***	-0.3511 ***
	(0.0080)	(0.0047)	(0.0110)
d_episode * $\Delta_{t,t-4}$log(terms of trade)	0.2291	0.2218	0.1233
	(0.2924)	(0.3104)	(0.5630)
Observations	1239	1239	1239
Adjusted R^2	0.3784	0.3914	0.3925

Heteroskedastic robust p-value in parentesis

* 10% significative; ** 5% significative; *** 1% significative