FDI Flows and Sudden Stops in Small Open Economies*

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March 2020

Abstract

Balance of payment crises, characterized by Sudden Stops, are not a phenomenon exclusive to emerging economies. This paper identifies 16 and 50 crises in advanced and emerging economies, respectively. Further, decomposing the Financial Account uncovers important differences between both groups of economies in the Foreign Direct Investment (FDI) flows: the average net FDI in advanced economies is close to zero and in emerging economies is negative, and during Sudden Stop episodes, net FDI in emerging economies shows large contractions while advanced economies flows do not move at all. To quantify the FDI's channel effect on the dynamics of a crisis episode we develop a model with incomplete markets and an endogenous collateral constraint that generates endogenous Sudden Stops. The results from the model suggest that an emerging economy that increases the outflow FDI and eliminates the expropriation risk would reduce the long-run probability of a Sudden Stop from 2.9 to 1.3 percent.

Keywords: Sudden Stops; capital flows; foreign direct investment.

JEL codes: E21, F21, F32, G01.

*I am grateful to Alessandro Dovis, Dirk Krueger, Enrique G. Mendoza and Frank Schorfheide for valuable advice. I want to thank the participants of the Money-Macro Club at the University of Pennsylvania, the 2018 Macro Financial Modeling Summer Session, the 2018 Latin American Meeting of the Econometric Society and the 2018 European Winter Meeting of the Econometric Society for their comments. All remaining errors are my own.

Declarations of interest: none.

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"European stock funds suffered their largest redemptions in nearly six months... Investors pulled $1.4bn from European equity funds in the week ending August 30... It marks the largest redemptions since March..."

Joe Rennison and Eric Platt, The Financial Times, August 31, 2017

"Japan equity funds suffered record outflows in the past week as traders and investors turned defensive..."

Nicole Bullock, The Financial Times, October 20, 2017

"Investors continued to pull money out of US equity funds despite a rebound in share prices... Outflows from US equity funds moderated to $2.4bn for the week ending February 21..., after $6.2bn was withdrawn during the prior week..."

Joe Rennison, The Financial Times, February 23, 2018

1 Motivation

Most of the Sudden Stops (SS) literature has focused on emerging economies[1] neglecting that from 1990 to 2016 there have been 16 SS episodes in advanced economies (see Figure 1). Although, for the past almost three decades advanced economies have been experiencing episodes of capital outflows that have been associated only to emerging and fragile economies, the probability of experiencing a SS in an advanced economy is 20 percent smaller than in an emerging economy[2]. Is there any difference other than income levels driving these probabilities? This paper contributes to closing the literature gap by studying and contrasting SS episodes in advanced and emerging economies, focusing on the role of Foreign Direct Investment (FDI) through the lens of a small open economy framework.

[1]The terms emerging and upper-middle income will be used interchangeably, as well as the terms advanced and high income. The income threshold is taken from the World Bank classification.

[2]Specifically, using the panel database constructed in this paper, the probability in an advanced economy is 2.3 percent while for an emerging economy is 2.9 percent.

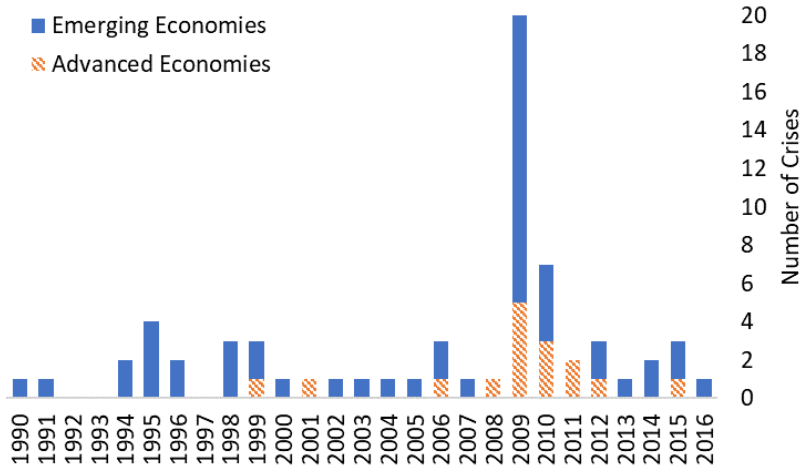


Figure 1: Number of Sudden Stops by year and by classification of economies.

This paper explores the complementaries between FDI and Portfolio Investment (PI). The mechanism through which both accounts interact is the following. As FDI enters an economy, the borrowing capacity of the economy increases because the amount of available collateral increases through two channels. First, the direct effect in emerging economies is that a fraction of the foreign stock of capital is subject to expropriation risk[3] and thus can be used as collateral to increase the borrowing capacity of the economy, and second, the indirect effect is that FDI flows affect the domestic price of capital and thus change the market value of all the available collateral in the economy (both domestic and foreign capital stocks). Both channels move the borrowing capacity of the economy in the same direction: less (more) foreign capital tightness (loosens) the borrowing constraint. This spillover effect from FDI to the borrowing constraint amplifies the negative shocks that hit an economy that is close to its debt limit. The above mechanism, together with a price deflation mechanism similar to the one introduced by Mendoza (2010), will generate endogenous Sudden Stop crises.

A Sudden Stop is defined as a large, fast, and unlikely outflow of capital in the Financial Account (FA) of the Balance of Payments Identity (similar definitions have been used by Calvo et al. (2006), Mendoza (2010), among others). At the aggregate FA level, every country that experiences a SS is similar since they all register a large capital outflow. However, after decom-

[3]Discussion and evidence of the fact that expropriation risk is only present in emerging economies will be presented in Sections 2 and 4.

posing the FA into its main components there are significant differences between emerging and advanced economies (see Figures 2 and 3 for a small sub-sample of economies from both groups). Advanced economies have net flows of FDI as a percentage of GDP that fluctuate around zero (some years positive and some years negative) while emerging economies tend to have only negative net flows (inflows of capital). This paper will focus on this difference between advanced and emerging economies and will explore the effects of FDI movements during crises.

A sizable literature, starting more than 25 years ago with Backus et al. (1992) and Baxter and Crucini (1995), has documented how international financial markets are a transmission mechanism of business cycles among economies. A strand of this literature, closely related to this paper, has studied business cycles in small open economies (see Heathcote and Perri (2002) and Garcia-Cicco et al. (2010)). However, the main focus of our paper is considerably narrower. We will measure the effect of the different characteristics of international capital flows, between emerging and advanced economies, on the dynamics and probability of a balance of payments crisis. In particular, this paper will study the differences between FDI and PI flows. Regarding the former, Albuquerque et al. (2005) study how an increase in FDI is related to global factors and higher integration in capital markets. In that paper, the authors argue that FDI may look similar to equity flows, although, the former does not depend on the existence of developed stock markets. For this reason, it seems more appropriate to use FDI given that capital liberalization has occurred in different stages of development for each country. They find that global factors have become more relevant and that these factors can explain better the dynamics of FDI since some local factor risks can be hedged due to the increase in financial liberalization. In line with the authors findings about the importance of global factors, our analysis will includes the international interest rate level and volatility as exogenous global factors. However, regarding local factors, this paper documents the importance of the expropriation risk for FDI and its effect during crises.

The two main components of the FA are Portfolio Investment and Direct Investment (FDI), which differ in maturity and volatility. As noted by Albuquerque (2003), FDI is a less volatile long-term position given natural constraints to rapidly withdraw illiquid investments. On the

other hand, Portfolio Investments have shorter maturity, since technological advances provide additional flexibility for the investments to leave an economy faster. Hence, from the perspective of international investors, the current opportunity cost of an investment (i.e. the international interest rate) is not the only moment affecting investment decisions, but also the current state of international volatility and its effect on future returns. Reinhart and Reinhart (2001) document that when volatility in the US interest rate is high, net FDI flows to emerging economies are 23 percent smaller. Therefore, introducing an element of time-varying volatility in the international risk provides a deeper understanding of the dynamics behind the different capital flows and the effect of having different FDI flows.

In terms of structural modeling, some characteristics of the FDI on which this paper focuses on have been previously documented in the literature. In Albuquerque (2003), the author argues that FDI is less volatile than other financial flows and that non-FDI flows are shorter-term investments facing less physical constraints to movement, and thus making it easier to flee a jurisdiction. The author proposes a model with enforcement constraints in which FDI is partly inalienable to the extent that it comprises intangible assets, and portfolio flows are subject to expropriation due to the lack international enforcement mechanisms. The author finds that more financially constraint economies should borrow more relatively through FDI. The model in our paper differs from his since we model portfolio flows to be subject to a loan-to-value constraint and we study the mechanism through which the risk of expropriation of FDI in emerging economies affects the debt capacity of the economy. Hence, in our paper, the risk of expropiation is one of the key elements that explain the difference between advanced and emerging economies. According to the World Bank (2017), 5 percent of foreign investment is expropriated in emerging economies and this risk is a major concern for multinationals when they choose where, when, and how much to invest. The World Bank, through the Global Investment Competitiveness group, surveyed executives of multinational corporations with investments in developing countries. They find that over 90 percent of all investors say that legal protections are critically important in the decision process of investing abroad. These guarantees include laws that protect against expropriation, breaches of contracts and arbitrary government conducts.

Regarding local factors, this paper contributes to the literature on emerging economies expropriation risk that has been studied by Thomas and Worrall (1994), Antras et al. (2009), Hajzler (2012), among others, by analyzing the effects of the risk of FDI expropriation on Sudden Stop crises. In particular, we study the complementarities between FDI and Portfolio flows, the relations between FDI and the debt capacity of the domestic economy, and the different exposure to crises between advanced and emerging economies. Lastly, our paper quantifies the effect of this risk in a small open economy model with financial frictions in which Sudden Stops arise endogenously.

Another closely related strand of the literature focuses on the real effect of time-varying volatility of the international interest rate. Justiniano and Primiceri (2008) estimate a large-scale DSGE model that allows time variation in the volatility of the structural innovations and conclude that volatility has decreased dramatically in the postwar era having a large effect on investment. Following this line of research, Fernández-Villaverde et al. (2011) document how changes in the volatility of the interest rate can have an effect on output, consumption, investment and hours worked even when the interest rate level does not change. The present paper contributes to this growing literature by introducing time-varying volatility to a small open economy model with an endogenous occasionally-binding constraint and quantifies the effect of time-varying volatility on the dynamics of the Balance of Payment accounts and GDP during a Sudden Stop.

All the previous works have studied real business cycles long-run moments. However, the focus of this paper is on the dynamics of Sudden Stops. Hence, our model will build on Mendoza (2010) work which introduces the debt-deflation mechanism to study SS episodes (Uribe and Schmitt-Grohé (2017) provide a textbook treatment of open economy models with collateral constraints). We follow this set-up to analyze the FDI channel during Sudden Stop crises. In particular, this paper studies the different characteristics of the capital flows between advanced and emerging economies and its effect on the dynamics of the economies during crises.

The rest of the paper is structured as follows. Section 2 describes the panel database constructed and shows empirical evidence on the importance of the FDI channel. In Section 3, we propose a small open economy model with financial frictions that incorporates both types of international

capital flows: Portfolio Investment and Direct Investment subject to expropriation risk, and allows for time-varying volatility in the international interest rate. Then, Section 4 presents the quantitative results from running simulations with calibrated parameters for each type of economy. We quantify how much of the differences in the probability of a Sudden Stop observed in the data can be accounted by the FDI channel and also perform an impulse response exercise to quantify the effects of temporal and permanent increases in the volatility of the interest rate and the expropriation risk. Finally, Section 5 concludes.

2 Empirical Evidence

The first point this paper aims to make is that Sudden Stop crises happen also in advanced economies. To accomplish this, we construct a panel database of 31 advanced and 75 emerging economies from 1990 to 2016. The economies were selected according to the classification of the World Bank of high income economies (advanced) and upper-middle income economies (emerging)[4]. Following Calvo et al. (2006), we identify a SS episode as a large outflow of capital from an economy. Specifically, a change in the Financial Account as a percentage of GDP 2 standard deviations above the historical mean in a year will be considered a SS episode. Figure 1 shows the number of crises per year for both groups of economies. There have been 16 crises in advanced and 50 crises in emerging. This evidence suggests that SS are not a phenomenon exclusive of emerging economies although they are more probable than in advanced economies. Moreover, the distribution of capital outflows in emerging economies shows fatter tails. The average Kurtosis coefficient for an emerging economy is 2.0 while for advanced economies is 0.9. This evidence suggests that there is a fundamental difference between both groups of economies regarding how net international flows enter and leave the economies. Figure 1 also highlights the importance of global factors since SS crises do not happen in isolation; there seems to be a clustering of episodes during the mid 90's, early 2000's, and during the great recession years. Given this evidence, we state the following Fact 1.

[4]See the Appendix for the list of countries in each group.

Fact 1: The probability of a SS in advanced economies is 20 percent smaller than in emerging and the distribution of outflows in emerging economies shows fatter tails.

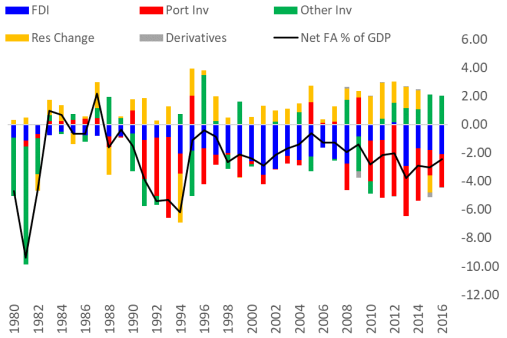
2.1 Differences in the FDI flows and the capital stock

Although at the aggregate level of the Financial Account a crisis seems similar between economies (see Figure 4b), a decomposition of the FA suggests fundamental differences between both groups of economies. The mean[5] net FDI to GDP flow for emerging economies is -3.9 percent (negative sign corresponds to inflows) while for advanced economies is -0.3 percent, and the mean inflow FDI to GDP flow for both emerging and advanced economies is -5.1 percent. These percentages suggest that net FDI and inflow FDI are similar in emerging economies while very different in advanced. Moreover, the net FDI account in the former is mainly an inflow account: capital is only flowing into the economy. While for advanced economies, similar magnitudes of inflows and outflows of capital are registered such that the net FDI is around zero and even positive in some years. Hence, emerging economies only have inflows of capital while advanced economies attract capital and invest abroad approximately in the same magnitudes possibly due to diversification motives.

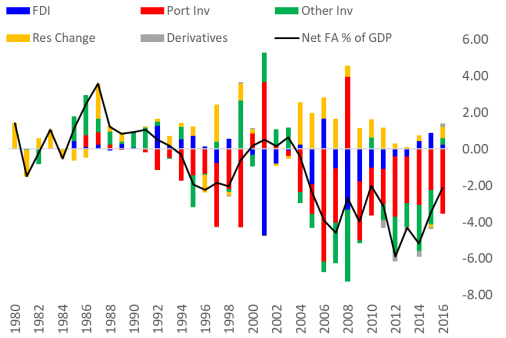
Figures 2 and 3 show the decomposition of the Financial Account for a subsample of 4 economies for each group. Emerging economies (Figure 2) consistently have negative FDI flows. This means that capital from abroad is flowing into the economy. As a global resource constraint would imply, this capital is coming from another economy, which most likely is an advanced economy. Figure 3 gives evidence that advanced economies have both positive and negative large flows of FDI. Hence, let Fact 2 be:

Fact 2: The mean net FDI as a percentage of GDP flow for emerging economies is -3.9 percent and for advanced is -0.3 percent.

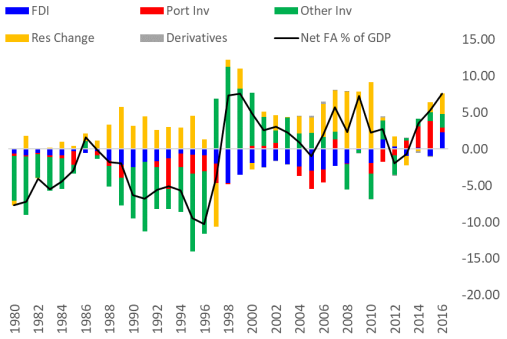
[5]To obtain the following statistics we averaged each country across time and then took the mean across countries.



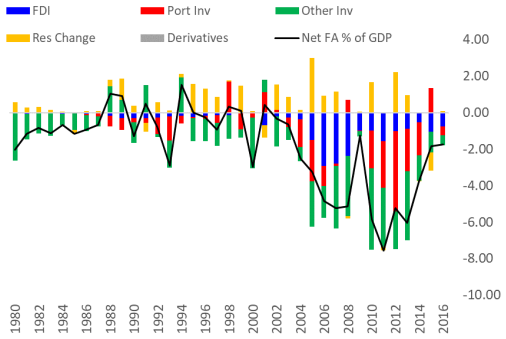
(a) Mexico



(b) South Africa

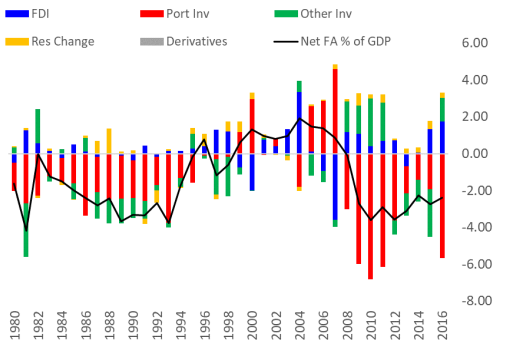


(c) Thailand

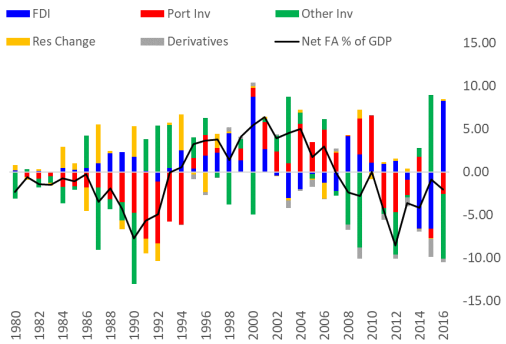


(d) Turkey

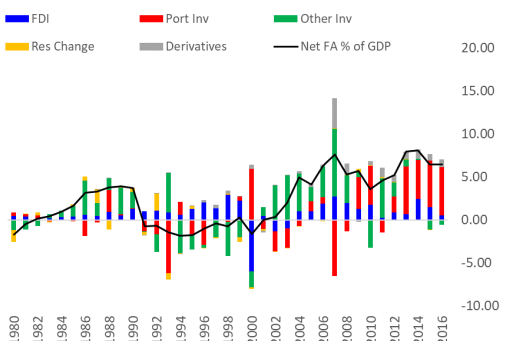
Figure 2: Financial Account in Emerging Economies. Source: World Bank WDI and IMF.



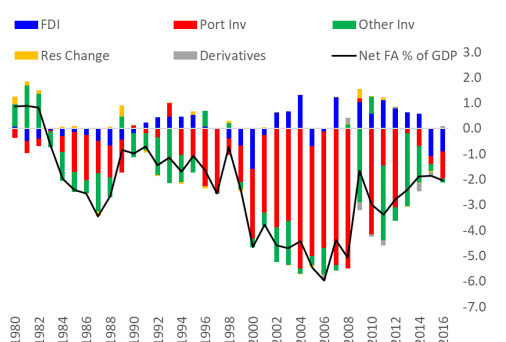
(a) Canada



(b) Finland



(c) Germany



(d) United States

Figure 3: Financial Account in Advanced Economies. Source: World Bank WDI and IMF.

Lastly, estimates of the total stock of capital in each group of economies also show significant differences. Advanced economies have a stock of capital to GDP ratio 15 percent larger than emerging economies[6]. Given this evidence, we state Fact 3.

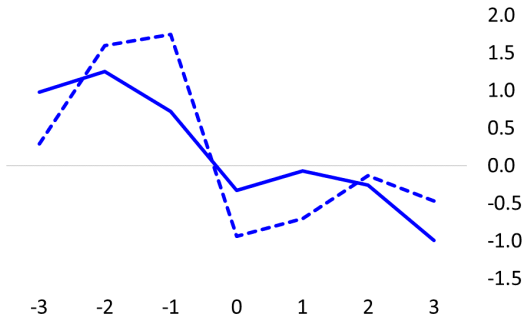
Fact 3: The mean capital to GDP ratio in advanced economies is 2.4 and in emerging economies is 2.1.

Facts 2 and 3 can be rationalized as follows: under a national aggregate production function with diminishing marginal returns to capital and no domestic investment, emerging economies that have smaller stocks of domestic capital relative to advanced economies will have a greater rate of return on capital and will attract a larger amount of international capital inflows.

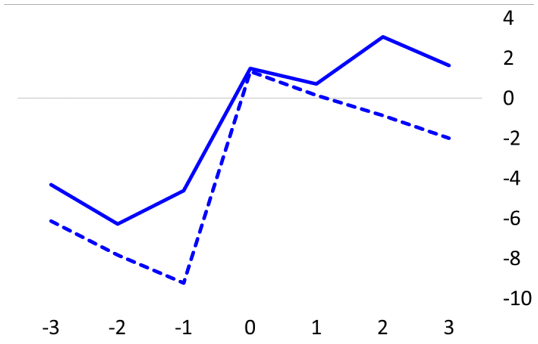
These differences can be seen not only at a business cycle level among the whole sample but also during Sudden Stop episodes. Figure 4 shows median GDP, FA, FDI, and Portfolio plus Other Investments during crisis episodes for both classifications of economies. The graphs are centered around period 0 that corresponds to the period identified as a SS. Even when the method to identify a crisis does not include directly a drop in the GDP, Figure 4a shows a drop in the cycle component of the GDP for both groups. In this sense, SS's are accompanied by declines in the production that are 1.5 percentage points more severe in emerging economies. We can see in Figure 4b that at the aggregate level, the FA as a percentage of GDP follows a similar movement in both economies although, before the SS, emerging economies have a more negative position, of around 4 percentage points more than advanced economies. However, after decomposing into FDI and PI (that also includes Other Investments) we can see a clear difference between groups. On the Portfolio side (Figure 4c), although both groups show similar movements, before the SS, advanced economies have a more negative position and the contraction during the crisis is larger. Figure 4d shows two clear differences between both groups of economies: the FDI flows previous to a SS account for almost half of the FA deficit in emerging economies (4 percent) while for advanced economies the flows are close to zero, and emerging economies suffer a large correction in FDI the year of the SS (1.5 percentage points) while advanced economies can smooth it out. This second difference might suggest that multinational corporations seem to behave different if

[6]Capital stock estimated are obtained from the IMF Investment and Capital Stock Dataset, see International Monetary Fund (2015).

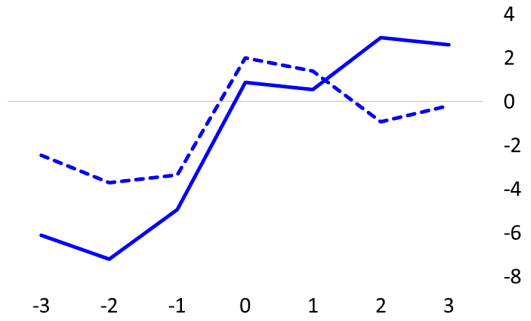
they have invested in emerging or in advanced economies. Whenever there is a crisis in an emerging economy, international investors will move their FDI investments out of such economy while if the crisis happens in an advanced economy they are more resilient to move their investments. However, Figure 4e suggests that this is not the case.



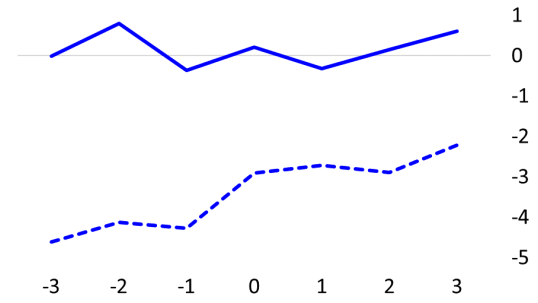
(a) GDP cycle



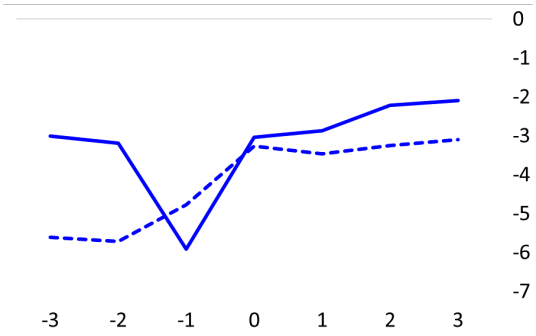
(b) Financial Account as a percentage of GDP



(c) Portfolio and Other Inv. as a percentage of GDP



(d) FDI as a percentage of GDP



(e) Inflow FDI as a percentage of GDP

Figure 4: Event Study of a Sudden Stop. Solid (dashed) lines correspond to advanced (emerging) economy.

Figure 4e shows the inflow FDI event study analysis for both groups of economies. The graph suggests that multinational corporations react in the same way in both groups of economies. Whenever the crisis hits the domestic economy, FDI investments are pulled out of the economy (independently if it is advanced or emerging). Hence, the difference between groups comes from domestic investors and relies on the fact that advanced economies have outflow FDI investments of the same magnitude as the inflows they receive and these outflows react and move in opposite ways to the inflows such that the net FDI account is around zero, even when the crisis hits the advanced economy. In this sense, outflow FDI investments serve as buffer savings in advanced economies that let them smooth their Financial Account account whenever the economy enters a Sudden Stop episode and possible prevents them from experiencing more severe crises more frequently.

2.2 Importance of the international volatility

The Financial Account records transactions that involve financial assets and liabilities that take place between residents and non-residents. Its two main components, FDI and Portfolio Investment, are different in nature. According to the International Monetary Fund (2013):

> *"Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy."*

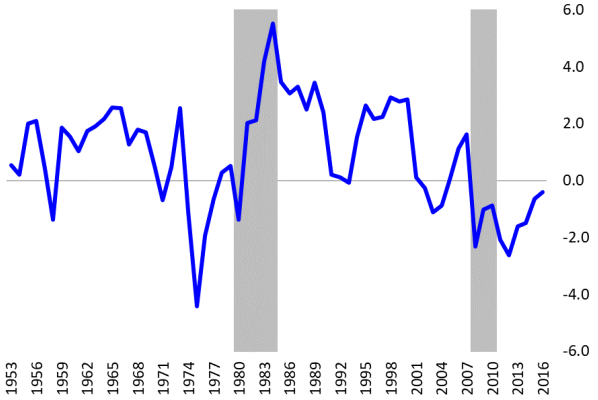
and,

> *"Portfolio investment is defined as cross-border transactions and positions involving debt or equity securities, other than those included in direct investment or reserve assets."*

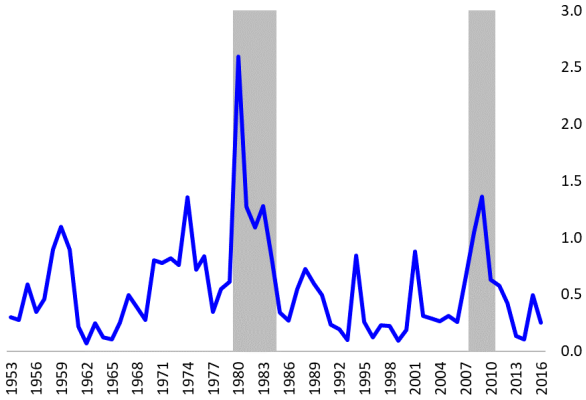
Hence, these accounts involve international transactions of different things. Portfolio investments are the exchanges of financial securities while Direct investments are the exchanges of control (ownership) of enterprises. From the perspective of an international investor (noted earlier by

Albuquerque (2003)), FDI is a less volatile longer-term investment while Portfolio could be short-term. Given the different possible maturities of each investment, not only the current interest rate is relevant but also its volatility. Moreover, Reinhart and Reinhart (2001) find that when volatility in the US interest rate is high net FDI flows to emerging economies are 23 percent smaller.

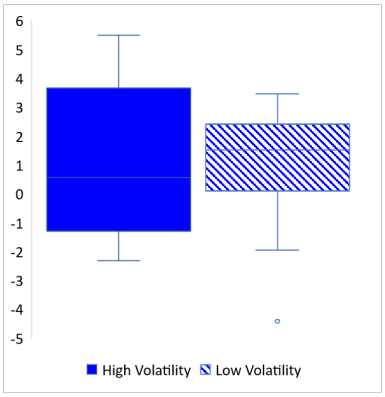
Following the literature on high frequency data we construct a proxy of the volatility of the US interest rate using its realized volatility. Using average monthly series (intra-period information) we estimate the standard deviation for a year (period length of analysis) and use it as a proxy for international volatility. Figure 5 shows the 3-Month Treasury Bill real rate[7] for the US and its realized volatility.



(a) US Real Rate Average %



(b) US Real Rate Realized Volatility



(c) US Real Rate Box Plot

Figure 5: US real interest rate and realized volatility. The gray area corresponds to high volatility periods. Source: FRED.

[7]The nominal rate was converted to a real rate using the past 12 months inflation.

Having documented the importance of the FDI flows and the state of the international volatility to study Sudden Stop episodes, the next section will describe the proposed model that incorporates both elements.

3 Model

3.1 Environment

This paper proposes a standard real business cycle of a small open economy model (RBC-SOE) with an endogenous occasionally-binding constraint, a fixed domestic stock of capital, and foreign investment subject to expropriation risk. The model builds from Mendoza (2010) with two new elements: an FDI channel and time-varying volatility in the international interest rate.

The economy is inhabited by an infinitely lived household with preferences defined over stochastic sequences of consumption and labor $\{c_t, L_t\}$ for $t = 0, ..., \infty$. The preference specification is:

$$\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t u(c_t, L_t) \right], \text{ where } u(c_t, L_t) = \frac{(c_t - \frac{L_t^{\omega}}{\omega})^{1-\nu}}{1-\nu} \tag{1}$$

The GHH type utility function proposed by Greenwood et al. (1988) is commonly used in RBC-SOE models since the wealth effects on the labor supply are eliminated and a closed form expression for the labor supply can be obtained.

The representative household has access to a non-state-contingent bond, b_{t+1}, that pays one unit in the next period with price equal to the inverse international interest rate factor, $q_t = (1+r_t)^{-1}$. The household will choose sequences of consumption, supply of labor and bond positions to maximize her lifetime expected utility subject to the following period budget constraint:

$$c_t + q_t b_{t+1} = w_t L_t + r_{k,t}\bar{k} + b_t + T_t \tag{2}$$

The agent income comes from the labor income, $w_t L_t$, plus the capital income from the fixed domestic stock of capital owned by the agent, $r_{k,t}\bar{k}$, plus any bond position coming from the

previous period, b_t, plus any transfers from the government, T_t. On the expenditure side, the agent will buy consumption (numeraire good with normalized price equal to 1) goods, c_t, plus the next period bond position, b_{t+1}, multiplied by its price, q_t. However, next period bond position is subject to a collateral constraint:

$$q_t b_{t+1} \geq -\kappa[q_{k,t}\bar{k}] - \kappa_{f,t}[q_{k,t}k_{f,t+1}] \tag{3}$$

The household will not be able to issue more debt (negative bond positions) than a constant fraction κ of the market value (the capital, both locally and foreign owned, has price[8] $q_{k,t}$) of the fixed domestic capital stock, $\bar{k}$, plus a stochastic fraction $\kappa_{f,t}$ of the market value of the next period foreign stock of capital in the economy, $k_{f,t+1}$. The market value is the price of the capital multiplied by the corresponding stock of capital (i.e. for the domestic capital, the market value is $q_{k,t}\bar{k}$). The fraction $\kappa_{f,t}$ corresponds to the exogenous probability that the government expropriates the foreign capital.

The consumption good is produced by a single firm with a constant-returns-to-scale production function, that uses labor and capital as production inputs, and is exposed to a stochastic total factor productivity (TFP) shock, $y_t = \exp(\epsilon_t)AK_t^{\alpha}L_t^{1-\alpha}$. Total capital demanded by the firm, K_t, is composed of the exogenously fixed domestic stock, $\bar{k}$, and an endogenous foreign stock (FDI), $k_{f,t}$, which are additive perfect substitutes: $K_t = \bar{k} + k_{f,t}$. The firm, which is owned by the household and has zero profits, chooses every period how much capital to rent at the competitive rate, $r_{k,t}$, and how much labor to demand for a competitive wage, w_t. Both input prices are taken as given by the firm. The TFP shock, ϵ_t, follows a first-order Markov process. The international interest rate, r_t, follows a stochastic process with time-varying volatility, σ_t, that follows a regime-switching process. The stochastic process's will be specified at the end of this section.

There is also an international investor that chooses sequences of foreign capital to invest in the economy and rent to the domestic firm (note that the rental rate will be such that the

[8]Following Mendoza (2010) and Mendoza and Villalvazo (2020), in the competitive equilibrium the price of capital will be obtained from Tobin's Q investment optimality condition: $q_{k,t} = \partial\tilde{I}_t/\partial K_{t+1}$

foreign capital market will clear), $k_{f,t}$ for $t = 1, ..., \infty$, as to maximize the expected present discounted value of profits paid to their global shareholders (a similar setup was introduced in Mendoza and Smith (2006)) with the addition that the international investor takes into account the expropriation risk. The objective function of this investor is:

$$\sum_{t=0}^{\infty} \mathbb{E}_0 \left[M_t \left\{ r_{k,t} k_{f,t} (1 - \kappa_{f,t}) - (k_{f,t+1} - (1 - \delta)(1 - \kappa_{f,t}) k_{f,t} + \Phi(k_{f,t+1}, k_{f,t}) \right\} \right] \quad \text{given } k_{f,0}$$

Where M_t is the stochastic discount factor used by the financial institution (we will assume $M_t = q_t = \frac{1}{1+r_t}$). The function $\Phi(k_{f,t+1}, k_{f,t}) = \frac{\phi}{2} \frac{(k_{f,t+1} - k_{f,t})^2}{k_{f,t}}$ corresponds to a standard quadratic adjustment cost function incurred by the international investor to move capital globally.

Lastly, the government will play a simple but crucial role of expropriating foreign capital and transferring these resources to the agent in a lump-sum transfer T_t every period.

As noted above, the exogenous stochastic shocks of the model are four: the TFP shock ϵ_t, the international interest rate r_t, the international interest rate volatility σ_t, and the expropriation risk $\kappa_{f,t}$. The TFP shock will follow a standard independent AR1 process. The interest rate will follow an AR1 process with time-varying volatility:

$$r_t = (1 - \rho_{\sigma_r})\bar{r} + \rho_{\sigma_r} r_{t-1} + \sigma_t \epsilon_{r,t} \ , \quad \epsilon_r \sim N(0, 1)$$

The volatility, σ_t, will follow a regime-switching process between low and high periods of volatility. Finally, the probability of expropriation will also follow a regime-switching process between low and high probability of expropriation periods (independent of all the other processes).

3.2 Recursive competitive equilibrium

The individual state variables are today's bond position b, the foreign owned capital stock in the economy k_f, and the exogenous state vector of shocks composed by TFP shock, the international interest rate and its volatility and the probability of expropriation: $s = (\epsilon, r, \sigma, \kappa_f)$, and the aggregate state variable is today's aggregate total capital K. In the recursive formulation

variables with a prime, $'$, correspond to the next period.

Household's problem:

$$\begin{aligned}
v(b,s;K) = &\max_{c,L,b'} \quad u(c,L) + \beta\mathbb{E}[v(b',s';K')|\sigma(s)] \quad s.t. \\
&c + q(s)b' = w(s;K)L + r_k(s;K)\bar{k} + b + T(s;K) \text{ , Budget Constraint,} \\
&q(s)b' \geq -\kappa[q_k(s;K)\bar{k}] - \kappa_f(s)[q_k(s;K)k'_f(s;K)] \text{ , Debt Constraint,} \\
&K' = H_K(s;K) \text{ , Rational Expectations of the household.}
\end{aligned}$$

Let $\lambda(b,s;K) \geq 0$ be the multiplier on the budget constraint and $\mu(b,s;K) \geq 0$ on the debt constraint, then first order conditions are:

$$\begin{aligned}
\left(c - \frac{L^\omega}{\omega}\right)^{-\nu} =& \lambda(b,s;K) \\
\left(c - \frac{L^\omega}{\omega}\right)^{-\nu}(-L^{\omega-1}) =& \lambda(b,s;K)w(s;K) \\
\beta\mathbb{E}[v_{b'}(b',s';K')|\sigma(s)] =& \lambda(b,s;K)q(s) - \mu(b,s;K)q(s) \\
0 =& \mu(b,s;K)[q(s)b' + \kappa[q_k(s;K)\bar{k}] + \kappa_f(s)[q_k(s;K)k'_f(s;K)]]
\end{aligned}$$

We can see from the last first order condition how the introduction of expropriation risk loosens the constraint on the maximum amount of debt that the economy can hold.

Firm's problem:

$$\begin{aligned}
&\max_{K,L} \ \exp(\epsilon(s))AK^\alpha L^{1-\alpha} - w(s;K)L - r_k(s;K)K \\
&\Rightarrow \text{F.O.C.:} \\
r_k(s;K) =& \alpha\exp(\epsilon(s))AK^{\alpha-1}L^{1-\alpha} \\
w(s;K) =& (1-\alpha)\exp(\epsilon(s))AK^\alpha L^{-\alpha}
\end{aligned}$$

Foreign Investor's problem:

$$
\begin{aligned}
v_f(k_f, s; K) = &\max_{k'_f > 0} \; r_k(s; K) k_f (1 - \kappa_f(s)) - I + \frac{1}{1 + r(s)} \mathbb{E}[v_f(k'_f, s'; K') | \sigma(s)] \quad s.t. \\
&I = k'_f - (1 - \delta) k_f (1 - \kappa_f(s)) + \Phi(k'_f, k_f) \\
&K' = H_K(s; K) \\
&\Rightarrow \text{F.O.C.:} \\
1 + \Phi_1(\cdot) = &\frac{1}{1 + r(s)} \mathbb{E}[r_k(s'; K')(1 - \kappa_f(s')) + (1 - \delta)(1 - \kappa_f(s')) + \Phi_2(\cdot') | \sigma(s)]
\end{aligned}
$$

Where $\Phi(k'_f, k_f) = \frac{\phi}{2} \frac{(k'_f - k_f)^2}{k_f}$ and $\Phi_n(\cdot)$ corresponds to the first derivative of the adjustment cost function with respect to the n argument.

From the first order condition we can see how the introduction of the expropriation risk distorts the optimal decision of the international investor. In the current period, the investor takes into account that if there is a positive probability of being in a state with positive κ_f in the future, the expected return on the investments will be lower. Hence, optimality is achieved with a lower level of foreign capital (less FDI enters the economy).

Finally, the Recursive Competitive Equilibrium is given by the allocation functions $\{c(b, s; K),\ L(b, s; K),\ b'(b, s; K),\ k'_f(k_f, s; K),\ T(s; K)\}$, the price functions $\{w(s; K),\ r_k(s; K),\ q_k(s; K),\ q(s)\}$ and the functions $\{v(b, s; K),\ v_f(k_f, s; K),\ H_K(s; K)\}$ such that:

1. Given the prices, the functions $\{c(b, s; K),\ L(b, s; K),\ b'(b, s; K)\}$ solve the household's problem.

2. Given the prices, the firm maximizes profits.

3. Given the prices, the function $k'_f(k_f, s; K)$ solves the Foreign Investor's problem.

4. The price of the bonds satisfies $q(s) = (1 + r(s))^{-1}$ and the price of the capital satisfies Tobin's Q optimality condition $q_k(s; K) = \partial I(K', K) / \partial K'$

5. The capital market clearing condition is satisfied:

   $K = \bar{k} + k_f$

6. The representative agent's condition is satisfied:

   $K' = H_K(s; K) = \bar{k} + k'_f(K - \bar{k}, s; K)$

7. The government's budget is balanced:

   $T(s; K) = \kappa_f(s) k_f [r_k(s, K) + 1 - \delta]$

4 Quantitative Analysis

In this section we report the results obtained after solving the model calibrated to an emerging and an advanced economy.

4.1 Calibration

The parameters of the utility function and the capital depreciation rate were taken from the literature with studies that used data from the Mexican economy. In particular, the risk aversion coefficient, ν, equal to 2 and the labor parameter that determines the wage elasticity of labor supply, ω, equal to 1.85 were taken from Mendoza (2010). The annual depreciation rate, δ, equal to 8.8 percent and was taken from Garcıa-Verdú (2005).

Regarding the parameters that were calibrated to match specific moments of the data[9], the discount factor, β, equal to 0.956 was calibrated to match the probability of a Sudden Stop of 2.9 percent in emerging economies. The fix domestic capital stock, $\bar{k}$, for an emerging (advanced) economy was set to 1.90 (3.14) to match the average FDI to GDP percentage of -3.9 (-0.3) percent. The share of capital, α, was set to 0.23 to match the average capital to GDP ratio for an emerging economy of 2.1. The debt fraction of domestic collateral, κ, was set to 0.22 to match Mexico's Debt to GDP ratio of -35 percent. Lastly, the adjustment cost coefficient, ϕ, equals 8.5 to match the median ratio of Portfolio flows standard deviation to FDI flows standard deviation of 1.85 in emerging economies.

With respect to the exogenous process, the 3-Month Treasury Bill for the US was used as a

[9]The data used to calibrate the emerging economy model consists of averages from the sample of emerging economies data and for some parameters data only for Mexico was used.

proxy for the international interest rate and was converted to a real rate using the past 12 months inflation. Intra-period data (monthly) was used to construct period (yearly) realized volatility. The volatility process is assumed to follow a two-state regime-switching process. To identify the different volatility periods we divided the sample from 1953 to 1984 and from 1985 to 2016, the latter period is also known as the Great Moderation era. Then, high volatility periods were identified to start the first year in which the volatility was 2 standard deviations above the historical mean, for each sub-sample, and lasted all the subsequent years for which the volatility was a quarter of a standard deviation above the mean. The resulting high volatility episodes are from 1980 to 1984 which is known as the period of highly active monetary policies made by Federal Reserve Chairman Paul Volcker to control inflation[10] and from 2008 to 2011 which were the years of the Great Recession. The low volatility episodes are from 1953 to 1979 and from 1985 to 2007 (see Figure 5). Finally, the volatility process calibration is set to capture the average duration of low volatility periods of 25 years and of high volatility periods of 4 years[11]. The resulting transition probabilities are $F_{ll} = 0.94$ and $F_{hh} = 0.60$. The value for the low volatility is set to the average of both low volatility periods: $\sigma_l = 0.44$ percent. Then, given the long-run probabilities implied by the duration of each period, high volatility is set to $\sigma_h = 1.20$ percent to match the full-sample 1953-2016 average volatility of 0.55 percent.

For the interest rate process, the Tauchen and Hussey (1991) discretization algorithm was used with 5 grid points, mean interest rate of 0.7 percent, and autocorrelation coefficient 0.479 for the high volatility process and 0.799 for the low volatility process. The autocorrelation coefficients were estimated using the periods identified in Section 2.2. Regarding the TFP shock, the autoregressive coefficient and standard deviation were set to commonly used values for small open economies of 0.54 and 2.58 percent respectively (Bianchi (2011)).

Finally, the debt fraction of foreign collateral κ_f is assumed to follow a two-state regime-switching process. The parameter κ_f will take the value of 0 for low-risk periods and 0.05 for high-risk periods following the evidence documented in World Bank (2017). The transition matrix

[10] Bianchi (2012) finds that the appointment of Volcker marked a change in the conduct of monetary policy.

[11] The sample used starts at the beginning of a full observed period of low volatility and ends at the end of a full observed period of high volatility.

calibration is set to capture the length of a full presidential term in Mexico of 6 years for high-risk periods, and for the low-risk periods, the duration is calibrated such that when there is no expropriation risk the average capital to GDP ratio is equal to the advanced economies average of 2.4. Table 1 shows the calibrated parameters.

Table 1: Calibrated Parameters

Parameter		Value	Source or Target
Common in the literature			
ν	Risk aversion	2	From Mendoza (2010)
ω	Determine wage elasticity	1.85	From Mendoza (2010)
δ	Depreciation rate	8.8%	From Garcıa-Verdú (2005)
A	TFP level	1.0	Normalized value
Matched moments			
β	Discount factor	0.956	Match SS probability of 2.9%
$\bar{k}_{EE}$	Fix capital stock for emerging eco.	1.90	Match FDI/GDP% = -3.9 for emerging eco.
$\bar{k}_{AE}$	Fix capital stock for advanced eco.	3.14	Match FDI/GDP% = -0.3 for advanced eco.
α	Share of capital	0.23	Match K/GDP = 2.1 for emerging eco.
κ	Debt fraction of domestic collateral	0.22	Match Mexico's Debt/GDP ratio -35%
ϕ	FDI adjustment cost	8.5	Match s.d.(PI)/s.d(FDI) = 1.85 in emerging eco.
Exogenous process			
$\bar{r}$	Mean interest rate	0.7%	Match US average real interest rate data
r	Interest rate values in percent	{-0.8, 0.0, 0.7, 1.4, 2.3}	Discretized using Tauchen and Hussey (1991)
ρ_r	Interest rate AR1 coefficient	{0.799,0.479}	Estimated using low and high volatility periods
σ_l	Low volatility s.d.	0.44%	Match average of low volatility periods
σ_h	High volatility s.d.	1.20%	Match average full sample volatility
F_{ll}	Transition probability σ_l to σ_l	0.94	Match duration of low volatility periods
F_{hh}	Transition probability σ_h to σ_h	0.60	Match duration of high volatility periods
ρ	TFP autoregressive coefficient	0.58	From Bianchi (2011)
σ	TFP autoregressive s.d.	2.58%	From Bianchi (2011)
κ_f	Collateral fraction of foreign capital	{0, 0.05}	World Bank (2017) 5% of expropriation
$F_{ll,\kappa}$	Transition probability $\kappa_{f,l}$ to $\kappa_{f,l}$	0.92	Match K/GDP = 2.4 when no exp. risk
$F_{hh,\kappa}$	Transition probability $\kappa_{f,h}$ to $\kappa_{f,h}$	0.83	Match presidential term in Mexico (6 years)

4.2 Quantitative results

This paper explores the role of FDI during Sudden Stop episodes. In particular, the analyzed mechanism has two effects: the direct effect that comes from having a positive probability of expropriation and hence increasing the debt capacity of the economy, and the indirect effect that comes from movements in the FDI account during a crisis that affects the price of capital and hence the market value of all the collateral.

To account for the role of FDI, we compare the results obtained from an emerging economy following the calibration proposed in Section 4.1 with the results obtained from the calibration of an advanced economy. To discipline the quantitative results, the advanced economy calibration will defer only in two ways from the emerging economy calibration. First, as noted in Section 3, the advanced economy will have a larger stock of domestic capital (this is a proxy to having outflow FDI and hence reduce the net FDI position), and second, following the World Bank (2017), the advanced economy will not be exposed to any expropriation risk. To additionally motivate that advanced economies have no expropriation risk we use the International Country Risk Guide[12] (ICRG) database. In particular, we will use the variable that corresponds to Investment Profile (*inv*) to document any correlation evidence between expropriation risk and FDI in both groups of economies. The *inv* variable takes values from 0 (very high risk) to 12 (very low risk). Column (1) of Table 3 shows the results from a descriptive panel regression model that includes as explanatory variables the lag US interest rate level, the lag US interest rate volatility, the interaction of the *inv* variable with both a dummy variable for advanced economies and a dummy variable for emerging economies and country Fixed Effects. From the coefficients of the interaction of the investment profile variable we get two results. First, focusing on the effect of investment risk in advanced economies (*-inv * Dummy Adv*), the regression coefficient is not statistically different from zero suggesting that in fact, the expropriation risk is only present in emerging economies. Second, the coefficient for the emerging economies (*-inv * Dummy Eme*) is highly significant and negative meaning that more risk decreases the FDI flows into the economy

[12]The ICRG database is a well-known source for political and economic risk measures and has been used by Herrera et al. (2020) among others.

(since the regression is done with -*inv*, higher numbers mean more risk). Hence, as expected, expropriation risk increases the cost of FDI, disincentives multinationals to invest in the domestic economy, and is only present in emerging economies.

After solving both models[13], we simulated 200,000 periods and dropped the first 10,000 points. Table 2 shows the moments of the simulated data for both classifications of economies. To discipline the results we match Fact 2 and Fact 3 described in Section 2 and will use the structural model to quantify the role of the FDI channel in the probability of a Sudden Stop (Fact 1).

Concerning the business cycle moments, the middle section of Table 2 shows that the calibrated models are consistent with advanced economies having larger GDP per capita than emerging economies and having more debt-to-income ratios. The model suggests that advanced economies are 11 percent larger than emerging and have 46 percent more debt relative to their GDP than emerging economies. Also, in line with the evidence presented in Section 2, the capital outflows distribution for the advanced economy model has thinner tails and a Kurtosis coefficient 1 unit below the coefficient in the emerging economy model.

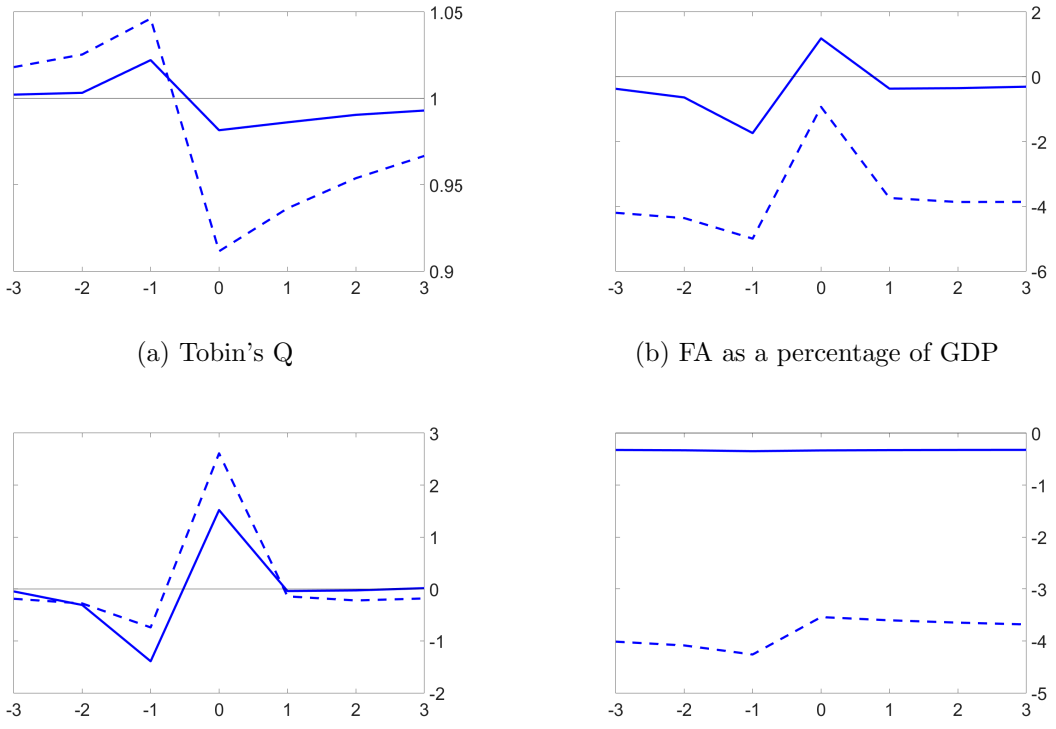
Finally, with respect to the probability of a Sudden Stop (Fact 1), the model suggests that an emerging economy that increases the outflow FDI and eliminates the expropriation risk would reduce the probability of a Sudden Stop to 1.3 percent.

Table 2: Simulated Statistics

	Emerging Eco.	Advanced Eco.	
Matched Business Cycles Moments			
Mean FDI / GDP %	-3.9%	-0.3%	Fact 2
Mean Capital / GDP	2.1	2.4	Fact 3
Business Cycle Moments			
Mean GDP (index EE = 100)	100	111	
Mean Debt / GDP %	35%	51%	
Kurtosis of capital outflows	4.7	3.6	Fact 1
Sudden Stops			
Long-run prob. of SS (matched for EE)	2.9%	1.3%	Fact 1

[13]We use the *FiPIt* algorithm proposed by Mendoza and Villalvazo (2020). Note that a global solution method is required due to the time-varying volatility in the interest rate and the high non-linearities that models with occasionally-binding constraints are characterized to show in the policy functions.

Figure 6 shows the simulated dynamics of the variables of interest during a Sudden Stop. With respect to the price of the capital (Tobin's Q), the drop in the emerging economy model is about 8 percent and this drop is 6 percentage points larger than in the advanced economy model. Regarding the Financial Account, advanced economies have smaller deficits in the FA, while emerging economies show a larger contraction in the FA consistent with the data presented in Figure 4. This difference is due mainly to the FDI channel since both groups show similar dynamics in the Portfolio flows. Also in line with the data, advanced economies have a larger deficit in the Portfolio flows and register a larger contraction during the Sudden Stop. Finally, there is a large contraction in FDI flows in the emerging economy and no movement in advanced economies also consistent with the evidence presented in Section 2.



(a) Tobin's Q

(b) FA as a percentage of GDP

(c) PI as a percentage of GDP

(d) FDI as a percentage of GDP

Figure 6: Simulated Event Study of a Sudden Stop. Solid (dashed) lines correspond to advanced (emerging) economy model.

Finally, in Column (2) of Table 3, we compare the results obtained from a descriptive regression using the simulated data from the model with the results obtained from the panel database in

Column (1). Since the expropriation risk is only present in the emerging economy model, instead of having the investment risk interaction with a dummy variable for each economy group, we use the time series of the probability of expropriation κ_f to measure the effect of expropriation risk in emerging economies. We can see that the results from the simulated data obtained from the model are consistent qualitatively with the results from the panel database.

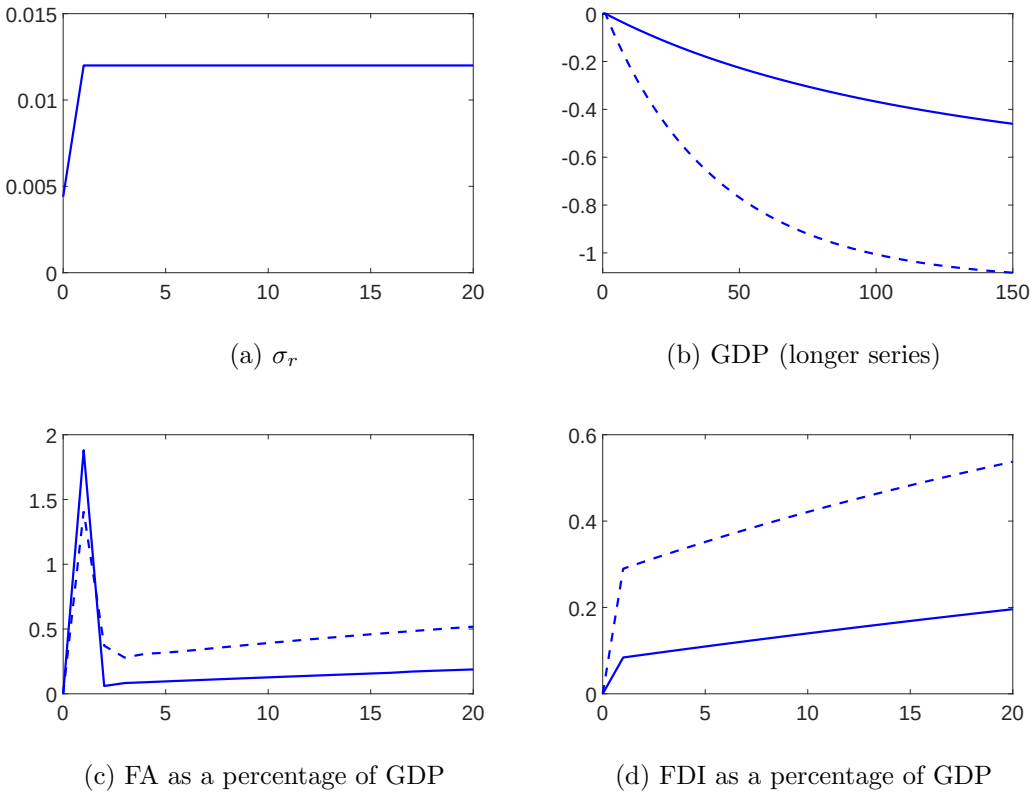
Table 3: Descriptive Regression

	Dependent variable: -FDI / $GDP_{i,t}$ %	
	Real Data (1)	Simulated Data (2)
r_mean$_{US,t-1}$	-0.452^{**}	-0.030^{***}
	(0.183)	(0.003)
r_vol$_{US,t-1}$	0.580	-1.041^{***}
	(0.751)	(0.010)
-inv * Dummy Adv	0.430	–
	(0.264)	
-inv * Dummy Eme	-0.524^{**}	–
	(0.249)	
$\kappa_{f\ i,t}$	–	-2.718^{***}
		(0.018)
Country FE	*YES*	*YES*
Observations	1,923	389,997
R^2	0.199	0.629
Note:		*p<0.1; **p<0.05; ***p<0.01

In terms of the signs of the coefficients, the model does a successful job. With simulated data, the regression coefficients with respect to the interest rate level and volatility are negative. An interpretation of this is that as the international interest rate increases, the opportunity cost of FDI investment increases and capital that had previously enter the economy will be reallocated and invested at the international rate. Concerning the volatility coefficient, in line with the results from Reinhart and Reinhart (2001), with simulated data the regression coefficient suggests that as the volatility increases FDI decreases while the coefficient using real data is not statistically significant. Finally, the coefficient for investment risk (κ_f in the simulated data) in the emerging economies is highly significant and negative for both real data and simulated data. Suggesting that as investment risk increases, net FDI flows into the domestic economy decrease.

4.3 Impulse response analysis

As documented in Fernández-Villaverde et al. (2011), changes in volatility affect real term variables. This paper extends their analysis to study how changes in volatility can cause Sudden Stops and quantifies the effect on the Financial Account flows and the GDP. Figure 7 corresponds to a permanent increase in the US interest rate volatility from a high interest rate and mean productivity state. The model suggests that a permanent increase would generate a permanent contraction in the FA/GDP ratio close to 0.5 percent in an emerging and to 0.25 percent in an advanced economy, and a permanent decrease of 1.1 percent in the GDP of emerging and of 0.5 percent in advanced economies. However, in the short run, the outflows of capital are 0.5 percent higher in advanced economies. With respect to a temporal shock, Figure 8 shows that a temporal increase of 1 period in the volatility of the US interest rate would generate a Sudden Stop in both types of economies and a contraction in the FA/GDP ratio of close to 2 and 1.5 percent in advanced and emerging economies, respectively. However, this increase in volatility would generate a decrease of only 0.03 percent in emerging economies while a decrease of about 0.005 percent in advanced economies. Hence, the model suggests that in terms of the GDP effect from a temporal increase in the international volatility, advanced economies are more resilient.



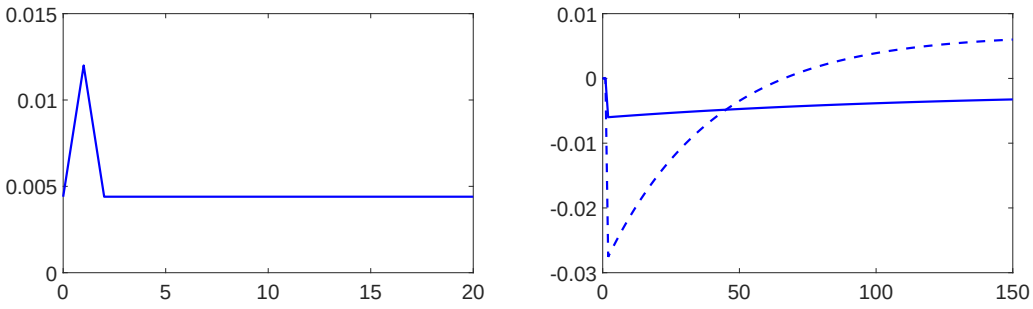
(a) σ_r

(b) GDP (longer series)

(c) FA as a percentage of GDP

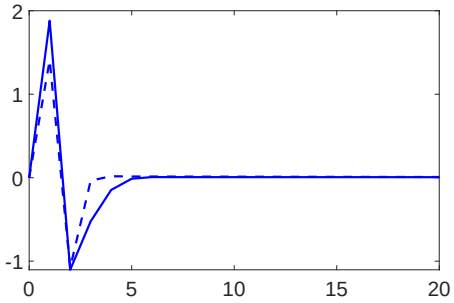
(d) FDI as a percentage of GDP

Figure 7: Impulse response analysis after a permanent increase in the international interest rate volatility. Solid (dashed) lines correspond to advanced (emerging) economy model.

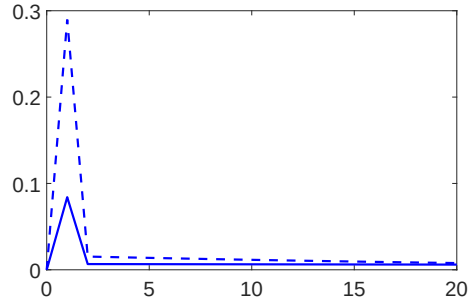


(a) σ_r

(b) GDP (longer series)



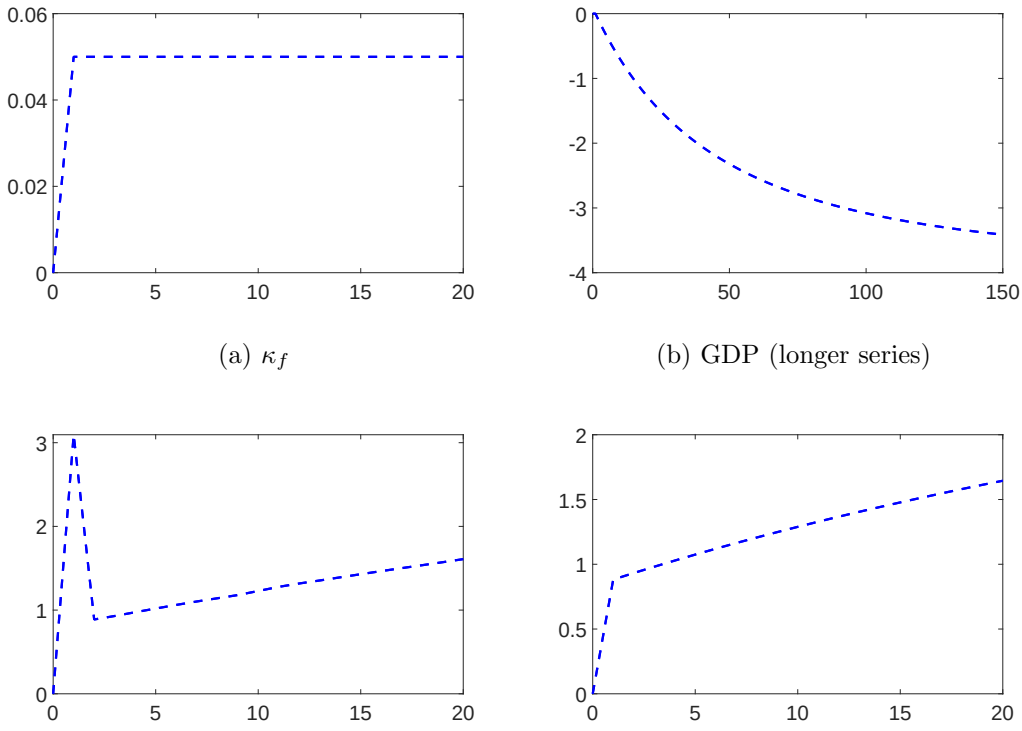
(c) FA as a percentage of GDP



(d) FDI as a percentage of GDP

Figure 8: Impulse response analysis after a temporal increase in the international interest rate volatility. Solid (dashed) lines correspond to advanced (emerging) economy model.

To account for the importance of providing certainty to international investors and multinationals, we perform an impulse response analysis after a shock to the probability of expropriation. Figure 9 corresponds to a permanent increase in the probability of expropriation from a mean interest rate and mean productivity state. This shock generates a permanent contraction in the FA/GDP ratio of 1.5 percent and a permanent decrease of 3.5 percent in the emerging economy's GDP. However, in the short run, the FA/GDP ratio shows a large contraction of 3 percent. With respect to a temporal shock, Figure 10 shows that a temporal increase of 1 period in the risk of expropriation would cause a large Sudden Stop with a contraction in the FA/GDP ratio of 3 percent. Moreover, this increase in expropriation risk would generate a temporal decrease close to 0.09 percent in GDP.



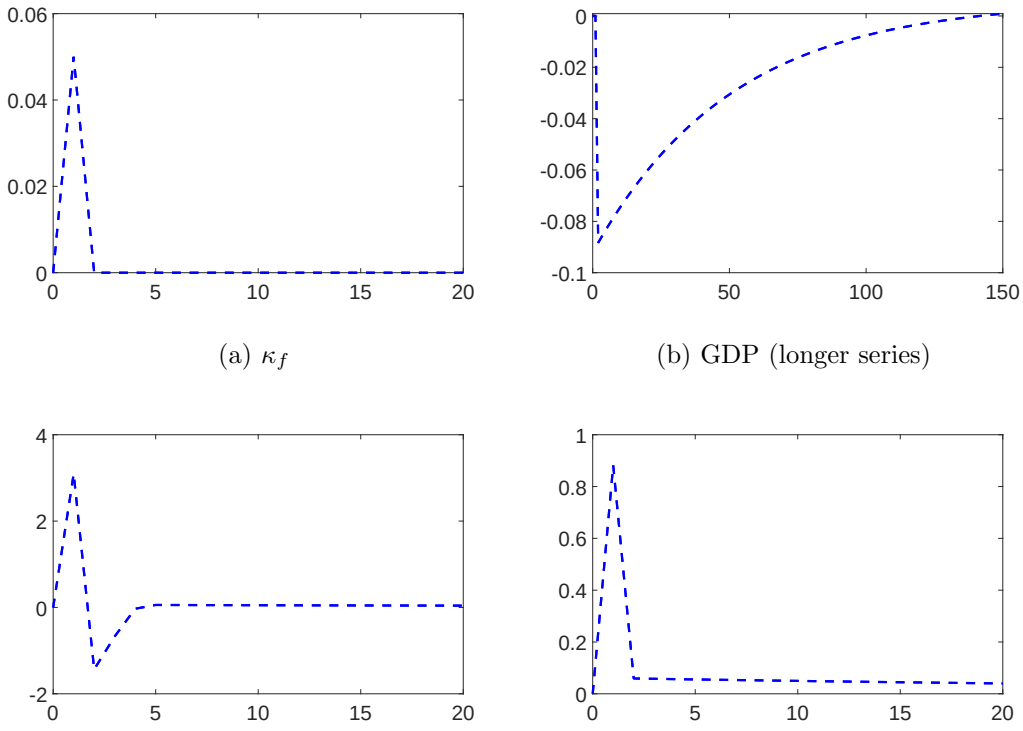
(a) κ_f

(b) GDP (longer series)

(c) FA as a percentage of GDP

(d) FDI as a percentage of GDP

Figure 9: Impulse response analysis after a permanent increase in the risk of expropriation. Dashed lines correspond to emerging economy model.



(a) κ_f

(b) GDP (longer series)

(c) FA as a percentage of GDP

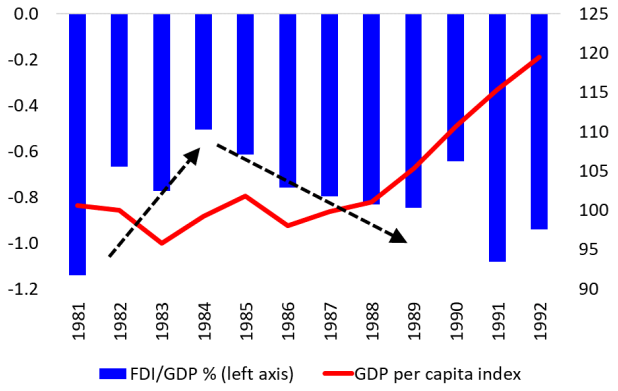
(d) FDI as a percentage of GDP

Figure 10: Impulse response analysis after a temporal increase in the risk of expropriation. Dashed lines correspond to emerging economy model.

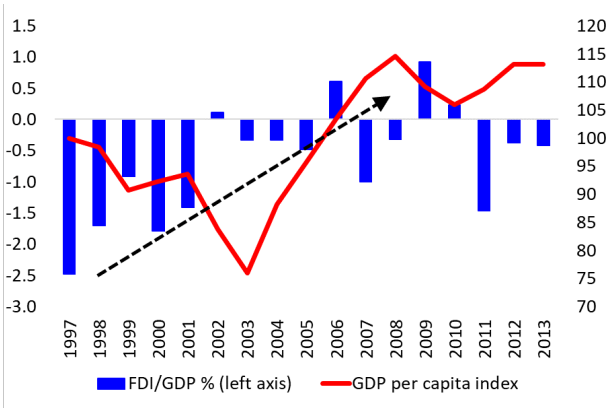
4.4 Anecdotal evidence: episodes of expropriation

To give the previous results some historical context, in this subsection we present anecdotal evidence of temporal and permanent episodes of increases in the risk of expropriation. For the case of a temporal shock, in Mexico in 1982, 3 months before leaving the office, President Jose Lopez Portillo nationalized the banks. However, by 1984 almost all assets were re-privatized and by 1990 only 18 out of the 58 originally nationalized banks remained (Haber (2005) and Gruben et al. (1997)). Figure 11a shows how after the nationalization, FDI/GDP ratio dropped 0.8 percent and the GDP decreased 4.2 percent in 1983. The drop in FDI is similar to the drop obtained by the model as Figure 10d shows. However, it is important to note that the movement in the GDP is larger than the results of the previous section because, among other things, this episode was of an actual privatization and not only an increase in the risk of privatization.

With respect to a permanent shock, in Venezuela in 1998, after Hugo Chavez was elected president the risk of expropriation increased and it was until 2003 when the oil industry was re-nationalized (Weisbrot et al. (2009)). Figure 12b shows how from 1997 to 2001 the FDI/GDP ratio decreased 1 percent. In this case, the results obtained from the model for a permanent shock in the risk of expropriation (Figure 9b and 9d) are in line with the anecdotal evidence from Venezuela when only the risk of expropriation increased (the GDP decreased by 5 percent from 1997 to 2001). However, in 2002 and 2003 large expropriations (the oil industry was nationalized) happened in Venezuela and after 2003, the GDP increased dramatically, possibly due to a large increase in oil prices that went from $30 to $100 dollars per barrel and also to a lack of credibility in the Venezuelan national accounts.



(a) Mexico, FDI/GDP% and GDP per capita (Index 1982=100)



(b) Venezuela, FDI/GDP% and GDP per capita (Index 1997=100)

Figure 11: Episodes of Expropriations. Source: World Bank WDI.

5 Conclusion

Balance of payment crises, characterized by Sudden Stops, are not a phenomenon exclusive to emerging economies. However, the underlying factors are not necessarily the same; these countries have opened their economies to foreign capital in distinct ways. These differences motivate the study of the components of capital flows in both types of economies to better understand why the probability of having a Sudden Stop in an emerging economy is 20 percent

larger than in advanced economies.

Decomposing the Financial Account uncovers important differences between advanced and emerging economies in their FDI account. First, advanced economies have on average zero net FDI flows as a percentage of GDP, and second, advanced economies have sufficient FDI outflows that act as a buffer saving during Sudden Stops. To quantify the effect of the FDI channel on the probability of a SS, we propose a standard real business cycle of a small open economy model with an endogenous occasionally-binding constraint, a fixed domestic stock of capital and foreign investment subject to expropriation risk, that generates Sudden Stop crises endogenously.

We calibrate the model using data for a large sample of advanced and emerging economies and find that the FDI channel has a large impact on the probability of a Sudden Stop. In particular, the model's results suggest that on average an emerging economy that increases their capital to GDP ratio and eliminates the expropriation risk would reduce the probability of a Sudden Stop from 2.9 to 1.3 percent and would increase its debt-to-income ratio from 35 percent to 51 percent.

Also, the impulse response analysis suggests that a temporal (permanent) increase in the international interest volatility would lead to a short-run (long-run) decrease of 0.03 (1.1) percent in the GDP in emerging economies. Moreover, in advanced economies, although the movements in the Financial Account are 0.5 percentage points larger than in emerging economies, the effect in the GDP is a third of the magnitude of emerging economies. Regarding the expropriation risk, a temporal (permanent) increase in the expropriation risk would lead to a short-run (long-run) decline of 0.09 (3.5) in the GDP for an emerging economy.

On the policy side, in addition to encouraging a stronger rule of law that would bring certainty to foreign investors (i.e. reduce the risk of expropriation), emerging economies should promote policies that encourage outflow FDI to diversify the capital flows and become more resilient to volatility shocks. This would reduce the probability and the severity of a Sudden Stop crisis while increasing the debt capacity of the economy.

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6 Appendix

6.1 Description of the data

The panel database consists of 31 high income economies and 75 upper-middle income economies according to the World Bank's classification. Data on the Financial Account components comes from the IMF Balance of Payments Statistics, GDP comes from the World Bank National Accounts database, capital stocks come from the IMF Investment and Capital Stock Dataset, debt stocks come from the Joint External Debt Hub, and the US interest rate comes from the FRED. The economies considered are:

Table 4: List of Countries

Name	Classification
Albania	Upper-Middle Income
Algeria	Upper-Middle Income
Angola	Upper-Middle Income
Antigua and Barbuda	Upper-Middle Income
Argentina	Upper-Middle Income
Australia	High Income
Austria	High Income
Azerbaijan, Republic of	Upper-Middle Income
Bahamas, The	High Income
Bahrain, Kingdom of	Upper-Middle Income
Barbados	Upper-Middle Income
Belarus	Upper-Middle Income
Belgium	High Income
Belize	Upper-Middle Income
Bermuda	High Income
Bosnia and Herzegovina	Upper-Middle Income
Botswana	Upper-Middle Income
Brazil	Upper-Middle Income
Brunei Darussalam	High Income
Bulgaria	Upper-Middle Income
Canada	High Income
Chile	Upper-Middle Income
China, P.R.: Mainland	Upper-Middle Income
Colombia	Upper-Middle Income
Costa Rica	Upper-Middle Income
Croatia	Upper-Middle Income
Cyprus	High Income
Czech Republic	Upper-Middle Income
Denmark	High Income
Dominica	Upper-Middle Income
Dominican Republic	Upper-Middle Income
Ecuador	Upper-Middle Income
Equatorial Guinea	Upper-Middle Income
Estonia	Upper-Middle Income
Fiji	Upper-Middle Income
Finland	High Income
France	High Income
Gabon	Upper-Middle Income
Georgia	Upper-Middle Income
Germany	High Income
Greece	Upper-Middle Income
Grenada	Upper-Middle Income
Guyana	Upper-Middle Income
China, P.R.: Hong Kong	High Income
Hungary	Upper-Middle Income
Iceland	High Income
Iran, Islamic Republic of	Upper-Middle Income
Iraq	Upper-Middle Income
Ireland	High Income
Israel	High Income
Italy	High Income
Jamaica	Upper-Middle Income
Japan	High Income
Jordan	Upper-Middle Income
Kazakhstan	Upper-Middle Income
Korea, Republic of	Upper-Middle Income
Kuwait	High Income
Latvia	Upper-Middle Income
Lebanon	Upper-Middle Income
Libya	Upper-Middle Income

Lithuania	Upper-Middle Income
China, P.R.: Macao	High Income
Macedonia, FYR	Upper-Middle Income
Malaysia	Upper-Middle Income
Maldives	Upper-Middle Income
Malta	Upper-Middle Income
Marshall Islands, Republic of	Upper-Middle Income
Mauritius	Upper-Middle Income
Mexico	Upper-Middle Income
Montenegro	Upper-Middle Income
Namibia	Upper-Middle Income
Netherlands	High Income
New Zealand	High Income
Norway	High Income
Oman	Upper-Middle Income
Palau	Upper-Middle Income
Panama	Upper-Middle Income
Paraguay	Upper-Middle Income
Peru	Upper-Middle Income
Poland	Upper-Middle Income
Portugal	High Income
Romania	Upper-Middle Income
Russian Federation	Upper-Middle Income
Saudi Arabia	Upper-Middle Income
Serbia, Republic of	Upper-Middle Income
Seychelles	Upper-Middle Income
Singapore	High Income
Slovak Republic	Upper-Middle Income
Slovenia	Upper-Middle Income
South Africa	Upper-Middle Income
Spain	High Income
St. Kitts and Nevis	Upper-Middle Income
St. Lucia	Upper-Middle Income
St. Vincent and the Grenadines	Upper-Middle Income
Suriname	Upper-Middle Income
Sweden	High Income
Switzerland	High Income
Thailand	Upper-Middle Income
Trinidad and Tobago	Upper-Middle Income
Turkey	Upper-Middle Income
Tuvalu	Upper-Middle Income
United Kingdom	High Income
United States	High Income
Uruguay	Upper-Middle Income
Venezuela, Republica Bolivariana de	Upper-Middle Income

The list of Sudden Stop episodes are:

Table 5: List of Sudden Stops

Name	Year of SS
Albania	1995
Angola	2010
Antigua and Barbuda	2014
Argentina	2002
Argentina	1990
Austria	2006
Bahamas, The	2015
Bahrain, Kingdom of	1995
Belgium	2010
Belize	2006
Bosnia and Herzegovina	2009
Botswana	2005
Brunei Darussalam	2010
Bulgaria	2009
China, P.R.: Hong Kong	1999
Colombia	1999
Costa Rica	2009
Cyprus	2009
Denmark	2011
Dominica	2016
Dominican Republic	1991
Ecuador	1999
Estonia	2009
Fiji	2007
Georgia	2009
Greece	2012
Grenada	2004
Grenada	2014
Guyana	1996
Hungary	2009
Hungary	1995
Iceland	2009
Ireland	2009
Israel	2001
Italy	2012
Jamaica	2009
Jamaica	2015
Kazakhstan	2010
Korea, Republic of	1998
Latvia	2009
Lebanon	2010

Lithuania	2009
Macedonia, FYR	2009
Malaysia	1998
Mauritius	2013
Mexico	1995
Montenegro	2009
Namibia	2006
Norway	2008
Oman	2010
Palau	2015
Panama	2000
Paraguay	1996
Poland	1994
Portugal	2011
Romania	2009
Serbia, Republic of	2009
Slovenia	2009
Spain	2009
St. Kitts and Nevis	2012
St. Lucia	2009
Switzerland	2010
Thailand	1998
Turkey	1994
United States	2009
Uruguay	2003