

When Do Sudden Stops Really Hurt?

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Abstract

This paper analyzes the drivers and consequences of sudden stops of capital flows. It focuses on the impact of external vulnerability on the depth and length of sudden stop crises. The authors analyze 43 developing and developed countries between 1993 and 2006. They find evidence that external vulnerability not only significantly impacts the probability of a sudden stop crisis, but also prolongs the time it takes for growth to revert to its long-term trend once a sudden stop occurs. Interestingly, external vulnerability does not significantly impact the size of the instantaneous output effect in case of a sudden stop but prompts a cumulative output effect through significantly diminishing the speed of adjustment of

output to its trend. This finding implies that countries financing a large part of their absorption externally do not suffer more ferocious output losses in a sudden stop crisis, but take longer to adapt afterward and are hence expected to suffer more protracted crises periods. Compared with previous literature, this paper makes three contributions: (i) it extends the country and time coverage relative to datasets that have previously been used to analyze related topics; (ii) it specifically accounts for time-series autocorrelation; and (iii) it provides an analysis of the adjustment path of economic growth after a sudden stop.

This paper—a product of the Economic Policy and Debt Department, Poverty Reduction and Economic Management Network—is part of a larger effort in the network to examine the causes of sudden stops of capital flows and impact of the ongoing global financial crisis on developing countries. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at fkoehler@worldbank.org, gvincelette@worldbank.org, and mcaner@nsu.edu.

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When Do Sudden Stops Really Hurt?

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I. Introduction

After the unraveling of the subprime crisis in the US starting in summer 2007, financing conditions in international financial markets tightened substantially, leading to sudden stops of capital flows in a large number of emerging markets in autumn 2008. Argentina, Jamaica, Pakistan, and Ukraine were among the first countries hit by a sudden stop after the failure of Lehman Brothers in September 2008, as indicated by their EMBI spreads (Emerging Markets Bond Index), maxing out at 1965, 1821, 2222 and 2774 basis points, respectively. The recent incidences of sudden stops have reinvigorated the interest in studying the causes and consequences this type of crisis. In particular, understanding the factors driving the depth and the length of such crises periods is a valuable contribution to the current discussion about the adequacy and the timing of fiscal stimulus packages as a crisis response.

This paper analyzes the drivers and consequences of sudden stops of capital flows with a particular focus on the impact of external vulnerability on the depth and length of sudden stop crises. We follow a twofold agenda by first quantifying the impact of a number of variables on the probability of a sudden stop crisis with its ensuing growth impact, and second by investigating the adjustment dynamics of output to its long-term path after a sudden stop takes place.

Drawing from the experiences of a panel of 43 developing and developed countries from 1993-2006, we estimate a treatment effects model that specifies the effect of a sudden stop of capital flows on growth and the effect of factors such as liability dollarization and vulnerability to real exchange rate fluctuations on the probability of a sudden stop of capital flows. The methodology in the present study is based on and improves upon Edwards (2004) and Sorsa et al. (2007). We then resort to the analysis of the speed of adjustment of GDP growth to its equilibrium path to describe the dynamics of output after the crises.

We find evidence that external vulnerability significantly impacts not only the probability of a sudden stop crisis, but also prolongs the time it takes for growth to revert to its long-term trend once a sudden stop occurs. Interestingly, external vulnerability does not significantly impact the size of the instantaneous output effect in case of a sudden stop but prompts a cumulative output effect through significantly diminishing the speed of adjustment of output to its trend. This finding implies that countries financing a large part of their absorption externally do not suffer more ferocious output losses in a sudden stop crisis, but take longer to adapt afterwards and are hence expected to suffer more protracted crises periods.

In line with the existing literature on sudden stops, we find that liability dollarization increases the probability of sudden stops, while higher FDI inflows decrease it. Also, as expected, incidences of sudden stops along with negative terms of trade shocks significantly decrease GDP growth, and GDP growth is found to be mean-reverting. All these findings are robust to various specifications.

The paper contributes to the existing literature on sudden stops in several ways. First, we extend the country and time coverage relative to datasets that have previously been used to analyze related topics. Second, we contribute two methodological improvements, by introducing the use of cluster-robust standard errors into the analysis of sudden stops and by formally testing the exogeneity of this type of crisis. Thirdly, we provide an analysis of the adjustment path of economic growth after a sudden stop, a new angle of analysis in this context.

The rest of the paper is organized as follows. The next Section II describes the data. Section III lays out the estimation methodology and the set of robustness checks applied to quantify both the likelihood of sudden stops of capital flows and their impact on GDP growth. Section IV reports and interprets the estimation results. The last section concludes the paper.

II. Data and Descriptive Statistics

The analysis relies on a data set of 43 countries, 26 emerging and 17 industrialized, consisting of yearly observations for the period 1993-2006. This dataset represents an improvement relative to previous studies on related topics by extending both, country coverage and time horizon.¹ Countries are listed in Appendix 1, data sources in Appendix 3.

The sample consists of a heterogeneous group of countries with a wide variance of real per capita income levels and growth rates. While industrial and emerging economies in real terms grew by close to 3 percent on average over the period 1993-2006, the sample exhibits diverse dynamics. For example, starting from a low level, real per capita income has on average grown fastest in Latvia with a 7 percent annual growth rate over the 14-year period under consideration. In comparison, Italy had the weakest growth performance with merely 1 percent annual growth on average.

The focus of this paper is on the causes and consequences of sudden stops of capital flows, therefore the sudden stop variable itself and factors explaining this type of crises are in the center of the following data description. First, we explain the sudden stop variable, and give a brief overview of sudden stop incidences in the sample. Second, we explain the construction of sudden stop drivers and describe them.

We define sudden stops with the help of a dummy variable capturing large and unexpected falls in capital flows. We construct this variable following Calvo et al. (2004), based on monthly data to maximize the chances to detect sudden stops, because annual data might hide the origin of such crises. Capital flow figures are generally unavailable on a monthly basis, therefore we proxy them by netting out the trade balances from the changes in foreign reserves. Sudden stops are then defined as episodes in which the year-on-year drop

¹ The dataset that is usually referred to in this type of analysis is based on Calvo et al. (2004), covering 31 countries from 1993-2001.

in capital flows falls at least two standard deviations below the (rolling) sample mean, and where the drop is also associated with a contemporaneous fall in output.

Countries vary largely with respect to their likelihood to experience sudden stop crises. Within the sample of 602 country year observations, we identify 31 sudden stop periods leading overall to a 5 percent probability of such an event. However, emerging market economies are more prone to experience a sudden stop than industrialized countries. The sudden stop probability in emerging market economies in the sample amounts to almost 8 percent, compared to less than 2 percent in industrialized countries.² Of all the countries in the sample, Argentina and Turkey have experienced the most sudden stops, with both economies having undergone 4 such episodes during the 14 year period under examination. In contrast, 21 countries in the sample have not experienced any sudden stop.

We expect the probability of a sudden stop of capital flows to be primarily driven by external vulnerability and by liability dollarization. Hence, these variables are essential to the present study.

Following Calvo et al. (2004), we define external vulnerability as the degree to which absorption of tradable goods is financed abroad. The higher the measure of external vulnerability the more a country relies on foreign financing of its absorption. When we understand a sudden stop as the sudden closure of a current account deficit back to zero, a higher degree of external vulnerability means that a country is more susceptible to changes in relative prices of tradable versus non-tradable goods, i.e. a depreciation of the real exchange rate, when a sudden stop happens. This is measured as the ratio of the current account deficit to domestic absorption of tradable goods. We construct domestic absorption by summing agricultural and industrial output as a measure of the supply of tradable goods, and then subtract exports and add imports to obtain the desired measure of absorption of tradable goods.

With respect to external vulnerability the sample displays a large variance over time and across countries (see Appendix 2). Additionally, there are two regional patterns worth emphasizing. While large inflows of capital into transition economies of Eastern Europe have contributed to rapid per capita income growth (leading to a notable income convergence toward European Union levels), large external imbalances (manifested in current account deficits) accompanied by rapid credit growth and currency mismatches have exposed the region to elevated external financial risks and a considerable buildup of vulnerabilities. In contrast, the majority of the countries in Latin America have moved from more externally vulnerable situation in the beginning of the period (mid-1990) to less dependence on external financing of domestic absorption in more recent years.

Liability dollarization is proxied by a measure of what is known in the literature as the original sin, using data by Eichengreen et al. (2002). The idea of original sin refers to many

² Calvo et al. (1998) explains this tendency as a result of greater financial market imperfections, such as liability dollarization, and limited access to longer-term capital and equity finance in emerging market economies.

countries' practice to borrow in foreign currency, both abroad and in the domestic market when it comes to long maturities and fixed rates.³ In our sample, emerging markets (especially in Eastern Europe and Latin America) tend to exhibit a high degree of liability dollarization over time. Such countries are financially fragile due to either currency mismatches (because of the currency composition of the debt) or maturity mismatches (because of the short-term nature of the domestic currency debt). Eichengreen et al. (2002) show that countries with original sin exhibit greater output and capital flow volatility, lower credit ratings, and limited ability to manage an independent monetary policy.⁴

Alternatively, following Sorsa et al. (2007), we construct domestic liability dollarization through the BIS reporting banks' local asset positions in foreign currency as a proportion of GDP. For many emerging market countries, however, BIS banking data are unavailable. To overcome this drawback, we build an estimate by summing the foreign currency deposits and net foreign liabilities of the banking sector. Under the assumption that banks match their foreign currency assets and liabilities, this should be an adequate proxy for foreign currency lending to the domestic nonbank sector.

In our estimations, we mostly rely on the proxy of liability dollarization through original sin, because of drawbacks in the alternative measure. Namely, the liability dollarization calculated following the methodology in Sorsa et al. (2007) displays high values (indicating a high degree of liability dollarization) for the UK relative to other countries and negative values for Nigeria. Despite these shortcomings, we apply this second measure of liability dollarization to test robustness of the results.

While external vulnerability and liability dollarization are expected to increase the probability of sudden stops, FDI inflows are expected to lower it. FDI flows have been shown to be less volatile than other types of financial flows in crisis periods.⁵ The lower volatility could be linked to a longer-term investment perspective for this type of capital flows.

In terms of regional patterns of FDI, the sample shows evidence of a rapid growth of FDI inflows to emerging markets over the sample period - especially to the transition economies of Eastern Europe (see Appendix 2). It is worthwhile mentioning that growth rates of FDI to mature economies tend to be lower in comparison, but also less volatile over the period under consideration.

III. Methodology of Estimating the Likelihood and Consequences of Sudden Stops of Capital Flows

Carefully taking into account the specific features of the dataset, we estimate a treatment effects model that specifies the effect of a sudden stop of capital flows on growth ("outcome

³ See Eichengreen and Hausmann (1999).

⁴ See Eichengreen, Hausmann, and Panizza (2002).

⁵ See for example Levchenko and Mauro (2006).

equation”) and the effect of factors such as liability dollarization and external vulnerability on the probability of a sudden stop of capital flows (“treatment equation”). In particular, we jointly estimate the outcome and treatment equations using maximum likelihood estimation with clustered standard errors. The joint estimation accounts for un-modeled factors that may drive the probability of a sudden stop at the same time as impacting GDP growth, i.e. for a potential simultaneity bias. For example, in the case where risk aversion in international financial markets also affects domestic confidence and hence growth, a separate estimation of the outcome equation would most likely overestimate the growth impact of a sudden stop. The use of cluster-robust standard errors takes care of potential time series autocorrelation within the different countries as well as of unobserved country specific effects.⁶

Additionally, we run a set of robustness checks, based on single equation estimations. First, we test whether the outcome and the treatment equations are correlated. The test fails to reject the null hypothesis of no correlation, indicating that sudden stops in our sample appear to be exogenous. Second, we therefore estimate the treatment and the outcome equations separately, applying both, random and fixed effects estimations to check for robustness. We also use clustered standard errors in these estimations.

The current study builds upon the existing literature on the determinants and impacts of sudden stops of capital flows. While Edwards (2004) pioneers the use of treatment effects models to quantify the drivers and consequences of current account reversals, Sorsa et al. (2007) first use this estimation technique in the context of sudden stops of capital flows, incorporating findings of Calvo et al. (2004) on drivers of this type of crisis. We follow Edwards (2004) and Sorsa et al. (2007) in jointly estimating the outcome and treatment equations to evaluate the drivers and consequences of sudden stops of capital flows in the presence of potential reverse causality.

However, departing from this existing literature, we contribute two improvements. The first improvement consists of using cluster-robust standard errors. In contrast to Edwards (2004) and Sorsa et al. (2007), we use cluster-robust standard errors in the estimations to account for potential time series autocorrelation. Ignoring this autocorrelation potentially leads to inefficient coefficient estimates and hence artificially large standard errors. Using cluster-robust standard errors is particularly valuable in the context of sudden stops of capital flows, given the possible time series autocorrelation in most macroeconomic variables.⁷ Their use allows taking care of both, unobserved country specific effects and potential time series autocorrelation.

The second improvement consists of taking into account that sudden stops appear exogenous in the considered samples. Even though Sorsa et al. (2007) also report an

⁶ See Wooldridge, Chap. 11.5, p.330.

⁷ For a thorough description of the cluster method see p.831 of Cameron and Trivedi (2005), for its usage and desirable properties see Petersen (2009). Additionally, see chapter 15.8.6 of Wooldridge (2002) for comparison and relevance of cluster based estimation versus panel random effects probit.

insignificant correlation between the error terms of the outcome and the treatment equation they stop short of following up on this result by estimating both equations separately. The current study provides this analysis in a dataset with larger country and time coverage.

In the following, we first describe the joint estimation approach, followed by a brief description of the single estimation approach. Specifically, following Edwards (2004), our joint estimation approach starts with estimating a long-term growth equation:

$$y_i^* = \alpha + X_i\beta + r_i\gamma + \varepsilon_i \quad (1)$$

where y_i^* represents the long-run real per capita growth in country i , X_i is a vector of covariates capturing traditional determinants of growth (log of initial GDP per capita, the investment ratio, the degree of openness in the economy, and the ratio of government consumption-to-GDP), r_i are regional dummies, and ε_i is the error term for each country i .

The estimates of the long-run growth are used later on in the outcome equation describing the dynamics of GDP per capita growth. Estimating long-run growth separately reduces the risk of reverse causality in the subsequent estimations. We estimate equation (1) by feasible GLS with heteroskedasticity correction. Heteroskedasticity may arise in the dataset because of the wide variety of different countries.

Equation (2), the “outcome equation” describes the GDP growth dynamics:

$$\Delta y_{it} = \lambda_0(y_i^* - y_{it-1}) + \lambda_1[(y_i^* - y_{it-1})(1 - w)_{it-1}] + \delta_0 z_{it} + \delta_1[z_{it}(1 - w)_{it-1}] + \theta W_{it} + (\mu_i + u_{it}) \quad (2)$$

where Δy_{it} represents the change of GDP per capita growth between t and $t-1$ in country i ; $(y_i^* - y_{it-1})$ is the error-correction term that measures the growth gap between the long-run GDP growth rate estimated in equation (1) and the observed real GDP per capita growth rate; $(1 - w)$ is the measure of external vulnerability; z_{it} is a sudden stop dummy; W_{it} is the terms of trade shock; μ_i represents the country specific unobserved effect, and u_{it} is the error term for country i in period t . We introduce two interaction terms in (2), $[z_{it}(1 - w)_{it-1}]$, and $[(y_i^* - y_{it-1})(1 - w)_{it-1}]$. The first interaction term measures the negative impact of a sudden stop with an increase in country’s external vulnerability. The second measures analogously the negative impact of the growth gap with a worsening of external vulnerability.

The determinants of a sudden stop of capital flows are modeled in the treatment equations (3)-(4), representing a probit framework where the occurrence of a sudden stop of capital flows is assumed to depend upon an unobserved latent variable, z_{it}^* , in equation (3).

$$z_{it} = \begin{cases} 1 & \text{if } z_{it}^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

The latent variable in turn depends on a vector of covariates S_{it} , as described in equation (4):

$$z_{it}^* = S_{it-1} \varphi + \zeta_{it} \quad (4)$$

Specifically, S_{it-1} consists of a dollarization index, the ratio of net FDI inflows-to-GDP, and external vulnerability, all lagged one period. ζ_{it} is the error term.

We estimate equations (2) and (4) jointly, using maximum likelihood estimation with cluster-robust standard errors. The main assumption needed to apply maximum likelihood is bivariate normality of the error terms in equations (2) and (4), where ρ is the constant correlation between errors u_{it} and ζ_{it} the variance of the ζ_{it} is 1, and the variance of u_{it} is σ^2 .

The data set shows the characteristics of a normal distribution. We draw q-q plots as well as histograms from the predictors in equations (2) and (4), which display normality. In addition, we check the dependent variable in equation (2) in a histogram and q-q plot, which again shows evidence of normality. Lastly, the residuals in equation (2) are analyzed and also exhibit characteristics of normal distribution.⁸ These plots are available from the authors upon request.

As described above, we also estimate the outcome and the treatment equations separately. First, we run the estimations, assuming random effects. In this set of estimations, we use generalized least squares (GLS) random effects for the outcome equation, and panel probit random effects equation for the treatment equation, which take into account the unobserved country specific effects. In a second set of estimations to check robustness, we run fixed effects (least squares) estimations for the outcome equation and logit fixed effects for the treatment equations. The results of the robustness check with fixed effects estimation are very similar, and hence, are not reported here. In all these estimations, we use cluster-robust standard errors.

IV. Results

Overall, the estimation results demonstrate that the occurrence of sudden stops of capital flows is associated with a sharp and imminent decline in output per capita growth. The results further indicate that external vulnerability significantly impacts the probability of a

⁸ It should be noted that our estimation technique could be interpreted as a quasi-maximum-likelihood estimation in the case of absence of normality.

sudden stop crisis. Moreover, external vulnerability does not worsen the immediate effect of sudden stops on output growth, but it significantly prolongs the time it takes for growth to revert to its long-term trend.

In the following, we first describe the joint estimation results of outcome and treatment equations, we then move on reporting on robustness checks including single equation estimations, and finally we discuss the country and time specific adjustment path of GDP growth to its trend once a crisis occurs through the lens of speed of adjustment.

Estimation results – joint estimation

Table 1a reports strong evidence of the negative effect of sudden stops of capital flows (z_{it}) on changes in output per capita growth rate (Δy_{it}). In the event of a sudden stop, growth of per capita GDP drops by 5.3 percentage points, as indicated by the coefficient estimate of δ_0 . This effect is statistically significant.

Moreover, the impact of a sudden stop on Δy_{it} would tend to worsen with an increased external vulnerability, as indicated by the negative coefficient of the interaction term δ_1 between the sudden stop and the external vulnerability variables, but δ_1 turns out statistically insignificant. This implies that external vulnerability does not seem to have on average an immediate impact on growth when a sudden stop occurs.

Table 1: Joint Estimation of Outcome and Treatment Equations, Maximum Likelihood, Clustered Standard Errors

1a: Equation (2)

Dependent Variable: Change of a Country's GDP per Capita Growth Rate

| Variables | Coefficient Estimate | Std. Error | P-value |
|---|----------------------|------------|---------|
| $\lambda_0: (y_i^* - y_{it-1})$ | 0.556 | 0.040 | 0.000 |
| $\lambda_1: (y_i^* - y_{it-1}) \times (1-w)_{it-1}$ | -0.657 | 0.279 | 0.018 |
| $\delta_0: z_{it}$ | -0.053 | 0.020 | 0.009 |
| $\delta_1: z_{it} \times (1-w)_{it-1}$ | -0.013 | 0.151 | 0.825 |
| $\theta: W_{it}$ | 0.115 | 0.036 | 0.001 |

1b: Equation (4)

Dependent Variable: Sudden Stop Dummy

| Variables | Coefficient Estimate | Std. Error | P-value |
|--------------------------|----------------------|------------|---------|
| Φ_0 : Dollarization | 0.932 | 0.390 | 0.017 |
| Φ_1 : FDI | -3.117 | 3.686 | 0.398 |
| $\Phi_2: (1-w)_{it-1}$ | 2.495 | 0.971 | 0.010 |

Source: See Data Appendix

The most interesting results of Table 1a concern the coefficient estimates λ_0 on the deviation of per capita GDP growth rate from its long-term trend, and λ_1 on the interaction of this deviation with external vulnerability. Separately, these coefficients do

not convey much information. However, when considered in combination, they allow for an analysis of the adjustment of per capita growth to its long-term trend after a crisis. Given the importance of this new interpretation of the estimation results, we discuss this point in a separate section on speed of adjustment below.

Finally, Table 1a shows a significant and positive effect of terms-of-trade shocks (W_{it}) on per capita GDP growth. A worsening of terms of trade by 1 percentage point would bring the GDP growth rate down by 0.12 percentage points, everything else equal.

Table 1b reports on the determinants of sudden stops. The results illustrate that liability dollarization and external vulnerability increase the probability of a sudden stop. Both coefficients, Φ_0 and Φ_2 , are strongly positive and statistically significant. While influx of foreign direct investment would tend to diminish the probability of a sudden stop of capital flows (revealed by the negative coefficient Φ_1), the coefficient is statistically insignificant.

Robustness – single equation estimations

We perform a series of robustness tests to check the validity and magnitude of the results reported in Table 1. As discussed in the methodology section, we also estimate equations (2) and (4) separately. Specifically, we formally test the null hypothesis of no correlation between the error terms of equation (2) and (4) in a treatment effects model, applying a Wald test. Finding a p-value of 0.93 does not allow for rejecting the null hypothesis. Hence, we find that sudden stops in outcome equation (2) are exogenous.

Table 2: Separate estimation of outcome and treatment equations, GLS estimation with random effects of equation (2) and panel probit estimation with random effects of equation (4), clustered standard errors

a: Equation (2)

Dependent Variable: Change of a Country's GDP per Capita Growth Rate

| Variables | Coefficient Estimate | Std. Error | P-value |
|---|----------------------|------------|---------|
| $\lambda_0: (y_i^* - y_{it-1})$ | 0.548 | 0.041 | 0.000 |
| $\lambda_1: (y_i^* - y_{it-1}) \times (1-w)_{it-1}$ | -0.665 | 0.274 | 0.015 |
| $\delta_0: z_{it}$ | -0.049 | 0.020 | 0.016 |
| $\delta_1: z_{it} \times (1-w)_{it-1}$ | -0.053 | 0.145 | 0.715 |
| $\theta: W_{it}$ | 0.114 | 0.037 | 0.002 |

b: Equation (4)

Dependent Variable: Sudden Stop Dummy

| Variables | Coefficient Estimate | Std. Error | P-value |
|--------------------------|----------------------|------------|---------|
| Φ_0 : Dollarization | 1.279 | 0.518 | 0.014 |
| Φ_1 : FDI | -3.852 | 4.917 | 0.433 |
| Φ_2 : (1-w) | 4.480 | 1.582 | 0.005 |

Source: See Data Appendix.

Table 2 reports the results of the random effects estimations. We estimate the outcome equation (2), applying GLS, random effects, and then estimate the treatment equation (4) by panel probit. The results of the separate estimations reported in Table 2 do not exhibit notable differences with the ones of the joint estimation in Table 1.

Second, we apply another robustness test by conducting single equation estimation. We use fixed effects on the outcome equation (2), and logit fixed effects on the treatment equation (4). The results are very similar to the one reported in Table 1, and hence we omit to report them here.

Discussion of the speed of adjustment of economic growth

While determinants of sudden stops and their potential impact on growth have been extensively discussed in the literature on financial crises, a systematic evaluation of the speed of adjustment to country's long-term growth path after sudden stops of capital flows has not been done.⁹

We define speed of adjustment as the portion of the deviation of per capita growth that can be recovered within a year after a sudden stop materializes. In the current set-up, this equates to the combined coefficients on $(y_i^* - y_{it-1})$, i.e. the sum of λ_0 and the product of λ_1 and the time and country specific variable of external vulnerability in Tables 1 and 2:

$$\Lambda_{it} = \lambda_0 + \lambda_1(1 - w)_{it-1}$$

Note that the coefficients λ_0 and λ_1 represent averages over countries and time period covered. In contrast, external vulnerability varies over countries and time; being part of Λ_{it} it therefore allows for a discussion that differentiates countries and time.

Figure 1 plots the speed of adjustment Λ_{it} against external vulnerability for the emerging market economies in our sample for the years 2006 and 2007. The figure is based on the estimates presented in Table 1. As predicted by the model, countries with a higher degree of external vulnerability tend to experience longer periods to rebound. Additionally, countries vary considerably in their ability to revert to their long-run growth path implying a large variance in the cost of crises across countries.

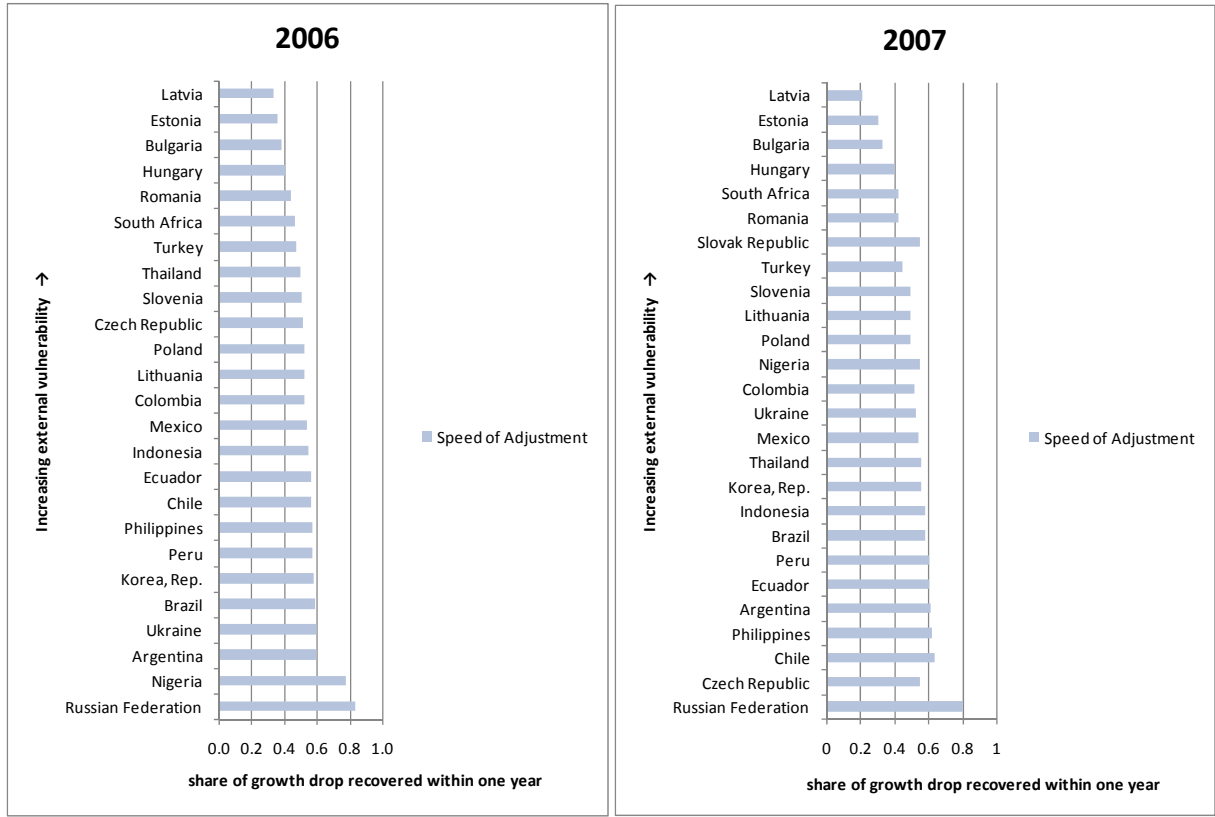
Figure 1 illustrates that more externally vulnerable countries take longer to revert to their long-run growth path. Looking at the ten most vulnerable countries in our samples, we observe that their speed of adjustment is considerably slower than in less vulnerable countries. In 2006, after a potential sudden stop, the 10 most vulnerable countries would all have recovered less than 44 percent of the drop in GDP and 41 percent in 2007. In contrast, the least externally vulnerable economy in this sample, Russia, would have been able to recover 83 percent in 2006 and 80 percent in 2007.

⁹ For a discussion of the drivers of sudden stops see for example Calvo et al. (2004) and (2006), or Hutchison and Noy (2006). For a discussion of the role of FDI in financial crises see for example Levchenko and Mauro (2006). For an analysis of whether sudden stops are followed by a growth drop or not, see Chari et al. (2005). □

The full extent of the variation becomes clear when comparing the recovery of the most vulnerable economy with the least vulnerable. The time to recovery in the most vulnerable economy would have been more than twice as long as in the least vulnerable economy in 2006 and even almost four times longer in 2007. This finding also implies that sudden stop crises in more vulnerable economies tend to be more costly, and that these crises have become even more costly relative to less vulnerable economies in 2007 compared to 2006.

Overall in the sample, the speed of adjustment has been reduced between 2006 and 2007, with Eastern European and Latin American economies showing diverging trends. In the whole sample, on average, countries would have recovered 53 percent of a potential growth drop in 2006 and only 51 percent in 2007. This result might be primarily driven by Eastern European economies, where the average economy would have recovered 49 percent of the growth drop after a crisis in 2006 and only 46 percent in 2007. In contrast, the average Latin American country would have recovered 57 percent of a growth drop in 2006 and even 59 percent in 2007.

Figure 1: Speed of adjustment, with countries sorted by external vulnerability



Source: authors' calculations

Notwithstanding the comparatively faster output adjustment suggested by our model for less externally exposed countries, it should be noted that net commodity exporters (as for example Russia) would face much different external vulnerability in the conditions of

radically lower commodity prices in 2009. While highly relevant in the current global context of financial markets turmoil, the topic of drivers of fast recoveries is beyond the scope of this inquiry.

V. Conclusion

We demonstrate empirically that sudden stops of capital flows lead to costly output losses. Sudden stops not only contribute significantly to drops in economic growth, but their effect is more pronounced in countries with large external vulnerability. Interestingly, the output cost does not stem from a deeper crisis, but from a more prolonged crisis. This is to suggest that while external vulnerability does not significantly affect the instantaneous output loss, it has sizable effects in the case of a slower adjustment by delaying the return to equilibrium.

The empirical results of this study point to an ambitious research agenda, based on advancing the findings presented here. Factors such as commodity exports, fiscal balances, indebtedness, among others, may well play an important role in unpacking the determinants of recovery from a sudden stop crisis.

Moreover, the speed of adjustment of output gains huge relevance in the context of the current discussion about the adequacy of fiscal stimulus packages as response to crises. Stimulus packages are less likely to work if the duration of the crises is underestimated. In contrast, overestimating the speed of rebound may be costly if governments have committed sizeable rescue packages to stimulate the economy.

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Appendix 1: List of Countries in the Sample

- | | | | |
|----|----------------|----|--------------------|
| 1 | Argentina | 23 | Netherlands |
| 2 | Australia | 24 | New Zealand |
| 3 | Brazil | 25 | Nigeria |
| 4 | Bulgaria | 26 | Norway |
| 5 | Canada | 27 | Peru |
| 6 | Chile | 28 | Philippines |
| 7 | Colombia | 29 | Poland |
| 8 | Czech Republic | 30 | Portugal |
| 9 | Denmark | 31 | Romania |
| 10 | Ecuador | 32 | Russian Federation |
| 11 | Estonia | 33 | Slovak Republic |
| 12 | Finland | 34 | Slovenia |
| 13 | France | 35 | South Africa |
| 14 | Germany | 36 | Spain |
| 15 | Hungary | 37 | Sweden |
| 16 | Indonesia | 38 | Switzerland |
| 17 | Italy | 39 | Thailand |
| 18 | Japan | 40 | Turkey |
| 19 | Korea, Rep. | 41 | Ukraine |
| 20 | Latvia | 42 | United Kingdom |
| 21 | Lithuania | 43 | United States |
| 22 | Mexico | | |

Appendix 2: Summary Statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|-----|----------|-----------|----------|----------|
| Real Per Capita Growth - y_{it} | 645 | 0.02707 | 0.03732 | -0.23 | 0.13 |
| Sudden Stop - z_{it} | 616 | 0.050325 | 0.218792 | 0 | 1 |
| Terms of Trade - W_{it} | 645 | 0.00841 | 0.063608 | -0.36416 | 0.433878 |
| Long Run Real Per Capita Growth (Predicted, Cross section) - y_i^* | 602 | 0.019447 | 0.007967 | -0.00345 | 0.045772 |
| Change of GDP Growth - Δy_{it} | 602 | 0.003154 | 0.034158 | -0.17566 | 0.2 |
| Deviation of growth from trend - $y_i^* - y_{it-1}$ | 602 | -0.00605 | 0.037625 | -0.11 | 0.25 |
| External vulnerability - $(1-w)_{it-1}$ | 571 | 0.001179 | 0.186967 | -0.92 | 0.53 |
| External vulnerability * Deviation of growth from trend - $(1-w)_{it-1} * (y_i^* - y_{it-1})$ | 569 | -0.0011 | 0.008047 | -0.05912 | 0.076374 |
| Sudden Stop * external vulnerability - $z_{it} * (1-w)_{it-1}$ | 552 | 0.004923 | 0.028408 | -0.16224 | 0.267687 |
| Dollarization | 579 | 0.5229 | 0.480863 | 0 | 1 |
| Foreign Direct Investment - FDI | 597 | 0.013964 | 0.035195 | -0.1431 | 0.231629 |

The countries with most Sudden Stops(1993-2007): Argentina (4), Turkey (4)The Countries with No Sudden Stops(1993-2007): Australia, Brazil, Canada, Denmark, Finland, France, Hungary, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Nigeria, Norway, Poland, South Africa, Spain, Switzerland, UK, USA.

*External vulnerability: Largest over time (average): Estonia, .213
Smallest over time (average): Switzerland: -0.430.*

*Dollarization: Largest average over time: 1, Ecuador, Nigeria, Turkey
Minimum Average over time:0, Australia, Canada, Denmark, France, Finland, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA.*

*FDI: Largest Average over time: Bulgaria:0.07
Minimum Average Over Time: Netherlands: -0.05
Real Per capita Growth: Largest over time average: Latvia: 0.069
Lowest Over Time Average: Italy: 0.010*

Appendix 3: Data

- long-run real per capita GDP:
DATA: Source: WDI, (in DDP – Worldbank, Central databases, GDF& WDI),
SERIES: GDP per capita, PPP (constant 2005 international \$)
- log of initial GDP per capita, PPP in 1970 (see above)
- investment ratio (gross fixed capital formation relative to GDP) from 1970-2008
DATA: Source: IFS, (in DDP – Other Agency Databases, IMF, IFS),
SERIES: Gross fixed capital formation, line 93e
SERIES: Gross domestic product, line 99b
- degree of openness (exports+ imports) relative to GDP from 1970-2008
DATA: Source IFS, (in DDP – Other Agency Databases, IMF, IFS),
SERIES: Exports of Goods and Services, line 90c
SERIES: Imports of Goods and Services, 98c
SERIES: Gross domestic product, line 99b
- ratio of government consumption relative to GDP from 1970-2008
DATA: Source IFS, (in DDP – Other Agency Databases, IMF, IFS),
SERIES: Government Consumption Expenditure, line 91f
SERIES: Gross domestic product, line 99b
- population growth from 1970-2008
DATA: Source: WDI, (in DDP – Worldbank, Central databases, GDF& WDI),
SERIES: Population, total
- terms of trade shock (change in terms of trade) from 1990-2008
DATA: Source: WEO, (in DDP – Other Agency Databases, WEO),
SERIES: Terms of trade, goods and services (Index number)
- Financial Dollarization – yearly from 1990-2005:
 - a) DATA: Source Eichengreen et al. (2002)
 - b) DATA: Source BIS
SERIES: BIS reporting banks' local asset positions in foreign currency
DATA: Source IFS, (in DDP – Other Agency Databases, IMF, IFS),
SERIES: Foreign liabilities, line 26c
SERIES: Reserve Money, line 14
SERIES: Demand Deposits, line 24
- Sudden Stop Dummy: Trade balance minus changes in reserves (MONTHLY) from 1989M1-2008M12 expressed in 1995 prices, real GDP growth
DATA: Source IFS, (in DDP – Other Agency Databases, IMF, IFS),
SERIES: Trade balance, line 78acd
SERIES: Reserve assets, line 79dbd
SERIES: CPI, line 64
DATA: Source: WDI, (in DDP – Worldbank, Central databases, GDF& WDI),
SERIES: GDP (constant 2000 US\$)
- Absorption of tradable goods: sum of agricultural and industrial output minus exports
DATA: Source: WDI, (in DDP – Worldbank, Central databases, GDF& WDI),

SERIES: Agricultural, value added (current US\$)

SERIES: Industry, value added (current US\$)

SERIES: Imports of goods and services, (current US\$)

SERIES: Exports of goods and services, (current US\$)

- Current account deficit

DATA: Source: WDI, (in DDP – Worldbank, Central databases, GDF& WDI),

SERIES: Current account balance, BOP (current US\$)