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Uncertainty about the fundamentals and the occurrence of sudden stops of capital flows: Theory and Empirics*

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Abstract

We analyse the effect of the uncertainty about the fundamentals on the probability of sudden stops of capital flows from a theoretical and empirical perspective. Our model predicts that the probability of crises increases with the uncertainty, ie. the dispersion of private signals about the true value of the fundamentals. Using two datasets of Consensus and WES forecasts for 31 developed and developing countries for the time period from January 1990 until December 2001 we verify the theoretical prediction. We apply probit estimation controlling for time and country effects. Additionally, we show that the result is robust for numerous specifications.

JEL classification: C 72, D 82, D 84, F 21, F 32, F 34, F 41
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1 Introduction

Most major financial crises involve the sudden stop of capital inflows.[1] Examples are the Latin American debt crises during the 1980s, the crisis experienced in south-east Asia in 1997 and Russia 1998. In the literature a sudden stop is defined as a sharp reversal in capital flows associated with severe economic consequences.

One of the most prominent financial crises, which even spread to other emerging countries around the world, was the Tequila crisis, that hit Mexico at the end of 1994 and beginning of 1995. Mexico experienced a reduction of net private capital flows of almost 4 percent of the GDP in 1994 and a drop of more than 5 percent in 1995. [2] The country went through a currency crises followed by a severe drop in output of 6 percent in the crisis year. During this time the country also plunged into a systemic banking crisis until 1997, including a temporary insolvency of 19 percent of the financial system assets.

This example illustrates the need to understand the causes of such a crisis and to find instruments in the effort to prevent them. This paper contributes to this agenda, first by explaining in the set up of a coordination game how the uncertainty about the fundamentals of an economy by private investors increases the probability of a sudden stop of capital flows. Second, we validate the predictions of the theoretical model empirically. Uncertainty describes the dispersion of private signals around the true value of the fundamentals. It can be seen as the disagreement between the private investors about the quality of the fundamentals. A sudden stop is defined as a sharp negative variation in capital flows associated with severe economic consequences.

The current theoretical and empirical literature on the occurrence of sudden stops ignores the effect of uncertainty about the fundamentals. This seems surprising and leaves room for a contribution - especially with respect to the fact that investors are assumed to take their investment decisions in a forward looking manner. They are assumed to base their decisions on expectations about future returns, which in turn depend on other investors' behavior and the future fundamentals in an economy.[3] This issue also has policy implications: If lower precision of information about the fundamentals of an economy and therefore uncertainty about these values increases the probability of a sudden stop of capital flows, then an economy will be more vulnerable in times when uncertainty is higher, and policymakers should adjust their policies.

The basic model is an extension of Calvo (2003) where we introduce infinitely many players of mass one. We then set up a coordination game. In this basic model investors maximize the value of their firm which is the net present value of their after tax returns net of investments. The government mechanically sets the tax rate that is necessary to cover

[1] cf. list of headline financial crises in appendix (A.12). These crises were so severe, that they were in the newspaper headlines around the world and are remembered by most of us for the turmoil that they involved.

[2] These percentages correspond to a drop in capital flows of 15,5 billion current US dollars in 1994 and further 15,2 billion in 1995 in absolute values.

[3] In our model sudden stops of capital flows are assumed to be unexpected to private investors, in this sense they are still not forward looking. Nevertheless, one can show that the results of our analysis also hold for an expected sudden stop. cf. Calvo (2003)

the exogenously given amount of debt. However, the tax lowers the after-tax productivity of capital which is the crucial variable in the investment decision of the firms in the economy.

For sufficiently low levels of debt, the government sets so low output taxes, that investing is attractive. In this model the level of investment directly determines the economic growth of the economy. Hence, a high level of investment induces high growth. On the other extreme, where the debt is high, only low growth can be observed due to the negative impact of the required high taxes.

However, for intermediate levels of the government debt the optimal action of a player depends on the actions of the other players. If a firm expects all other firms to invest, it is optimal for this company to invest. This is due to the debt burden being shared by a large number of other firms. Hence the government can choose a low tax rate and the after tax return of the investing firms is high. Otherwise, if a firm expects that few other firms will invest, it is optimal for this company to abstain from investing, as it will have to pay high taxes because the debt burden is shared by few investors. This mechanism explains a multiplicity of equilibria in the intermediate debt region. High (low) growth induces low (high) output taxes, which in turn generates high (low) economic growth.

A sudden stop takes place when growth discontinuously switches from high to low growth. With the help of the methodology of global games(first introduced by Carlsson and van Damme (1993) and then prominently applied to currency crises by Morris and Shin (1998)) we can show that there exists a threshold level of the government debt, below which everyone invests and above which no one does. Specifically, we assume that the true value of the government debt is no longer common knowledge, but that every investor receives a private signal on the level of debt.[4][5] This results in an additional equilibrium condition which allows us to find the unique threshold. Investors have to compare the expected value of their company in the following to cases: when they invest in the case that sufficient other companies share the tax burden and when they invest with only a few other firms to share the burden. Above the threshold the economy drops to the low growth equilibrium due to a lack of investment, although the state of the fundamentals would still support the high growth equilibrium. The reason for the switch is a coordination failure between private investors.

We find a set of interesting comparative static results from analyzing the threshold equilibrium. In our set up the change in the value of the threshold translates into a change in the probability of a crisis. First, we find that the probability of a sudden stops increases with the dispersion of the private signals on fiscal burden. Secondly, we find that the probability of a crisis also decreases with the parameter of technological progress. This parameter can also be understood as an indication how safe an investment is. Third we can show that the probability of sudden stops increases with the international interest rate. And lastly, we find that technological progress and international interest rate influence the scope of government

[4]It is a plausible assumption that investors interpret published information about the state of the fundamentals differently.

[5]We assume that the government debt and the private signals are uniformly distributed.

policies.

The policy implications of these findings are that governments should take the uncertainty about the fundamentals into account, because it has real effects. The advice would be to help private investors to get precise private information. One way of achieving this would be the government allowing unrestricted access to the government data, i.e. to independent agencies which are allowed to sell this data. One could argue that it would not make a difference if the government sold this information. However, a government could have an incentive to understate the true value of the fundamentals and then ask for higher taxes ex post. This credibility problem could be alleviated with the help of an independent agency. Secondly, these results suggest that governments should care for the investment safety in their country and foster technological progress.

How relevant are the described effects in reality? Specifically one would like to verify that technological progress, the international interest rate and most interestingly the uncertainty about the fundamentals influence the probability of a sudden stop in reality. The first hypothesis is that sudden stops are less likely to take place when internal factors of emerging market countries become more favorable, e.g. if governments adopt technology enhancing policies or take measures to ensure investment safety. The second hypothesis which follows from the theory, is that more sudden stops occur if the international interest rate increases. And a third hypothesis is that sudden stops are more likely to arise with more uncertainty on the government's fiscal policy (less precise private information).

It is the last hypothesis that we are focussing on, in the empirical analysis. The empirical analysis of sudden stops has been subject in the recent literature: Calvo et al. (2004) analyze drivers of sudden stops and find that especially the vulnerability to real exchange rate fluctuations and domestic liability dollarization increase the probability of a crisis. Edwards (2005) focusses on capital mobility and disputes its link to higher crisis probability. Also the question whether it is internal or external - rather global - factors that drive capital flows into and out of emerging markets has been extensively studied. Calvo et al. (1993),Calvo et al. (1996), Fernandez-Arias (1996), Montiel and Reinhart (1999) examine internal factors such as for example the price of debt on the secondary market, country credit ratings, the domestic rate of inflation versus external ones such as the interest rates and the economic activity in highly developed countries. These analyzes attribute a higher importance to the external factors. In the more recent literature with a focus on FDI Albuquerque et al. (2003) find that the most important driver of the capital flows is a synthetic global factor, which they interpret as a globalization measure. Broner and Rigobon (2004) detect regional patterns in capital flows and emphasize the role of contagion in determining capital movements to a country.

However, this literature ignores the effect of uncertainty about the fundamentals on the occurrence of sudden stops. Only in the context of currency crises the issue has been addressed so far: Prati and Sbracia (2002) conduct a convincing analysis of the effect of uncertainty on currency crises. With their seemingly unrelated time series regressions for six Asian economies they show, that higher dispersion of GDP growth forecasts (their proxy for the fundamentals) tends to have an additional independent effect from the effect exercised by the lagged level of the fundamental.

Sudden stops of capital flows seem a natural application for their approach. A drawback of the above mentioned analysis is its application to a small sample of countries that were all affected by the East Asian financial crisis 1997/98. Therefore, it seems appropriate to use a larger sample of countries, developing and developed. Secondly, as the model that we are developing is static we make predictions about crisis probabilities and therefore a probit estimation seems to be the best approach. As a benchmark regression we estimate a pooled probit with country and time dummies. The data set contains 31 developing and developed countries where the sample size is dictated by data availability. The analyzed period extends from 1990 until 2001. We analyze yearly and monthly data.

In line with Calvo et al. (2004), Cavallo and Frankel (2004) and Eichengreen et al. (2006) we detect sudden stops of capital flows by considering both the first and the second moments of a measure of capital flows. Provided that in a particular period the capital flows drop as low as two standard deviations below the sample mean, a crisis period starts when the flows drop lower than one standard deviation below the sample mean. For symmetry it stops when the flows exceed this limit again. In our analysis the most important explanatory variable is a measure of uncertainty about the fundamentals: The variance of speculators' expectations about the fundamentals. Here we use expectations about GDP growth of the current and following year. These data are collected by Consensus Economics and the IFO Institute for Economic Research. We work with the growth forecasts because they are available for a sufficiently large sample of countries.

The search for determinants of sudden stops very quickly leads to a problem of omitted variables and endogeneity. To tackle these difficulties we run various robustness checks. Specifically, to address the first problem we include a large variety of control variables. In order to address the endogeneity problem, we estimate the model with an increasing order of lags of the explanatory variables. Additionally, we employ two step estimation where we instrument the uncertainty in the current period with its own lag. Furthermore, we check the robustness of our results by doing the analysis for the full sample and an emerging market sample, by making use of a yearly and monthly data set and by using various different estimation methods. The positive effect of the uncertainty on the occurrence of sudden stops of capital flows is robust across these tests.

Calculating the marginal effects of a one unit increase of uncertainty suggests that an increase of the uncertainty by one standard deviation increases the probability of a crisis by up to nine percent.[6] These results suggest that indeed the uncertainty about the fundamentals has a non negligible effect on the probability of sudden stops in reality and should thus be incorporated in the considerations regarding economic policies.

[6]cf. table(5) in section (7.2)

2 Theoretical Background

This section presents a coordination game on the occurrence of sudden stops of capital flows. Our model is based on the framework presented in Calvo (1998) as well as Calvo (2003). We depart from the Calvo set up by introducing a continuum of infinitely existing, identical companies of mass one. Thereby we can set up a coordination game first with common knowledge. In section (4) we depart further from Calvo (2003) and introduce private signals on the fundamentals, allowing us to solve and analyze the private information game.

2.1 The Firms

Following Calvo (1998) and Calvo (2003) each of the infinitely many firms produces tradable output with a linear homogeneous production function, where tradable capital is the only production factor. Capital is fully internationally mobile ex ante but immobile after investment.

The firms maximize their value by choosing between constant growth paths. The value of the firm is defined as the sum of discounted future cash flows until infinity. Due to the linear production function, the rate of investment or capital accumulation equals the rate of output growth. In their optimization firms consider the technology parameter, the tax rate and the international interest rate as given. Thereby, we find the following representation of the value of firm i:[7]

$$V^i = \frac{\alpha(1-\tau) - z^i}{(r - z^i)} \tag{1}$$

V^i represents the firm value, α is the productivity factor, τ is the constant output tax rate, z^i is the variable that the firms can choose: the rate of investment. r represents the constant international interest rate.

Optimizing the value of the firm with respect to the rate of investment or capital accumulation leads to:

$$\frac{\partial V^i}{\partial z^i} = \frac{\alpha(1-\tau) - r}{(r - z^i)^2}$$

The model delivers corner solutions: If the after tax return on capital, $\alpha(1-\tau)$ exceeds the international interest rate, r, it is optimal for a firm to invest as much as possible and thus grow as fast as possible. If the return on capital is lower than the interest rate, the firm does not accumulate capital at all, it would even borrow as much capital as possible and invest it abroad. In order for the model to deliver a sensible outcome, it is necessary to restrain the parameter z^i to finite "corners". Following Calvo (2003) the value of z^i is

[7] For a detailed derivation please regard appendix (A.1). The firms expect the tax rate to be constant, because a sudden stop is unexpected to them. In the light of possible growth collapses and ensuing sudden stops a different tax policy τ_t might be optimal for the government. Therefore firms would expect the tax rate to change once a crisis occurs. Calvo (2003) shows that the growth collapse and the sudden stop also occur in the case when they are foreseen by the firm. So we do not consider the case of an anticipated crisis here.

restricted to an interval from $[0, \overline{z}]$ with $\overline{z} < r$, where the lower bound ensures that capital cannot be unbolted. The upper bound stands for reasonable outcomes with respect to the valuation of the firms. Especially, as z^i signifies the constant growth path of the firm, by bounding it, we rule out the possibility that the firm can outgrow the world market in the infinite horizon.

A firm will not invest if the value of the firm is reduced. So it is sufficient to consider the sign of the derivative of V^i with respect to z^i.

$$\text{sgn}\frac{\partial V^i}{\partial z^i} = \text{sgn}[\alpha(1-\tau) - r] \tag{2}$$

2.2 The Government

The government inherits a stock of debt, D, which has to be financed by an output tax. The tax rate is set such that the future discounted tax revenues cover the amount of debt. This is possible assuming full capital market access by the government.

$$D = \alpha\tau \int_0^{\infty} K_t^{econ} e^{-rt} dt = \frac{\alpha\tau}{r - z^{econ}} \tag{3}$$

with

$$z^{econ} = \frac{\int_0^1 \dot{K}^i di}{\int_0^1 K^i di} = \frac{\dot{K}^{econ}}{K^{econ}}$$

The superscript ^{econ} indicates that a variable refers to the economy and not to an individual i

2.3 The Reduced Form Game between Firms

The mechanical way in which the government sets the tax rate introduces the strategic complementarity between the firms into the model: the profit of investment for an individual company positively depends on the rate of investment of all other firms. This can be shown by solving equation (3) for τ and plugging it into (2):

$$\text{sgn}\frac{\partial V^i}{\partial z^i} = \text{sgn}[\alpha - D(r - z^{econ}) - r] \tag{4}$$

The return on investment is a positive function of z^{econ}. This results from the burden of debt repayment being carried by more agents. It is also through the tax setting mechanism that the investment decision of each firm depends negatively on the state of the fundamentals.

The main mechanism underlying the interaction of agents consists of the fact, that, if growth is high, the government sets a low tax rate, which in turn sustains high growth. Analogously, if growth is low, the government has to set a high tax rate holding firms off investing, which in turn further induces low growth.

3 The Common Knowledge Game

Let us assume that all the firms and the government know the true values of the relevant variables. Additionally, as we have shown, that firms either do not invest or invest $\overline{z}$ a strategy is defined as $\pi^i : [\breve{D}, \hat{D}] \rightarrow [0, 1]$. This means that company i invests in state D with probability $\pi^i(D)$. Because of the mass of players being one, the fraction of players who invest at a particular state of fundamentals can be expressed as: $\pi^{-i}(D) = \int_0^1 \pi^j(D)dj$ for $j \neq i$. Now we can express

$$z^{econ}(D) = \overline{z}\pi^{-i}(D) \tag{5}$$

3.1 High Growth and Low Growth Equilibrium

Equation (4) can be used to illustrate the area of existence of a low growth and a high growth equilibrium. On the one hand a low growth equilibrium can exist where a firm does not have an incentive to deviate from its strategy not to invest, given that all the other firms do not invest. This is the case, when equation (4) displays a negative value in the case that $z^{econ} = \overline{z} * 0 = 0$. When solving for the level of debt, we find that the low growth equilibrium exists in the case that the debt is higher than a threshold:

$$D > \underline{D} = \frac{\alpha - r}{r} \tag{6}$$

On the other hand a high growth equilibrium exists, when a firm does not have an incentive to deviate from the strategy to invest, given that the other firms do also invest. In terms of equation (4) this means that a high growth equilibrium exists, if the signum of the equation is positive for $z^{econ} = \overline{z} * 1 = \overline{z}$. Thereby we find, that the high growth equilibrium exists below a threshold:

$$D < \overline{D} = \frac{\alpha - r}{r - \overline{z}} \tag{7}$$

3.2 The Tripartite Classification of Fundamentals

The level of debt can be classified into three areas. By definition $0 < \overline{z} < r$ and $\alpha > r$. Therefore it is clear from the two equations in section (3.1) that $\overline{D}$ is bigger than $\underline{D}$. Between the two threshold values, $\overline{D}$ and $\underline{D}$, the two equilibria coexist. Above $\overline{D}$ only the low growth equilibrium exists and below $\underline{D}$ only the high growth equilibrium.

If D is smaller than $\underline{D}$, there exists a dominance region of investment, consequently the economy will be in a high growth equilibrium. If D lies between $\underline{D}$ and $\overline{D}$ it is not clear whether agents can coordinate on the high growth equilibrium or whether coordination failure occurs and the economy is captured in the low growth equilibrium. If D exceeds $\overline{D}$ there is a dominance region of no investment and the economy displays low growth with certainty. [8] The tripartite classification of fundamentals is illustrated in figure 1.

[8]The threshold cases, where $D = \underline{D}$ and $D = \overline{D}$ are not of interest and will therefore not be discussed.

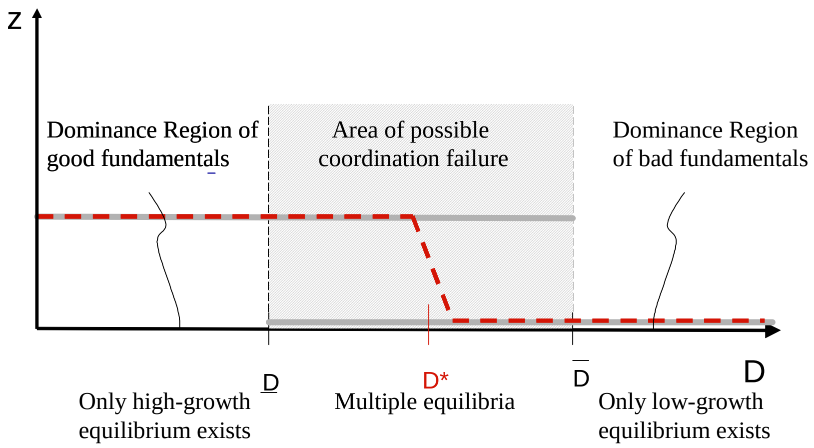

Figure 1: Model set up

Figure (1) shows the existence of the high and the low growth equilibrium as a function of the level of government debt. In case of common knowledge the model displays an indeterminacy between the high and the low growth equilibrium for those levels of debt, where both equilibria coexist. In section (4) however, we will be able determine a threshold signal of the debt,$D^{\star}$, below which investors can coordinate to high investment, thus leading to high growth. Above this level of debt, investors then decide not to invest, thereby inducing low growth. In the figure the dotted line represents the equilibrium that is found with the help of the private information game.

4 The Private Information Game

By introducing private, slightly noisy information on the state of the fundamentals we can eliminate the multiplicity area between $\underline{D}$ and $\overline{D}$ and find a threshold value of the level of debt, below which all agents coordinate on the high growth equilibrium and above which no one invests.

In the two following sections we will first show the uniqueness of the equilibrium and then analyze how the threshold equilibrium is influenced by changes in the technology parameter, by changes in the international interest rate and by changes in the precision of the private signal.

4.1 Informational Structure

The players cannot observe the true value of the debt but receive noisy signals D^i on the state of the debt. The true level of debt is uniformly distributed over the interval $[\breve{D}, \hat{D}]$. The signals are privately observable and uniformly distributed in an ϵ surrounding of the true value of the debt, $D^i \sim U[D-\epsilon, D+\epsilon]$. The players know the distribution and the support of D and of the private signals. All firms know about all other firms that they also receive private signals.

The fact that the signal on the state of the debt is private, reflects that agents interpret officially announced values of the government debt differently. In addition, the levels of debt are often revised ex post from official institutions which enforces the importance of the interpretation of the information and justifies the signals on debt being private.

In order to derive a unique equilibrium it is important to make sure that the signal is informative about the true level of the debt. Otherwise the players would not have an idea about the true value of debt and about the possible signals that the other players receive, given their own signal. As shown in Heinemann and Illing (2002) the distributional assumptions that we make in the current set up ensure that this requirement is fulfilled.

4.2 Object of Optimization

The firms cannot observe the true value of D in the private information set up, but only have an expectation about it, given the private signal that they receive.

Due to the fact that the expectation of D and of z^{econ} depend on the private signal the firms have an expectation about the tax rate that the government will set, given their private signal:

$$E(\tau|D^i) = E\left(\frac{D(r - z^{econ})}{\alpha}|D^i\right) \tag{8}$$

Therefore, the expectation of the value of the firm depending on the level of investment can be expressed as:

$$E(V|D^i) = E\left(\frac{\alpha - D(r - z^{econ}) - z^i}{r - z^i}|D^i\right) \tag{9}$$

The optimizing behavior in the private information game is analogous to the behavior under common knowledge. However, the actions of agents are now based on the signals that they get or their expectation on the true value of debt given the private signals that they receive. Also with respect to the optimization of the value of their firm, agents maximize the expected difference in payoffs following from alternative strategies, investing versus non-investing.[9] Now, a strategy is a function of the private signal received, instead of the true value of the fundamental: $\pi^i(D^i) : [\breve{D}, \hat{D}] \rightarrow [0, 1]$. As shown before, the extreme strategies of investing at the maximum versus not investing at all dominate all intermediate strategies. So it suffices to compare the expected payoffs of these two strategies. Following,

$$z^{econ} = \overline{z}\pi^{-i}(D^j) = \overline{z}\int_0^1 \pi^j(D^j)dj \tag{10}$$

.

[9] In the following this will simply be referred to as payoff difference. As in Doenges and Heinemann (2001), in our model also the payoff of the alternative action depends on the state of the fundamentals and is not fixed to some constant value.

With this :

$$\widetilde{U}(D^i) = E\big(\frac{\alpha - D(r - \overline{z}\pi^{-i}(D^j)) - \overline{z}}{r - \overline{z}} - \frac{\alpha - D(r - \overline{z}\pi^{-i}(D^j)) - 0}{r - 0}|D^i\big)$$

We know, that in the case of unbiased signals around the true value the expectation of the true value of an variable given the private signal that individual i receives is the signal itself: $E(D|D^i) = D^i$. Therefore the above expression can be simplified to:

$$\widetilde{U}(D^i) = \overline{z}\frac{\alpha - r - rD^i + \overline{z}E(D\pi^{-i}(D^j)|D^i)}{(r - \overline{z})r} \tag{11}$$

4.3 Unique Equilibrium

In this section we show the existence and uniqueness of the equilibrium:

Proposition 1 *There exists a unique threshold equilibrium $D^\star$ of the game with imperfect information, such that all the firms invest if and only if $D^i \leq D^\star$ and do not invest if $D^i > D^\star$.*

To prove proposition (1) we proceed in several steps. First of all, we assume that all agents follow a simple switching strategy. After that we eliminate those strategies that are dominated beginning at borders of the dominance regions. We can do this based on the payoff difference being strictly monotonically decreasing. Finally, we show that there is only a unique value of the level of debt for which the payoff difference given the private signal equals zero. This level of debt is the threshold value below which all players invest and above which, no one does.

A switching strategy, I_K, means that a firm invests with probability one if and only if the signal it receives is below a threshold K and abstains from investing with probability one, if the signal is above the threshold: [10]

$$I_K = \begin{cases} 1 & \text{if } D^i < K \\ 0 & \text{if } D^i \geq K \end{cases} {}^{11} \tag{12}$$

Lemma 1 *Under the assumption that in the game with infinitely many players of mass one all follow the same switching strategy, I_K, the fraction of players investing, $\pi^{-i}(D^j)$, can be replaced by the probability that one player receives a signal smaller than the threshold signal K, $prob(D^j < K|D)$, in equation (11).*

The proof of the Lemma can be found in appendix (A.2). With this, the payoff difference can be expressed in the following way [12]:

[10] By continuity arguments it is possible to show, that such a simple switching strategy is optimal. So one does not lose generality when imposing it in the first place.

[11] In terms of the payoff the behavior of the agents in a single event is irrelevant. Therefore it is also irrelevant, whether players invest at $D_i = K$ or not

[12] It is important to note, that this probability (as does the fraction of players investing) depends on the realization of D and hence agent i's expectation of it conditional on the private signal depends on the realization of D^i

$$\widetilde{U}(D^i, I_K) = \overline{z}\frac{\alpha - r - rD^i + \overline{z}E(D\text{prob}(D^j < K|D)|D^i)}{(r-\overline{z})r} \tag{13}$$

Next, we determine those signals where we can start the elimination of dominated strategies. We see that those signals correspond to the borders of the dominance regions in terms of the true value of the debt, $\underline{D}$ and $\overline{D}$.[13]

Due to the strict monotonicity of the payoff difference, the lowest possible threshold for a switching strategy of all the players is $\underline{D}$. Analogously, the highest possible threshold is $\overline{D}$. For all $D^i < \underline{D}$ the payoff difference is positive, irrespective of the actions of all other players. As the rationality of the players is common knowledge, not to invest is a dominated strategy for signals below $\underline{D}$. And at the other extreme for all signals $D^i > \overline{D}$ the payoff difference is negative.

Lemma 2 $\widetilde{U}(D^i, I_K)$ *is strictly monotonically decreasing in the private signal* D^i.

The proof of the lemma can be found in appendix (A.5).

Due to the strategic complementarity between the players the worst scenario that a firm has to consider, is the case where $I_K = I_{\underline{D}}$. It means that for all values of debt in the multiplicity area players choose not to invest although the levels of debt would in case of coordination on the high growth equilibrium also allow for this. And the best scenario would be a switching strategy of $I_K = I_{\overline{D}}$.

By applying the iterated elimination of dominated strategies we are able to cut the multiplicity area down to a unique threshold signal. The elimination functions as follows: If a player i receives a signal that is very close to the border of the dominance region the probability that other players receive signals within the dominance region and thus have a dominant strategy is very high. Due to the strict monotonicity this suffices to induce player i to have a dominant strategy as well. This is true for all the players and therefore one can add the area between the signal of player i and the former border of the dominance region to the dominance region. One does this at both ends of the support and iterates this process until one finds maximum [minimum] signal at which player i is indifferent between investing and not, and which is at the same time the threshold of the switching strategy of all other players.[14]

According to Milgrom and Roberts (1990) in all games with strategic complementarity the highest and the lowest equilibrium that resist the iterative elimination of dominated strategies are Nash equilibria. Put the other way round: Nash equilibria can never be eliminated. Thus $I_{\underline{D}^\star}$ and $I_{\overline{D}^\star}$ are the most extreme Nash equilibria of the game. We know that there is no Nash equilibrium below $\underline{D}^\star$ in which the firms do not invest. On the other hand side, there is also no Nash equilibrium above $\overline{D}^\star$ in which the firms invest.

[13]Details can be found in appendix (A.3).

[14]For a more formal consideration of the iterative elimination please check appendix (A.4).

So, due to the strict monotonicity of the payoff difference that we have proved in lemma(2) it suffices to show that equation

$$\widetilde{U}(D^i = D^\star) = \overline{z}\frac{\alpha - r - rD^\star + \overline{z}E(D\text{prob}(D^j < D^\star)|D^i = D^\star)}{(r-\overline{z})r} = 0 \tag{14}$$

has a unique solution.

Lemma 3 *Equation (14) has a unique solution.*

The proof of the Lemma can be found in appendix (A.6).

This unique solution is:

$$D^\star = \frac{\alpha - r - \frac{\epsilon}{6}\overline{z}}{(r - \frac{1}{2}\overline{z})} \tag{15}$$

This completes the proof of proposition (1). And we can conclude that the $D^\star$ that we have found in equation (15) is the unique threshold equilibrium of the game with private information.

By applying the methodology of global games we have been able to eliminate the area of multiplicity. We are now able to predict, for which levels of the fundamental a growth collapse occurs. In the Calvo set up a growth collapse automatically entails a sudden stop of capital flows. So the above analysis not only lays bare how the economy will plunge into a growth collapse but at the same time explains the onset of a sudden stop of capital flows. It is of interest to know how the change of economic variables alters the threshold and thereby the probability of a sudden stop.

5 Comparative Statics

In this section we analyze how a change in the productivity of the country, a change in the international interest rate and a change in the noise in the information on the debt influence the value of the threshold equilibrium at which the growth collapse and therefore the sudden stop take place.

5.1 Changes in the technology parameter α

First of all we analyze the technology parameter, which is in the model equivalent to the productivity of capital.

Proposition 2 *If the technology parameter, α, increases, the threshold equilibrium is shifted to a higher level of debt, ie. a growth collapse and thereby a sudden stop occurs at higher levels of debt only.*

Differentiating equation (15) with respect to α illustrates the correctness of proposition (2).

$$\frac{\partial D^\star}{\partial \alpha} = \frac{1}{(r - \frac{1}{2}\overline{z})} > 0 \tag{16}$$

The above expression must always be positive, because $\overline{z}$ is bounded to be bigger than r.

The result of the differentiation means that with increasing productivity the switch from high to low growth equilibrium only happens for higher levels of debt. Considering the finite support of the distribution of the debt, this implies that the probability of a growth collapse decreases and therefore the probability of a sudden stop. In figure (2) this is mirrored by $D'^\star$ lying right of $D^\star$ with α' being bigger than α.

One finds another interesting result when looking at the change of the borders of the multiplicity area with a change in the technology parameter.

Proposition 3 *If the technology parameter, α, increases, the area of multiplicity of equilibria widens in the common knowledge game.*

The derivative of the lower bound of the multiplicity area, $\underline{D}$, with respect to α is smaller than the derivative of $\overline{D}$.

$$0 \quad < \quad \frac{\partial \underline{D}}{\partial \alpha} = \frac{1}{r} \quad < \quad \frac{\partial D^\star}{\partial \alpha} = \frac{1}{(r - \frac{1}{2}\overline{z})} \quad < \quad \frac{\partial \overline{D}}{\partial \alpha} = \frac{1}{r - \overline{z}} \tag{17}$$

As illustrated in figure (2) the area of multiplicity enlarges with bigger α. Between $D^\star$ and $\overline{D}$ is the area, where the low growth equilibrium prevails due to coordination failure, although in terms of the fundamentals still the high growth equilibrium is possible. One could argue that the size of this area could be seen as a measure of inefficiency of the economy. Then one would argue, that with increasing α the inefficiency of the economy increases. However, this view is incorrect as simultaneously also the area between $\underline{D}$ and $D^\star$ increases by the same amount. For these levels of debt, the investors coordinate to the high growth equilibrium although also the low growth equilibrium exists. It seems to be more convincing to state that the overall situation improves because first of all the probability of a sudden stop decreases (as argued above) and second, the area between $D^\star$ and $\overline{D}$ can be seen as an area, where the government can improve the situation by helping investors to coordinate. So we can rather say that technological progress accords a larger scope to government policy to enhance coordination.

We also see that the effect of α decreases in r. This can be explained by the fact that the scope of action for the government is reduced, when external factors, such as the international interest rate, change. It is informative to analyze the direct effect of a change in the international interest rate on the threshold equilibrium.

5.2 Changes in the international interest rate r

Proposition 4 *If the international interest rate, r, increases, the threshold equilibrium is shifted to a lower level of debt, ie. a growth collapse and thereby a sudden stop occurs already at lower levels of debt.*

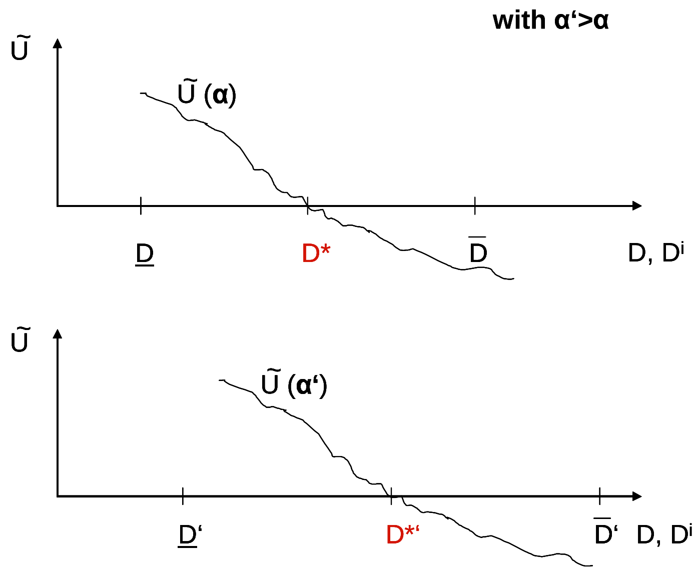

Figure 2: Changes in $D^\star$ and the borders of the multiplicity area due to changes in α

A change in the international interest rate produces the following effect:

$$\frac{\partial D^\star}{\partial r} = \frac{(3+\epsilon)\overline{z} - 6\alpha}{6(r - \frac{1}{2}\overline{z})^2} < 0 \tag{18}$$

The denominator of the fraction in equation (18) must always be positive. The numerator is negative for possible values of α and ϵ. Per definition α must exceed r, which in turn must exceed $\overline{z}$. ϵ is restraint to small numbers, for sure smaller than three, which would be the solution, when setting the numerator to zero for the limiting case that $\alpha = \overline{z}$. The effect of a change of r on $D^\star$ is negative; i.e. if the international interest rate increases, $D^\star$ moves to the left in figure (2). In terms of the real economy this implies that with higher international interest rates, sudden stops occur for lower levels of debt.

Proposition 5 *If the international interest rate, r, increases, the area of multiplicity of equilibria shrinks in the common knowledge game.*

When doing the comparative static analysis at the borders of the multiplicity area one finds that the derivative of $\overline{D}$ with respect to r is more negative, than the one of $\underline{D}$. This result implies, that the area of multiplicity shrinks with increasing r. With the analogous argument to the one we used for the comparative statics of α, we conclude that the scope of government policies is thereby diminished.

Again we see in this comparative static the opposing effects of α a parameter determined in the respective country and r, a parameter which is independent of the situation in the particular country.

These results of the comparative statics with respect to α and r are fully in line with the empirical literature on pull and push factors with respect to capital flows.[15] As a large

[15] cf. e.g. Calvo et al. (1993), Calvo et al. (1996),Diaz-Alejandro (1983), Fernandez-Arias (1996), Montiel and Reinhart (1999).

part of the mentioned literature tries to explain the surge of capital inflows into developing countries, "pull" refers to the factors that lie inside the economy and attract capital inflows. Montiel and Reinhart (1999) define these capital attracting factors as the ones that operate through the improvements in the risk-return characteristics of assets issued by the developing country debtors such as would result from productivity enhancing economic reforms.[16] So in our set up this would mean policies, that lead to an increase of the technology parameter α.

The most prominent of the "push" factors - which lie in the industrialized countries - is the world interest rate.[17] In their paper on inflows of capital to developing countries in the 1990s Calvo et al. (1996) mention that the low interest rates in the developed countries attracted investors to the high investment yields and improving economic prospects of economies in Asia and Latin America in the beginning of the 1990s. For example the short term interest rate in the USA reached its lowest point since the early 1960s in 1992. Fernandez-Arias (1996) contributes an interesting twist to the question of the influence of external factors to capital flows to emerging markets by laying bare, the positive effect of lower world interest rates on the creditworthiness of debtor countries that borrow at these rates. This is a further channel through which low world interest rates may induce capital to flow into emerging markets.

In the mentioned literature it is disputed, whether the external or internal factors are more important in the determination of the direction and composition of the flows. We cannot determine with our model, whether internal or external factors are more important, but we can illustrate in our model, that the scope of government policies coping with possible coordination failures changes as a function of external factors. If the international interest rate increases governments of developing countries lose scope whereas they gain if the interest rate falls. We find in accordance with the empirical literature, that the government can buy scope of its policies by for example productivity enhancing reforms. But at the same time we have to say, they lose if the productivity is decreased. This means that we expect the relative importance of internal versus external factors to vary over time. And we expect this change to be such that in unfavorable surroundings for the country the government can do even less.

5.3 Changes in the degree of uncertainty about the fundamentals on the level of debt ϵ

Finally, it is interesting to look at the impact of a change in the precision of the information ϵ:

[16]In addition Calvo et al. (1993) mention introduction of institutional reforms such as liberalization of the domestic capital market, opening of the trade account and policies that result in credible increases in the rate of return on investment.

[17]As stated in Calvo et al. (1996) additional external factors include terms-of-trade developments, international business cycle, regulatory changes that affect the international diversification of investment portfolios at the main financial centers.

Proposition 6 *If the degree of uncertainty about the fundamentals, ϵ, increases, the threshold equilibrium is shifted to a lower level of debt, ie. a growth collapse and thereby a sudden stop occurs already at lower levels of debt.*

That proposition (6) holds true can easily be seen by taking the derivative of $D^\star$ with respect to the variance of the private signal around the true value of debt.

$$\frac{\partial D^\star}{\partial \epsilon} = -\frac{\overline{z}}{6(r - \frac{1}{2}\overline{z})} < 0 \tag{19}$$

For possible values of r the derivative is always negative. This means that $D^\star$ decreases with increasing uncertainty. As argued before this in turn implies, that the probability of a sudden stop increases. Formulated differently this means that the more precise the information, the lower the probability of a bad equilibrium. This result contrasts the findings of the "game of refinancing".[18] In terms of government policies it means, that governments should aim for a information dissemination policy that entails small variation in the value of private signals, i.e. that entails little uncertainty about the fundamentals.[19]

We have shown that there exists a unique threshold equilibrium describing a discontinuous switch from the high to the low growth equilibrium, i.e. a growth collapse. Additionally, we have illustrated the comparative statics of this equilibrium. Calvo (2003) extensively explains how the growth collapse automatically translates into a sudden stop of capital flows.

6 Testable Implications

Here, we would like to identify the testable implications of the theoretical model so that we can then verify the predictions regarding the influence of technological progress, the international interest rate and the uncertainty about the fundamentals of the economy on the probability of a sudden stop.

The first hypothesis is that sudden stops become less likely if internal factors of emerging market countries get more favorable, e.g., if the investment safety increases or if governments adopt technology enhancing policies.

The second hypothesis is that more sudden stops occur if the international interest rate increases.

The third testable hypothesis is that sudden stops become more probable with more uncertainty on the fundamentals of the economy.

7 Empirical Evidence

The purpose of this section is to validate the predictions of the theoretical model. We focus on showing the effect of the uncertainty about the fundamentals on the occurrence of sudden

[18] cf.Morris and Shin (2004)

[19] For an extensive analysis of transparency cf Heinemann and Illing (2002).

stops of capital flows.

7.1 The Data

We work with two data sets: A yearly data set of 14 emerging and 17 industrialized countries and a monthly data set of 11 developing and 14 developed countries. Both sets run from from January 1990 until December 2001. We work with these two data sets because with the yearly data we cannot tackle the potential problem of endogeneity due to too little observations. However, we want to display the results of the analysis with yearly data, as we do not have all the series of control variables in monthly frequency and use interpolated series there.

The selection of countries reflects those emerging countries that are tracked by JP Morgan's Emerging Market Outlook, i.e. countries that significantly show in the world capital markets and for the developed countries picks OECD members. In addition some of the countries that fulfill those criteria are dropped due to lack in the relevant data.[20]

The dependent variable is an index of sudden stops of capital flows. Following Calvo et al. (2004) we employ a dummy variable that is based on monthly data of capital flows. This high frequency of data is chosen, because it best unveils the origin of crisis episodes. Due to the high frequency of data however, it is necessary to work with a proxy for the flows: Netting out the trade balance from changes in foreign reserves. Then the change in the capital flows with respect to the capital flows 12 months before is calculated to avoid seasonal effects.

The first criterion that determines whether a month is counted as a crisis month or not concerns the capital flows: This criterion is fulfilled if the year on year fall in capital flows undershoots its sample mean by more than two standard deviations. To introduce persistence in this measure the criterion is also regarded fulfilled if the flows fall more than one standard deviation below the sample mean in the months that encircle the two standard deviation fall. In addition to this first criterion, secondly the output of the economy has to contract at the same time. Thereby, one only picks up crisis episodes with costly disruption in economic activity. For robustness checks we make also use of the dummy variable, where only the capital flow criterion has to be fulfilled in our analysis.[21] In the analysis with yearly data, a year is counted as a sudden stop year, if it contains at least one month that fulfills the above mentioned criteria.

[20] For more details cf. the data appendix (A.8).

[21] There is no consensus in the literature about the concept of capital flows or the criteria to detect a sudden stop. While eg. Calvo and Reinhart (2000) examine variations in net private capital flows, Milesi-Ferretti and Razin (1998) and Hutchison and Noy (2006) analyze changes in the current account. In addition the measures of the variation in capital flows differ. While in one part of the literature negative differences are measured relative to the country's GDP and considered a sudden stop if they exceed a specific threshold (cf. eg. Calvo and Reinhart (2000) and Hutchison and Noy (2006)). However, a newer part of the literature also takes into consideration the unexpected character of such an extreme event and considers a drop in capital flows a crisis when it falls below a threshold in terms of the standard deviations below the sample mean cf. Calvo et al. (2004), Cavallo and Frankel (2004) and Eichengreen et al. (2006). This latter approach is consistent with our theoretical model and that is why we use it.

The explanatory variable that we are most interested in, is the uncertainty about the fundamentals. We use the standard deviation of growth forecasts by a group of country experts as a measure of uncertainty. In the models a la Morris and Shin (1998) the uncertainty takes the form of the dispersion of the private signals around the true value of the fundamental. In the current model this is the dispersion of the private signals about the true value of the government debt, i.e. the evaluation of the value of the government debt by each of the private investors. One cannot directly observe such data. However, there exist data that one can use as reliable proxy.

First of all, given the distributional assumptions that we have made in the theoretical model the expectation of the true value of the debt, given the private signal is exactly the private signal itself: $E(D|D^i) = D^i$. If the private signals are dispersed with a standard deviation of ϵ around the true value of the debt, the expectations will as well. Therefore the standard deviation of the expectations will give a good indication of the standard deviation of the signals that we are interested in. Data that closely proxies the expectations by private agents about the fundamentals are available.

Data on the standard deviation of expectations about the level of government debt are not available in a sufficient coverage. Therefore, we use the standard deviation of expectations about GDP growth as a proxy. In doing this we follow Prati and Sbracia (2002) who use these data to test the effect of uncertainty on the occurrence of currency crises in a similar model. In addition, with regard to the fact that our model also works if the uncertainty lies on the productivity parameter this procedure seems even more justified.

A second restriction is that there exists no data on the private signals of all investors. The data collecting firms only survey the opinions of a group of about 20 banks and other market analysts per country. However, assuming that private investors can buy the opinions of the experts, it is reasonable, that they will buy different numbers of those opinions and will weigh these signals differently. If the experts strongly diverge in their expectations it is most likely, that private agents will have even more divergent evaluations of the fundamental. Therefore the dispersion of the expert opinions, i.e. their standard deviation, seems a good indicator of the dispersion of private agents' expectations about the fundamentals.

Both data collecting institutions whose data we use, the IFO Institute for Economic and Consensus Economics collect GDP forecasts of a group of country experts at a particular point in time and then report mean and standard deviation of these forecasts for the respective country. We use those reported standard deviations as the measure of uncertainty. When working with yearly data we make use of both data sets. While the IFO institute asks experts within the countries that they track about their forecasts of GDP growth for the current year once a year in April, Consensus Economics collects forecasts of GDP growth, CPI inflation, government budget balance, current account balance trade balance and exports for the current and following year in monthly frequency. In the analysis with yearly data we display two sets of estimations, one, where the measure of uncertainty is a yearly average of the standard deviations of forecasts that Consensus economics gathers. In the second set of estimations, we combine the observations by Consensus and WES. We do this by only taking the April forecast for the current year by Consensus. If both observations are available we use the WES data.[22]

In order to achieve a constant one year forecast horizon for the data by Consensus economics, we follow Prati and Sbracia (2002) in computing a weighted average of the current and the following year forecast. In January a weight of 11/12 is attributed to the current and of 1/12 to the following year forecast. In February the weights equal 10/12 and 2/12 respectively, for every month in the same logic, another set of weights is applicable until December were the respective weights are 0/12 and 12/12.[23]

We use a large set of control variables. First of all, we control for the mean of the growths forecasts. This seems to be the most important control because we want to disentangle the effect of private investors having diverging opinions as opposed to all being sure that growth will be low. Additionally, we draw upon Calvo et al. (2004). They convincingly put forward the vulnerability to large real exchange rate fluctuations and the degree of domestic liability dollarization as drivers of the occurrence of sudden stops. In addition, we use a large set of macroeconomic controls. When we work with monthly data we have to interpolate several time series of the control variables that are only available in yearly frequency. It is clear that we thereby understate the variance of those series. Since we have monthly observations on the variables that we are most interested and most of the controls that we have to interpolate represent economic variables that do not vary substantially in a year's time it is very unlikely that this fact influences the results. In addition, we can show the presence of the effect of the uncertainty on the occurrence of sudden stops of capital flows with yearly data.

7.2 Benchmark Regression

As a benchmark regression we estimate a pooled probit controlling for country and time effects. The theoretical model is static and predicts the probability of a crisis at a particular point in time. Therefore a probit approach to estimating the effect of the uncertainty on the occurrence of a crisis seems most appropriate.

$$\text{Prob}(Suddenstop = 1|x_{it}\beta) \tag{20}$$

with $i = 1, 2, ..., n; t = 1, 2, ..., T$

Suddenstop equals one if country i experiences a sudden stop in period t. x_{it} represents the set of explanatory variables, including the measure of uncertainty, β is the vector of the corresponding coefficients. $G(.)$ is the standard normal cumulative distribution function.

We include country dummies into our analysis. The level of uncertainty varies strongly across countries.[24] While in some countries like for example the Netherlands or Italy the av-

[22]For robustness checks we ran the same regressions also once using WES data only and another time using a combination where in case of redundance we took the Consensus data. The results are qualitatively the same and quantitatively similar.

[23]As a robustness check we rerun all the estimations with the current year and with following year forecasts separately. The results are qualitatively the same and quantitatively similar.

[24]This is illustrated in appendix (A.9).

erage of the uncertainty measure over the analyzed period from January 1990 till December 2001 is as low as 0.24 standard deviations in countries like Indonesia or Turkey it reaches levels of 1.022 and 1.15 standard deviations respectively. These statistics suggest that systematically some countries are characterized by higher uncertainty than other countries and therefore it is necessary to control for country fixed effects. In a probit estimation one can only consistently achieve this by incorporating country dummies into the regression.

Additionally, we control for time fixed effects. Calvo et al. (2004) in line with a large part of the literature state that sudden stops in emerging economies bunch around the Tequila (1994), East Asian (1997) and Russian (1998) crises. In developed countries they materialize mostly around the ERM crisis in 1993. The graphs in appendix (A.10), which depict the sudden stop periods against the measure of uncertainty, also show this feature of the crises. Thus, controlling for time fixed effects is necessary. Mostly we do this by including time dummies in the regressions. However, where the data quality does not allow for this, we use polynomial time trends to reduce the number of dummy variables and approximate the variation over time.

7.3 Analysis with Yearly Data

First, we run a pooled probit regression with the sample of all countries with yearly data. As can be seen in table (1) in appendix (A.11) the coefficient on the contemporaneous uncertainty has a positive sign irrespective of the measure of uncertainty that we choose. Controlling for country and time effects the result is significant.[25] However, sudden stops are mainly an emerging market phenomenon.[26] For some of the countries that do not experience sudden stops of capital flows the country dummies are dropped from the regression, while the observations are included. This makes the result look weaker. To circumvent this difficulty we redo the analysis for emerging economies only. The results are reported in table (2) in appendix (A.11). Again the effect of the uncertainty on the crisis probability is positive and significant. However, when working with the uncertainty measure based on the Consensus data in the case where we include the quadratic time trend, column (3) in the left half of the table, none of the explanatory variables is significant. This seems to be related to the little number of observations of 64. This does not happen with the combined measure of uncertainty, where we have 97 observations.

In all regressions we control for the mean of the expectations over all the experts. Hereby, we want to disentangle the self-fulfilling effect of the expectations and actually the uncertainty about the fundamentals, hence the disagreement on the state of the economy. In most of the regressions the mean of the expectations turn out to significantly impact the crisis probability: the lower the mean of the expectations the higher the crisis probability. The other control variables, namely the domestic liability dollarization, the vulnerability to

[25]The results stay the same when including higher order time trend. However if including country and year dummies none of the explanatory variable is significant, which indicates that one would demand too much from the data by doing so.

[26]cf. appendix (A.10)

real exchange rate fluctuations, the index of exchange rate flexibility, the reserves over the current account deficit, M2 over reserves, credit growth, foreign direct investment over GDP, public balance over GDP, total debt over GDP and TOT growths,turn out to be insignificant in many of the regressions once one controls for country fixed effects.[27]

We can conclude from the analysis with yearly data that the empirical findings are in line with the theoretical model. However, due to data limitation, we cannot tackle one obvious problem of the analysis: the direction of causality. Here, the monthly data contributes to finding a remedy.

7.4 Analysis with Monthly Data

When repeating the analysis with monthly data we use the one month lag of the explanatory variables as a first step to reduce the problem of endogeneity. Additionally, one month seems an appropriate time on average that investors can act according to their expectations. On the one hand the capital flow proxy comprises portfolio investments which are very liquid and on the other hand foreign direct investment which might be more difficult to buy or sell. The regression where we include the entire country sample suffers from the same difficulty of dropped country dummies as the counterpart in the regression with yearly data. The result of these regressions is displayed in table (3). Still, we can see that the sign of the effect of the uncertainty on the occurrence of crises is positive as expected. The most insights can be won from the pooled probit estimation with monthly data and the emerging market sample.

(Table (4) here)

The results of the analysis with monthly data and the emerging market sample turn out as expected.[28] The lagged uncertainty influences the crisis probability positively. The lagged expectations themselves have the opposite impact. The insignificance of the vulnerability against real exchange rate fluctuations and the domestic liability dollarization, the variables that Calvo et al. (2004) put forward as main drivers of sudden stops, may root in the interpolation of these series from yearly data. However, already in the analysis with yearly data (cf. appendix A.11, tables (1) and (2)) the two variables do not appear significant in a lot of specifications. This finding suggests, that it is difficult to argue for an analysis

[27]We show the results with our preferred specification in terms of the control variables, however, we have run all the regressions with a larger set of controls and the results are qualitatively the same and quantitatively similar.

[28]The result with respect to the uncertainty holds also when applying monthly time dummies into the analysis. However, most of the other variables get insignificant which can emerge from the fact that part of them are interpolated from yearly data. Therefore the specification with time dummies is not displayed here and not our favorite specification.

assuming random effects as Calvo et al. (2004) do. [29]

The effect of the uncertainty on the occurrence of sudden stops is not negligible. To gain a feeling for the relevance of the topic we calculate the marginal effects for the regressions from table(4). We find that the effect ranges between a 2.5 and 10.8 increase of the crisis probability when the uncertainty is increased by one unit, thus one standard deviation. Our favorite specifications are those with a quadratic or cubic time trend. Therefore, we would say that an effect of 2.5 to 5.6 percent is most realistic. The variation stems from different specifications.

(Table (5) here)

7.5 Facing Endogeneity

In order to be able to dispel the possibility that the above results rather stem from an endogeneity problem than displaying the effect of the uncertainty about the fundamentals we first apply higher order lags as explanatory variables. Second, we implement instrumental variable estimation.

The analysis applying lags of the potentially endogenous variables, namely the uncertainty measure, the mean of the expectations and the vulnerability to real exchange rate fluctuations reveals that the uncertainty up to four month previous to the crisis period has a significant positive effect on the probability of a crisis. Earlier uncertainty however does not matter for a crisis to occur. This pattern does not materialize with respect to the mean of the expectations and the vulnerability to real exchange rate fluctuations, which both stay significant when applying these higher order lags. These results are illustrated in table (6) in appendix (A.11).

We cannot be sure that a lag of four month is enough to deny possible endogeneity. Nevertheless, it is unlikely that a crisis announces itself in all its precipitation four months prior to the moment where we would count a month as a sudden stop month and thus people could be certain that a crisis is going to happen. Furthermore, it is also not surprising that the uncertainty does not have an effect for more than four month into the future: If it is the disagreement between investors about future outcomes at the point of the investment decision itself that matters, then as we argued before one month should be a good proxy for the reaction time. To summarize, these results cannot exclude the possibility that the result is driven by endogeneity but it renders it much less likely.

[29] The result of the uncertainty influencing the crisis probability positively also holds under the assumption of random effects controlling for time effects. However, assuming country fixed effects is more rigorous and we find it difficult to argue for random effects in this context.

The next step in the attempt to cope with the potential endogeneity is to instrument the contemporaneous variable with its own lag. In the first stage we regress the uncertainty measure on its own lag controlling for the same set of controls as in the second stage regression. Based on the estimated coefficients, we predict the contemporaneous uncertainty. In the second stage we employ the predicted values along with the control variables that we are interested in.

The results in table (7) in appendix (A.11) suggest that the uncertainty does have an aggravating effect on the probability of a crisis. Here, we display the results where we used the six month lags of the potentially endogenous variables as instruments. We did the same analysis with lower and higher order lags. The results are similar for lower order lags. For higher order lags however they break down. Then, under some specifications the lags are not significant in the first stage regressions any more and under other specifications the predicted values do not significantly explain the occurrence of a crisis. Keeping in mind the fast speed in which a lot of the crises burst out it seems that a lag of six months is a sufficient distance to exclude the causality from the crisis to the uncertainty. In addition, and this also applies already to the argument when explaining the results with the lagged explanatory variables, we control for the mean expectations and also for time effects which ensure further that we are not picking up the reverse causality by the uncertainty variable. Hence, we consider the analysis with lagged explanatory variables as well as the instrumental variable estimation as further indication for the validity of the theoretical findings. One additional possibility to avoid the endogeneity might be to look for past data revisions as an instrument for the uncertainty. However, there might be also a problem, that revisions of data often happen in sight of a crisis to smooth outcomes etc.

7.6 Robustness Analysis

We report one additional set of estimations in order to assure ourselves that the results are not sensitive to the econometric method that we have chosen. Table (8) in appendix (A.11) reports the results of these estimations. Additionally to the pooled probit that we chose as a benchmark case we estimate a pooled logit controlling for country and time effects, a conditional logit in a panel setting with fixed effects and a Chamberlain's Panel probit estimations. All these approaches have in common that one controls for country specific effects. Applying the logit estimation implies employing the logistic function instead of the normal cumulative distribution function as in the probit approach. The conditional logit allows for a fixed effects estimation which is not possible in a probit setting. A fixed effects estimation in a probit setting leads to inconsistent coefficient estimates as the country effects cannot cancel out when they are within the cumulative distribution function. The problem is less in the case of the logistic function. When using Chamberlain's panel probit approach one allows for the unobserved heterogeneity to be correlated with the mean of each of the explanatory variables which is calculated by country and included into the estimation as further control. Therefore this mean functions similar to a country dummy. [30]

As table (8) in appendix (A.11) illustrates the positive effect of the uncertainty on the occurrence of sudden stops is robust against different estimation approaches. In addition we see that the negative effect of the expectations themselves is also robust.

We have run all the regressions also with the complete list of control variables (cf. appendix(A.8)). The results do not qualitatively and quantitatively change when including the additional variables. The specification that we show here is our preferred one and we rather illustrate different specifications in terms of the control for time effects (including time trends of differing order). We have chosen this approach because part of the series of control variables are interpolated and therefore the data quality does not always allow to include the 144 monthly time dummies in the regressions.

Furthermore, we run all the above regressions with an alternative measure of sudden stops. Namely, we redo the analysis counting a month a sudden stop month when the criteria regarding the drop in capital flows are fulfilled and ignoring whether growth is positive or negative in the respective period. The results from this analysis are quantitatively the same as the ones that we report here.

We conclude the empirical findings by stating that in the analysis with the yearly data we have seen that contemporaneously the uncertainty affects the crisis probability significantly and positively. However with yearly data we cannot not resolve the difficulty of possible endogeneity. By calculating the marginal effects we can also show that the effect that we are showing is not negligible quantitatively. In order to circumvent the issue of endogeneity we switch to monthly data and first apply higher order lags as explanatory variables. In a further step we perform two stage estimation with the lags of the potentially endogenous variables serve as instruments. This works for lags up to six months. Additionally we check for different estimation approaches.

Summarizing the empirical results we understand them as a support for our theoretical prediction. The uncertainty about the fundamentals increases the probability of a sudden stop of capital flows.

8 Policy implications

To round off our analysis we now want to discuss what our theoretical and empirical results imply in terms of economic policies.

8.1 Implications Regarding the Technology Parameter and the International Interest Rate

We have seen that an increase in the technology parameter decreases the probability of a crisis. Hence this implies that governments should try to enhance technological progress and

[30]For a detailed description cf. Wooldridge (2002), pages 487f.

thus make their country more interesting for investment. Also in this context the safety of investment seems crucial so that investors can realize a high after tax return on their investment. In the same strand high tax policies seem counterproductive. To summarize, all steps toward a credible increase in the long term rate of return on investment help prevent crises. An interesting implication of our analysis is that apart from the direct effect of an increase in the technology parameter a government can buy scope for other policies that help private investors to coordinate on the good equilibrium if they increase this parameter.

The international interest rate is not under the control of one economy. We rather refer to small open economies in our analysis. Our findings in this context imply that governments should take into consideration that they have even less scope for action once the outside world turns unfavorable, ie. if the international interest rate increases. So they should take precautions for such cases.

8.2 Implications regarding the Uncertainty about the Fundamentals

We have found that private information with little noise is the most favorable setting for an economy. So it should be in the interest of the government to achieve such an informational structure. We have modelled the government as mechanically servicing its debt in a static model so we have abstracted from problems of credibility or commitment. Therefore, we can only infer policy implications for a credible government. We do not cover mechanisms how governments could achieve credibility. One venue how a credible government could achieve a setting in which investors decide upon private information would be to allow full access to government data to a small group of independent economic rating agencies to gather all relevant information on the fundamentals. These agencies could then sell their signals to private investors. The private agents could buy signals of different agencies and weigh those according to their own judgement or preferences. This would make sure that signals that the investors in the market have about the fundamentals would be private and characterized by a small amount of noise.

9 Conclusion

In the present paper we have added the possibility of coordination failure between investors as a factor triggering a sudden stop and have verified our finding empirically. More specifically, we can show that an increased uncertainty about the fundamentals of an economy increases the probability of a sudden stop of capital flows.

The main theoretical findings of the present paper are, that the probability of a sudden stop decreases with technological progress. It increases with a higher international interest rate. And it also increases with noisier private signals which can be interpreted as higher uncertainty or disagreement about the fundamentals among private investors. With regard to the discussion on internal versus external factors, that attract capital to emerging markets, we find that with increasing international interest rate, the scope of policy action, preventing a sudden stop, is reduced. In contrast to this result, with technological progress, the government gains scope for its actions. Thus in terms of the discussion regarding pull and push factors of capital flows, we find, that the relative importance of those factors vary over time in an unfavorable way for the concerned economies. When the external conditions are unfavorable governments have less possibility to influence the economic outcome, by for example helping private investors to coordinate on the good equilibrium.

It has to be mentioned, that in the present paper, we have not included considerations about default and thereby credit frictions. Furthermore, we have not extended the non-monetary model to one with money. Calvo (2003) illustrates these extensions in his model. In the mentioned paper Calvo also shows, that foreseen crisis are also possible in the model. The introduction of infinitely many firms and the coordination problem do not alter these considerations. Banking crises however, cannot be rationalized within the current framework.

In a second step we have reviewed the theoretical findings empirically. Our focus is on the effect of the uncertainty about the fundamentals on the occurrence of a sudden stop of capital flows. We can verify the theoretical result by a pooled probit analysis controlling for country and time effects. Calculating marginal effects we can also show that the influence of the uncertainty on the occurrence of sudden stops is quantitatively not negligible. Additionally we execute a rich set of robustness checks. These include two stage estimations to address the possible endogeneity problem. In all these regressions we can show a positive effect of the uncertainty about the fundamentals on the probability of the occurrence of a crisis.

These results strongly suggest, that governments should take the uncertainty about the fundamentals in the economy into account. Lower precision of information about the government's fiscal policy and therefore uncertainty about these values increases the probability of a sudden stop of capital flows. Hence an economy will be more vulnerable in times, when uncertainty is higher, and policymakers should adjust their policies. Specifically, the provision of less noisy private information seems crucial in this context. One venue would be to allow full access to all government data to a small set of independent agencies which could then sell their ratings to private investors. The set up that we are looking at is static so we abstract from problems of credibility or commitment.

There are two extensions of the theoretical model. First, it could be interesting to add the assumption of public information about the level of the debt to the assumption of private information of each investor. So far we have assumed, that agents base their decision on their personal interpretation of publicly available information, that is each investor does not know, how the other investors interpret the available information. Morris and Shin (2004), Metz (2002) and Hellwig (2002) include public information that is common knowledge to all players into their analysis. However, it is questionable whether we would generate different implications in the present set up. A vivid discussion on the interaction between public and private information exists in the context of central bank policy. It was triggered by Morris and Shin (2004).

Second, it would be insightful to analyze the distinction between domestic and foreign investors: How would the probability of a sudden stop be influenced if the signals of domestic and foreign investors are differently dispersed around the true value of the debt? Are economies with investors that differ with regard to the precision of their information more prone to crisis than economies with homogenous and only domestic investors? One could gain a first idea of an possible outcome looking at Corsetti et al. (2004) who analyze the effect of the presence of one big investor who is better informed than the rest on the occurrence of currency crises.

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A Appendix

A.1 Value of the firm

Linear production function:

$y_t^i = \alpha K_t^i$,

where y_t^i is firm i's output in period t, α is the productivity factor and K_t^i is the capital invested.

Period t cash flow of firm i:

$$S_t^i = \alpha(1-\tau)K_t^i - \dot{K}_t^i \tag{21}$$

where τ represents a constant output tax rate and $\dot{K}$ the rate of capital accumulation, neglecting capital depreciation.

The value of the firm at time zero:

$$V^i = \int_0^\infty S_t^i e^{-rt} dt \tag{22}$$

where r represents the constant international interest rate.

z^i is defined as $z^i = \frac{\dot{K}^i}{K^i}$.

Normalizing the initial capital stock to one, the value of the firm can also be expressed as

$$\begin{aligned} V^i &= \int_0^\infty [\alpha(1-\tau) - z_t^i] e^{-\int_0^t (r - z_s^i) ds} dt \\ \Leftrightarrow V^i &= \int_0^\infty [\alpha(1-\tau) - z^i] e^{-(r-z^i)t} dt \\ &= [\alpha(1-\tau) - z^i] \int_0^\infty e^{-(r-z^i)t} dt \end{aligned}$$

assuming r>z

$$= [\alpha(1-\tau) - z^i][\tfrac{e-(r-z^i)t}{-(r-z^i)}]_0^\infty = [\alpha(1-\tau) - z^i]\frac{1}{(r-z^i)}$$

A.2 Proof of Lemma 1

With the switching strategy I_K the fraction of players investing is: $\pi^{-i}(I_K) = \int_0^1 I_K(D^j)dj$. Thereby, for the expected value in equation (11) becomes: $E(D\pi^{-i}(D^j)|D^i) = E(D\pi^{-i}(I_K)|D^i)$.

By the use of the law of iterated expectations and the fact that D is more precise information than the private signals D^i and D^j, we know that:[31]

[31] In general we know that if one has an information set $\Omega_3 = (\Omega_1, \Omega_2)$ then the expectation of a random

$$E(D\pi^{-i}(I_K)|D^i) = E(E(D\pi^{-i}(I_K)|D)|D^i)$$

This is equivalent to

$$E(DE(\pi^{-i}(I_K)|D)|D^i)$$

.

As the signals, given D, are independent of each other, the expected fraction of players that receive a signal smaller than some threshold K is equal to the probability that one player receives such a signal given the realization of D:

$$E(\pi^{-i}(I_K)|D) = \text{prob}(D^j \leq K|D)$$

, which proves the lemma.

A.3 Starting Signals for the Iterated Elimination of Dominated Strategies

The support of the distribution of the true value of the debt $[\breve{D}, \hat{D}]$ exceeds $\underline{D}$ and $\overline{D}$ (the borders of the multiplicity area in terms of the true value of the fundamentals which were found in section (3.1) by at least more than ϵ each. Therefore, there exist signals $\underline{D}^0$ and $\overline{D}^0$, such that:

$$E(D|\underline{D}^0) = \underline{D} \quad \text{and} \quad E(D|\overline{D}^0) = \overline{D}$$

and as

$$E(D|D^i = \underline{D}) = \underline{D} \quad \text{and} \quad E(D|\ D^i = \overline{D}) = \overline{D}$$

this implies that $\underline{D}^0 = \underline{D}$ and $\overline{D}^0 = \overline{D}$.

If agent i receives a signal of exactly $\underline{D}$, and even in the worst case that the probability of another agent investing was zero, the payoff difference equals 0 given this signal.[32]

A.4 Iterated Elimination of Dominated Strategies

One starts the elimination at the borders of the multiplicity area.

Due to the strict monotonicity in D^i, there exist unambiguous signals $\overline{D}^1 < \overline{D}^0 = \overline{D}$ and $\underline{D}^1 > \underline{D}^0 = \underline{D}$, such that:

$$\widetilde{U}(D^i, I_{\overline{D}^0}) < 0 \quad \text{for all} \quad D^i > \overline{D}^1 \quad \text{and} \quad \widetilde{U}(D^i, I_{\underline{D}^0}) > 0 \quad \text{for all} \quad D^i < \underline{D}^1$$

As $\overline{D}^0 > \underline{D}^0$ it also holds that $\overline{D}^1 > \underline{D}^1$. For the case of the upper border of the

variable X conditional on a small information set Ω_2, $E(X|\Omega_2)$ is equivalent to the conditional expectation given this smaller set Ω_2 of the conditional expectation given the bigger information set Ω_3 of X: $E(E(X|\Omega_3)|\Omega_2)$

[32] Plug the right hand side of equation (6) into equation(13) and set $\text{prob}(D^j < K|D)|D^i = 0)$

multiplicity area this means: Given that the other players do not invest when receiving signals above $\overline{D}^0$ the investment does not pay for signals above $\overline{D}^1$ either. Where we find $\overline{D}^1$ by calculating $\widetilde{U}(D^i = \overline{D}^1, I_{\overline{D}^0})$. This process can be iterated. Given that the other players do not invest when receiving signals above $\overline{D}^n$ it does not pay to invest at a signal $\overline{D}^{n+1}$ with $\overline{D}^{n+1} < \overline{D}^n$. The signals $\overline{D}^{n+1}$ are found by setting the expected payoff difference to 0, reflecting indifference between investment and no investment at firm i:

$$\widetilde{U}(\overline{D}^{n+1}, I_{\overline{D}^n}) = \overline{z}^i \frac{\alpha - r - r\overline{D}^{n+1} + \overline{z}E(D\text{prob}(D^j < \overline{D}^n|D)|D_i = \overline{D}^{n+1})}{(r - \overline{z}^i)r} = 0 \tag{23}$$

The sequence $\overline{D}^n$ is decreasing, monotone and bounded. By the common knowledge of rationality this process is driven to its limit of $\overline{D}^\star = lim_{n\to\infty}\overline{D}^n$. Concretely, one finds a value $\overline{D}^\star$ such that

$$\widetilde{U}(\overline{D}^\star, I_{\overline{D}^\star}) = 0 \tag{24}$$

$\overline{D}^\star$ has the interpretation that above this signal all players do not invest with certainty.

At the lower bound of the multiplicity area the analogue situation occurs, just with the sequence $\underline{D}^n$ being increasing. There one iterates until one finds:

$$\widetilde{U}(\underline{D}^\star, I_{\underline{D}^\star}) = 0 \tag{25}$$

.

That means, one iterates until one finds maximum [minimum] signal at which player i is indifferent between investing and not, and which is at the same time the threshold of the switching strategy of all other players, when starting off at $\overline{D}^0 = \overline{D}$ [$\underline{D}^0 = \underline{D}$].

The switching strategies $I_{\underline{D}^\star}$ and $I_{\overline{D}^\star}$ are Nash equilibria of the private information game. According to Milgrom and Roberts (1990) in all games with strategic complementarity the highest and the lowest equilibrium that resist the iterative elimination of dominated strategies are Nash equilibria. Put the other way round: Nash equilibria can never be eliminated. If $\overline{D}^\star = \underline{D}^\star$ there exists an unambiguous signal $D^\star$, below which in equilibrium all players will invest and above which no one does.

A.5 Proof of Lemma 2

The monotonicity of $\widetilde{U}$ in D^i is a necessary condition for the iterated elimination of dominated strategies to work and to make sure, that there are not several values for which equation (14) holds.

The factor $\overline{z}\frac{1}{(r-\overline{z})r}$ is positive, thus we focus on the rest of the expression.

It is clear that the term $-rD^i$ is strictly decreasing in D^i:

$$\frac{\partial(-\overline{z}rD^i)}{\partial D^i} = -r < 0$$

.

It is more difficult to show the characteristics of the term $E(D * \text{prob}(D^j < K|D)|D^i)$:

Making use of the distributional assumptions that we made with regard to the true value of debt and the private signal, we can write the conditional density of the private signal given the true value of the fundamental in the following way:

$$g(D^i|D) = \begin{cases} \frac{1}{2\epsilon} & \text{if } D-\epsilon \leq D^i \leq D+\epsilon \\ 0 & \text{otherwhise} \end{cases} \tag{26}$$

Therefore, we can write $\text{prob}(D^j < K|D)$ as:

$$\text{prob}(D^j < K|D) = \begin{cases} 0, & \text{if } K < D-\epsilon \\ \frac{1}{2\epsilon}(K-D+\epsilon), & \text{if } D-\epsilon \leq K \leq D+\epsilon \\ 1, & \text{if } K > D+\epsilon \end{cases} \tag{27}$$

Now, in addition referring to the conditional density of the true value of debt given the private signal that agent i receives,

$$h(D|D^i) = \begin{cases} \frac{1}{2\epsilon} & \text{if } D^i-\epsilon \leq D \leq D^i+\epsilon \\ 0 & \text{otherwhise} \end{cases} \tag{28}$$

we can rewrite the expected value as:

$$E(D\text{prob}(D^j < K|D)|D^i) = \int_{D^i-\epsilon}^{D^i+\epsilon} D\text{prob}(D^j < K|D)\frac{1}{2\epsilon}dD$$

$$= \begin{cases} \int_{D^i-\epsilon}^{D^i+\epsilon} \frac{D}{2\epsilon}0dD, & \text{if } K < D^i-2\epsilon \\ \int_{D^i-\epsilon}^{K+\epsilon} \frac{D}{2\epsilon}\frac{1}{2\epsilon}(K-D+\epsilon)dD & \\ +\int_{K+\epsilon}^{D^i+\epsilon} \frac{D}{2\epsilon}0dD, & \text{if } D^i-2\epsilon \leq K \leq D^i \\ \int_{D^i-\epsilon}^{K-\epsilon} \frac{D}{2\epsilon}1dD & \\ +\int_{K-\epsilon}^{D^i+\epsilon} \frac{D}{2\epsilon}\frac{1}{2\epsilon}(K-D+\epsilon)dD, & \text{if } D^i \leq K \leq D^i+2\epsilon \\ \int_{D^i-\epsilon}^{D^i+\epsilon} \frac{D}{2\epsilon} * 1dD, & \text{if } D^i+2\epsilon < K \end{cases} \tag{29}$$

The value of the conditional probability depends on the relative position of K to D and therefore the expectation of it given D^i also depends on the relative position of K to D^i. Due to the fact that D^i is known to the agent, the integral is evaluated from $D^i-\epsilon$ to $D^i+\epsilon$.

Equation (29)delivers:

$$= \begin{cases} 0, & \text{if } K < D^i-2\epsilon \\ \frac{1}{4\epsilon^2}\big(\frac{1}{3}((D^i)^3) - \frac{1}{2}(3\epsilon+K)(D^i)^2 & \\ +(2\epsilon^2+K\epsilon)D^i + \frac{1}{6}K^3 + \frac{1}{2}K^2\epsilon - \frac{2}{3}\epsilon^3\big), & \text{if } D^i-2\epsilon \leq K \leq D^i \\ \frac{1}{4\epsilon^2}\big(-\frac{1}{3}((D^i)^3) - \frac{1}{2}(3\epsilon-K)(D^i)^2 & \\ +(2\epsilon^2+K\epsilon)D^i - \frac{1}{6}K^3 + \frac{1}{2}K^2\epsilon - \frac{2}{3}\epsilon^3\big), & \text{if } D^i \leq K \leq D^i+2\epsilon \\ D^i, & \text{if } D+2\epsilon < K \end{cases} \tag{30}$$

We have shown that the term $-rD^i$ is strictly monotonically decreasing in D^i. In addition we know, that $\overline{z} < r$. Hence, for the monotonicity of the expected payoff difference between investing and not investing,$\widetilde{U}(D^i, I_K)$, it is sufficient that the derivative of the expected value that we are analyzing is smaller or equal to 1. The derivatives for the different intervals of the expected value are the following:

$$\frac{\partial E(D * \text{prob}(D^j < K|D)|D^i)}{\partial D^i} = \begin{cases} 0, & \text{if } K < D^i - 2\epsilon \\ \frac{1}{4\epsilon^2}\big((D^i)^2 - (3\epsilon + K)D^i \\ +(2\epsilon^2 + K\epsilon)\big), & \text{if } D^i - 2\epsilon \leq K \leq D^i \\ \frac{1}{4\epsilon^2}\big(-(D^i)^2 - (3\epsilon - K)D^i \\ +(2\epsilon^2 + K\epsilon)\big), & \text{if } D^i \leq K \leq D^i + 2\epsilon \\ 1, & \text{if } D + 2\epsilon < K \end{cases} \tag{31}$$

For the cases of $K < D^i - 2 * \epsilon$ and $D + 2\epsilon \leq K$ it is clear that the derivatives are 0 or 1 respectively and hence that $\widetilde{U}(D^i, I_K)$ is monotone decreasing in D^i in these intervals.

For the case that $D^i - 2\epsilon \leq K \leq D^i$, the derivative is a positive quadratic function (U-shape) in D^i. So the derivative will take its maximum value at either of the borders of the analyzed interval.

Evaluated at $K + 2\epsilon$ the function

$$\frac{1}{4\epsilon^2}\big((D^i)^2 - (3\epsilon + K)D^i + (2\epsilon^2 + K\epsilon)\big)$$

takes the value of 0. Evaluated at K the function takes the value of $\frac{1}{2}\big(1 - \frac{K}{\epsilon}\big)$ if $K \geq -\epsilon$. This is the maximum value that the derivative takes in the mentioned interval. ϵ is a very small positive number and K is bound to be positive by the support of D, hence the restriction is not binding.

So we can conclude that also in the interval of $D^i - 2\epsilon \leq K \leq D^i$ the expected payoff difference is monotonically decreasing.

If $D^i \leq K \leq D^i + 2\epsilon$ we find the following results. First of all, the function

$$\frac{1}{4\epsilon^2}\big(-(D^i)^2 - (3\epsilon - K)D^i + (2\epsilon^2 + K\epsilon)\big)$$

is a negative quadratic function in D^i (inverse U-shape). So it is necessary to find out how the function looks in the relevant interval, especially, whether the maximum of the function lies within it. This can be analyzed by taking the second derivative of the expected value. If it is positive over the entire interval one knows, that the analyzed interval is entirely located on the increasing branch of the function. Hence the function takes the maximum value at the upper limit of the interval. Accordingly, for an entirely negative second derivative the interval lies in the decreasing branch and the function will take its maximum value at the lower limit of the interval. If the second derivative changes sign the situation is more complicated. Then has to find the maximum of the function.

In our case the second derivative of the expected value is:

$$\frac{\partial^2 E(D\text{prob}(D^j < K|D)|D^i)}{\partial (D^i)^2} = \frac{1}{4\epsilon}(-2D^i - 3\epsilon + K)$$

This is a linear function in D^i. Plugging in the borders of the interval, we can determine the sign over the interval: at $K - 2\epsilon$ the function takes the value $\frac{1}{4\epsilon^2}(-K+\epsilon) < 0$ if $K \geq \epsilon$. As the upper bound of the dominance region where all players invest, $\underline{D}$, is at least ϵ bigger than $\breve{D}$ and a signal within the dominance region cannot be a switching signal, the restriction of $K \geq \epsilon$ is not binding.

At K the second derivative takes the value of $\frac{1}{4\epsilon^2}(-K-3\epsilon) < 0$ if $K > -3\epsilon$, where clearly the restriction is not binding. So the interval that we are interested in is entirely located in the declining branch of the negative quadratic function of the first derivative of the expected value. Therefore, the maximum of the first derivative will be at $D^i = K - 2\epsilon$. It is:

$$\frac{1}{4\epsilon^2}\big(-(K-2\epsilon)^2 - (3\epsilon - K)(K-2\epsilon) + (2\epsilon^2 + K\epsilon)\big) = 1$$

This is sufficient to proof monotonicity. We conclude that the expected payoff difference is strictly monotonically decreasing in the private signal D^i.

To complete the evaluation of the function at the borders of the interval and thereby completing the proof of continuity of the first derivatives, we also show the value of the function at the upper bound K of the interval. Then

$$\frac{1}{4\epsilon^2}\big(-(D^i)^2 - (3\epsilon - K)D^i + (2\epsilon^2 + K\epsilon)\big)$$

takes on the value of $\frac{1}{2}\big(1 - \frac{K}{\epsilon}\big)$. And $\frac{1}{2}\big(1 - \frac{K}{\epsilon}\big) \leq 1$ if $K \geq -\epsilon$. This is the same value as when we evaluated the lower bound K for the interval $D^i - 2\epsilon \leq K \leq D^i$. At all borders of intervals, the derivatives coincide; this indicates the continuity of the first derivatives and shows the smoothness of the expected value. One can show continuity for the expected value itself as well.

The above expression for the derivative of the expected value can hence be expressed as follows:

$$\frac{\partial E(D\text{prob}(D^j < K|D)|D^i)}{\partial D^i} = \begin{cases} 0, & \text{if } K < D^i - 2\epsilon \\ \in \big[0, \frac{1}{2}(1 - \frac{K}{\epsilon})\big], & \text{if } D^i - 2\epsilon \leq K \leq D^i \\ \in \big[\frac{1}{2}(1 - \frac{K}{\epsilon}), 1\big], & \text{if } D^i \leq K \leq D^i + 2\epsilon \\ 1, & \text{if } D + 2\epsilon \leq K \end{cases} \tag{32}$$

Adding the two terms that are dependent on D^i, we find, that $\widetilde{U}(D^i, I_K)$ is strictly monotonically decreasing in D^i.

q.e.d.

A.6 Proof of Lemma 3

Finding the solution to equation (14) implies setting $K = D^i = D^\star$ in equation (29). It is straight forward that we do not have to take into consideration the cases where $K < D^i - 2\epsilon$ and $K > D^i + 2\epsilon$. From equation (29) we see that for $K = D^i = D^\star$ the second term in the case of $D^i - 2\epsilon \leq K \leq D^i$ disappears and the first term becomes:

$$\int_{D^\star-\epsilon}^{D^\star+\epsilon} \frac{D}{2\epsilon}\frac{D^\star - D + \epsilon}{2\epsilon} \quad \text{dD} \tag{33}$$

.

In the case of $D^i \leq K \leq D^i + 2\epsilon$ the first term disappears and the second term is identical with expression (33).

Solving the integral delivers:

$$= \frac{1}{4\epsilon^2}\Big[\frac{1}{2}D^2 D^\star - \frac{1}{3}D^3 + \frac{1}{2}\epsilon D^2\Big]_{D^\star-\epsilon}^{D^\star+\epsilon}$$

The above expression simplifies to:

$$\frac{D^\star}{2} - \frac{\epsilon}{6}$$

With this result, we can simplify equation (14) to become:

$$\widetilde{U}(D^\star) = \overline{z}^i \frac{\alpha - r - rD^\star + \overline{z}(\frac{D^\star}{2} - \frac{\epsilon}{6})}{(r - \overline{z}^i)r} = 0$$

Solving for $D^\star$ delivers the unique value:

$$D^\star = \frac{\alpha - r - \frac{\epsilon}{6}\overline{z}}{(r - \frac{1}{2}\overline{z})}$$

q.e.d.

A.7 Country Samples

	Industrialized Countries	Emerging Markets Countries
World Economic Survey (IFO Institute)	Australia, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Sweden, USA	Argentina, Brazil, Chile, Columbia, Czech Republic, Ecuador, Indonesia, South Korea, Mexico, Peru, Philippines, Thailand, Turkey, South Africa
Consensus Economics Forecasts (Consensus Economics)	Australia, Canada, Switzerland, Germany, Spain, France, United Kingdom, Italy, Japan, Netherlands, Norway, New Zealand, Sweden, USA	Argentina, Brazil, Chile, Colombia, Czech Republic, Indonesia, South Korea, Mexico, Peru, Thailand, Turkey

A.8 List of Variables

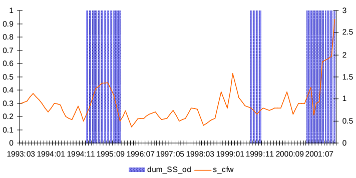
Variables	Expected effect on crisis probability	Measures	Sources
Dependent Variable:			
Sudden stop indicator		Capital flow proxy: Monthly data on trade balance minus changes in international reserves. Evaluated in 1995 US dollars	Calvo, Izquierdo, Mejia (2004), CIM(2004): IMF: IFS
		Yearly Growth rate of Gross Domestic Product	CIM (2004): IMF: IFS
Explanatory Variable:			
Uncertainty measure	positive	Monthly data of the weigthed average of the standard deviations of the current and following year forecast of ecomic growth. The standard deviation is calculated for the expectations that experts for the specific economy utter at a particular point in time. In January the standard deviation of the current year forecasts is weighted with 11/12 and the standard deviation of the following year forecasts with 1/12. In February the current year value receives 10/12 weight and the following year one 2/12. This scheme continues until December with a weighting of 0/12 for the current year value and 12/12 for the following year value. When working with yearly data, we build the mean of the 12 monthly values.	Consensus Economics
Control Variables:			
Vulnerability to real exchange rate fluctuations	positive	As shown in Calvo, Izquierdo, Mejia (2004), the fraction of the current account deficite relative to the demand for tradable goods in an economy is a good indicator for the vulnerability against real exchange rate fluctuations. This measure can be interpreted as the percentage fall in the demand for tradables needed to close the current account gap.	CIM(2004)
		The sum of agricultural and industrial output minus exports is used to proxy imports and the part of tradable output that is consumed domestically. The share of this tradable output is built relative to total GDP at constant prices. Then the share of tradale output in total output is multiplied with the total dollar GDP.	Worldbank: WDI
		Current account deficit	IMF: WEO
Domestic Liability Dollarization	positive	Developed countries: Local asset positions in foreign currency by BIS reporting banks as a share of GDP. EMs: Dollar deposits plus bank foreign borrowing as a share of GDP.	CIM (2004): BIS, Honohan and Shi (2002), Central Banks of Australia, New Zealand, Columbia, Korea, Brazil, IMF: IFS
TOT growth	negative	Terms of trade on goods and services, annual rate of change	CIM (2004): Worldbank: WEO
Total Debt over Revenues	positive		CIM (2004)
		Devoloped countries: Public debt from OECD. EMs: WDI; Gross central government debt	OECD, Worldbank: WDI
		Revenues of the central government	IMF: WEO
Reserves over CAD	negative		CIM (2004)
		International reserves	IMF: IFS
		Current account deficit	IMF: WEO
Ex. Regime 3	positive	Exchange rate regime classification into 3 categories: 1=float, 2= intermediate, 3= fix	Levy-Yeyati and Sturzenegger (2002)
Ex. Regime 5	positive	Exchange rate regime classification into 5 categories: 1=inconclusive, 2= float, 3= dirty, 4=dirty/crawling peg, 5= fix	Levy-Yeyati and Sturzenegger (2002)
Credit Growth	negative	Credit to private sector, annual rate of change	CIM (2004): IMF: IFS
FDI/GDP	negative	Net foreign direct investment	CIM (2004): IMF: IFS
Public Balance/GDP	positive	Balance of general government	CIM (2004): IMF: WEO
M2 over Reserves	positive	Money plus quasi-money	CIM (2004): IMF: IFS

A.9 Descriptive Statistics

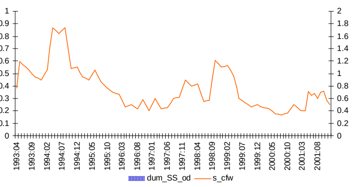
country	Mean (over time) of mean (over experts) of growth expectations by country	Max (over time) of mean (over experts) of growth expectations by country	Min (over time) of mean (over experts) of growth expectations by country	Mean (over time) of standard deviation (over experts) of growth expectations by country	Max (over time) of standard deviation (over experts) of growth expectations by country	Min (over time) of standard deviation (over experts) of growth expectations by country	Number of months that are counted as sudden stops
Argentina	3.29	6.45	-3.30	0.87	2.80	0.37	26
Australia	3.14	4.26	1.14	0.51	0.94	0.24	8
Brazil	2.69	4.67	-2.80	0.76	1.73	0.33	0
Canada	2.75	3.86	-0.15	0.42	0.70	0.15	0
Chile	5.20	8.93	2.10	0.49	0.80	0.24	12
Colombia	3.30	5.30	0.95	0.58	1.12	0.25	12
Czech Republic	2.76	5.28	0.25	0.53	0.93	0.28	3
France	2.37	3.56	0.38	0.27	0.58	0.14	0
Germany	2.02	4.06	-0.55	0.33	0.64	0.11	5
Indonesia	4.63	7.56	-7.71	1.02	3.32	0.18	11
Italy	2.07	3.37	0.62	0.24	0.51	0.06	0
Japan	1.71	4.91	-0.96	0.67	1.30	0.21	12
Mexico	3.43	5.48	-1.60	0.58	1.17	0.20	7
Netherlands	2.48	3.81	0.71	0.24	0.51	0.09	0
New Zealand	2.68	4.04	1.49	0.53	0.95	0.30	0
Norway	2.44	3.81	0.34	0.47	0.94	0.23	0
Peru	4.07	6.90	-1.35	0.67	1.20	0.30	6
South Korea	5.83	7.96	-1.40	0.82	2.11	0.20	11
Spain	2.85	4.65	0.50	0.24	0.38	0.10	9
Sweden	1.76	2.84	0.70	0.26	0.60	0.14	14
Switzerland	1.76	2.84	0.70	0.26	0.60	0.14	0
Thailand	4.15	8.53	-3.31	0.95	2.84	0.25	19
Turkey	3.23	5.38	-0.97	1.15	1.90	0.59	26
United Kingdom	2.11	3.42	-0.17	0.42	0.85	0.19	0
United States	2.53	4.13	-0.14	0.37	0.76	0.13	12

A.10 Graphs Sudden Stops versus Uncertainty

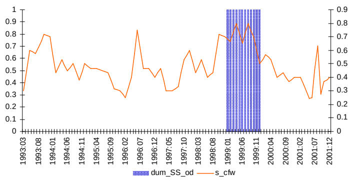
Argentina - Sudden Stop Dummies and the uncertainty about the fundamentals



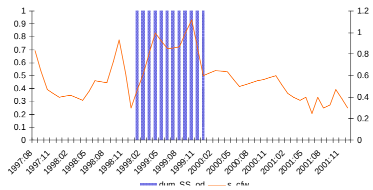
Brazil - Sudden Stop Dummies and the uncertainty about the fundamentals



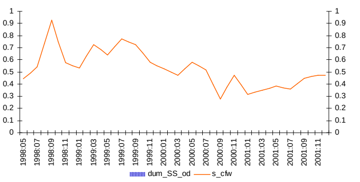
Chile - Sudden Stop Dummies and the uncertainty about the fundamentals



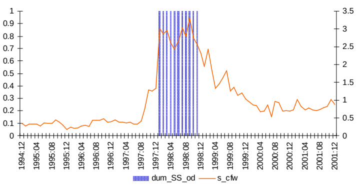
Colombia - Sudden Stop Dummies and the uncertainty about the fundamentals



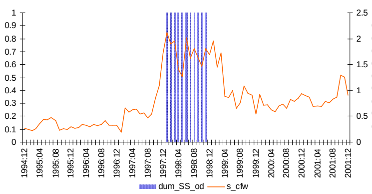
Czech Republik - Sudden Stop Dummies and the uncertainty about the fundamentals



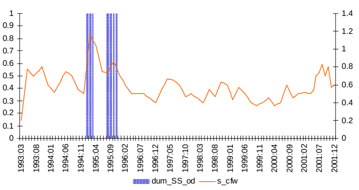
Indonesia - Sudden Stop Dummies and the uncertainty about the fundamentals



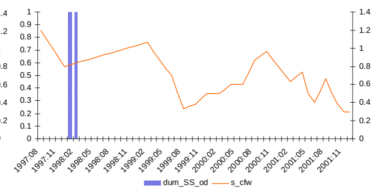
Korea - Sudden Stop Dummies and the uncertainty about the fundamentals



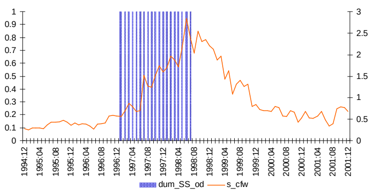
Mexico - Sudden Stop Dummies and the uncertainty about the fundamentals



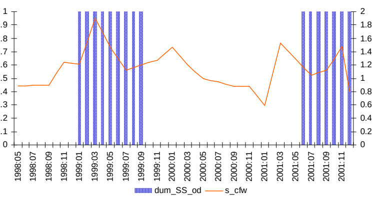
Peru - Sudden Stop Dummies and the uncertainty about the fundamentals



Thailand - Sudden Stop Dummies and the uncertainty about the fundamentals



Turkey - Sudden Stop Dummies and the uncertainty about the fundamentals



A.11 Empirical Results

Pooled Probit - Yearly Data

All Countries - Dependent Variable: Sudden Stop Indicator

	Uncertainty Measure: Consensus			Uncertainty Measure: Combination Consensus WES		
	(1)	(2)	(3)	(1)	(2)	(3)
uncertainty	4.227***	4.894*	6.688*	0.632*	1.340*	1.092
	(1.104)	*(2.644)*	*(3.718)*	*(0.328)*	*(0.795)*	*(0.795)*
mean expectation	0.034	-0.565	-1.539	-0.313***	-0.697***	-0.750***
	(0.122)	*(0.425)*	*(1.035)*	*(0.080)*	*(0.252)*	*(0.261)*
lag of RER vuln	-1.104	20.705	-16.247	2.194	64.480**	58.756**
lag of DLD	-14.942***	-41.949**	-70.996**	-0.628	29.896*	30.147**
int. RER vuln DLD	114.247***	199.502**	482.341**	62.741**	-164.842	-155.958
Ex. Regime 5	-0.138	0.571	2.439	-0.169	0.632*	0.700**
lag res over CAD	0.001	0.027	0.034	-0.001	0.023	0.019
lag M2 over reserves	-0.049*	-0.089	-0.575	-0.069*	-0.210	-0.224
lag credit growth	0.112	-1.818	-4.670	0.769	4.030	2.956
lag FDI/GDP	-15.205	-35.652	-8.392	-16.397*	-19.395	-24.774
country dummies	no	yes	yes	no	yes	yes
linear time tr.	no	no	yes**	no	no	yes
quadr. time tr.	no	no	yes**	no	no	yes
Constant	-2.093**	-0.974	-5.874	-0.495	-7.947*	-8.427*
	(0.911)	*(2.917)*	*(9.658)*	*(0.764)*	*(4.313)*	*(4.507)*
Observations	194	84	84	277	137	137

Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

Table 1: Estimation with Yearly Data - All Countries' Sample

Pooled Probit - Yearly Data

Emerging Markets - Dependent Variable: Sudden Stop Indicator

	Uncertainty Measure: Consensus			Uncertainty Measure: Combination Consensus WES		
	(1)	(2)	(3)	(1)	(2)	(3)
uncertainty	5.890***	9.637**	159.486	0.814*	2.011*	3.497**
	(1.822)	*(4.028)*	*(71,842.597)*	*(0.444)*	*(1.065)*	*(1.758)*
mean exp	0.311	-1.071	-37.497	-0.244**	-0.458*	-0.490
	(0.191)	*(1.151)*	*(4,422.012)*	*(0.100)*	*(0.268)*	*(0.421)*
lag of RER vuln	10.654	14.230	-899.803	15.429*	67.434*	124.065
lag of DLD	-13.805*	-80.466	-1,566.751	5.289	31.087	56.144
int. RER vuln DLD	82.528	438.659	9,034.767	12.653	-161.271	-455.848
Ex. Regime 5	-0.276	1.109	50.569	-0.057	0.742*	0.904*
lag res over CAD	0.022*	0.055	-0.853	0.008	0.01	0.041
lag M2 over reserves	0.089	0.024	14.904	-0.072	1.419	3.899
lag credit growth	-0.097	3.666	157.022	1.278	3.223	12.316
lag FDI/GDP	-25.805	-84.541	-1,675.585	-28.623	-9.163	-76.614
country dummies	no	yes	yes	no	yes	yes
linear time trend	no	no	yes	no	no	yes
quadratic time tr.	no	no	yes	no	no	yes
Constant	-4.838***	-0.469	-119.757	-2.392	-13.376	-40.099*
	(1.827)	*(8.049)*	*(135873.81)*	*(1.508)*	*(8.284)*	*(23.292)*
Observations	77	64	64	115	97	97

*Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%*

Table 2: Estimation with Yearly Data - Emerging Countries' Sample

Pooled Probit - Monthly Data

All Countries - Dependent Variable: Sudden Stop Indicator

	(1)	(2)	(3)	(4)	(5)	(6)
lag uncertainty	2.06***	1.021***	1.068***	0.473	0.503	0.551
	(0.200)	*(0.353)*	*(0.363)*	*(0.374)*	*(0.381)*	*(0.381)*
lag of mean exp	-0.198***	-0.523***	-0.544***	-0.638***	-0.648***	-0.622***
	(0.035)	*(0.062)*	*(0.065)*	*(0.071)*	*(0.072)*	*(0.072)*
lag of RER vuln	-0.525	3.494	3.956	0.455	-0.354	0.121
lag of DLD	-3.543***	-7.638***	-8.247***	-4.296	-3.567	-3.895
int. RER vuln DLD	55.443***	53.616***	55.504***	72.544***	78.018***	73.776***
Ex. Regime 5	-0.153	0.134	0.125	0.095	0.087	0.071
lag res over CAD	0.006***	0.02***	0.022***	0.023***	0.024***	0.024***
lag M2 over res	-0.003	-0.055**	-0.054**	-0.075***	-0.083***	-0.071***
lag credit growth	-1.833*	-3.28**	-3.503**	-3.927***	-4.121***	-4.174***
lag FDI/GDP	1.561	-4.023	-5.066	15.955	16.78	10.174
country dummies	no	yes	yes	yes	yes	yes
month dummies	no	no	yes	yes	yes	yes
linear time trend	no	no	no	yes***	yes	yes
quadratic time tr.	no	no	no	no	yes*	yes
cubic time tr.	no	no	no	no	no	yes
Constant	-1.894	-0.074	0.134	2.494	1.644	2.623
	(0.220)***	(0.572)	(0.631)	(0.815)***	(0.935)*	(1.155)**
Observations	2258	1217	1217	1217	1217	1217

*Standard errors in Parantheses, *significant at 10%, **significant at 5%, ***significant at 1%*

Table 3: Estimation with all Countries' Sample

Pooled Probit - Monthly Data

Emerging Markets - Dependent Variable: Sudden Stop Indicator

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lag uncertainty	1.077***	1.368***	1.545***	1.140***	1.157***	1.188***	1.169**	0.941*
	(0.31)	*(0.384)*	*(0.407)*	*(0.429)*	*(0.428)*	*(0.459)*	*(0.464)*	*(0.482)*
lag of mean exp	-0.258***	-0.381***	-0.391***	-0.473***	-0.458***	-0.497***	-0.497***	-0.469***
	(0.048)	*(0.065)*	*(0.068)*	*(0.077)*	*(0.076)*	*(0.083)*	*(0.083)*	*(0.088)*
lag of RER vuln	-0.574	0.725	0.853	-2.214	-2.842	-2.231	-2.547	-2.767
lag of DLD	-0.213	-6.390**	-7.166**	-5.511	-4.338	4.212	3.845	8.354
int. RER vuln DLD	44.532***	58.712***	62.125***	78.863***	76.978***	63.848***	65.458***	58.846***
Ex. Regime 5	-0.134**	0.116	0.1	0.083	0.051	0.111	0.117	0.052
lag res over CAD	0.028***	0.016**	0.017***	0.017**	0.019***	0.032***	0.032***	0.034***
lag M2 over reserves	0.182***	0.222**	0.247**	0.260**	0.295**	0.229*	0.235*	0.225*
lag credit growth	-1.024	-2.898*	-2.577	-2.960*	-3.105*	-3.484*	-3.507*	-3.742**
lag FDI/GDP	-15.750***	-2.008	-3.53	12.357	-0.788	-20.184	-19.751	-23.257
country dummies	no	yes	yes	yes	yes	yes	yes	yes
month dummies	no	no	yes	yes***	yes*	yes***	yes	yes**
linear time trend	no	no	no	yes***	yes*	yes***	yes	yes**
quadr. time trend	no	no	no	no	yes	yes***	yes	yes**
cubic time trend	no	no	no	no	no	yes***	yes	yes**
fourth order time tren	no	no	no	no	no	no	yes	yes**
fifth order time trend	no	no	no	no	no	no	no	yes**
Constant	-1.475***	-1.163*	-1.146	0.536	-2.45	-24.872***	-18.232	-266.830**
Observations	837	689	689	689	689	689	689	678

*Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%*

Table 4: Estimation with Monthly Data - Emerging Countries' Sample

Pooled Probit - Monthly Data - marginal effects

Emerging Markets - Dependent Variable: Sudden Stop Indicator

	(1)	(2)	(3)	(4)	(5)
lag uncertainty	0.108***	0.064***	0.056***	0.025***	0.09**
	(0.037)	*(0.031)*	*(0.027)*	*(0.018)*	*(0.068)*
lag of mean exp	-0.030***	-0.026***	-0.022***	-0.010***	-0.03***
	(0.008)	*(0.008)*	*(0.008)*	*(0.006)*	*(0.017)*
lag of RER vuln	0.059	-0.124	-0.137	-0.046	-0.15
lag of DLD	-0.507**	-0.308	-0.209	0.087	0.68
int. RER vuln DLD	4.655***	4.411***	3.704***	1.324***	3.16
Ex. Regime 5	0.009	0.005	0.002	0.002	0.003
lag res over CAD	0.001***	0.001**	0.001***	0.001***	0.005***
lag M2 over reserves	0.018**	0.015**	0.014**	0.005*	0.013
lag credit growth	-0.230*	-0.166*	-0.149*	-0.072*	-0.146
lag FDI/GDP	-0.159	0.691	-0.038	-0.419	-2.23
country dummies	yes	yes	yes	yes	yes
month dummies	no	yes	yes	yes	no
linear time trend	no	yes	yes	yes	no
quadratic time tr.	no	no	yes	yes	no
cubic time tr.	no	no	no	yes	no
fourth order time tr.					no
time dummies					yes
Observations	689	689	689	689	420

*Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%*

Table 5: Marginal Effects for the Estimation with Monthly Data and Emerging Markets

Pooled Probit Estimation - Monthly Data

Emerging Markets - Dependent Variable: Sudden Stop Indicator

lag explanatory variables	1. lag	2. lag	3. lag	4. lag	5. lag	6. lag
	(1)	(2)	(3)	(4)	(5)	(6)
lag uncertainty	1.188***	1.345***	1.179***	0.822**	0.35	0.038
	(0.459)	*(0.444)*	*(0.42)*	*(0.398)*	*(0.39)*	*(0.393)*
lag of mean exp	-0.497***	-0.457***	-0.395***	-0.320***	-0.240***	-0.179**
	(0.083)	*(0.081)*	*(0.077)*	*(0.073)*	*(0.071)*	*(0.072)*
lag of RER vuln	-2.231	1.692	6.294**	11.713***	19.231***	26.315***
lag of DLD	4.212	6.564	9.001*	12.190**	15.833***	17.385***
int. RER vuln DLD	63.848***	50.477***	25.93	-6.465	-48.207***	-77.978***
Ex. Regime 5	0.111	0.108	0.078	0.081	0.086	0.08
lag res over CAD	0.032***	0.033***	0.031***	0.032***	0.036***	0.040***
lag M2 over reserves	0.229*	0.218*	0.183	0.109	-0.004	-0.063
lag credit growth	-3.484*	-5.854***	-4.812***	-3.900***	-2.798**	-2.388*
lag FDI/GDP	-20.184	-19.906	-16.766	-21.202	-33.914***	-44.941***
country dummies	yes	yes	yes	yes	yes	yes
month dummies	yes	yes	yes	yes	yes	yes
linear time trend	yes***	yes***	yes***	yes***	yes***	yes***
quadratic time trend	yes***	yes***	yes***	yes***	yes***	yes***
cubic time trend	yes***	yes***	yes***	yes***	yes***	yes***
Constant	-24.872***	-27.880***	-27.670***	-27.591***	-27.948***	-28.148***
Observations	689	680	671	662	653	644

*Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%*

Table 6: Different Lags

Pooled Probit IV Estimation - Monthly Data

Emerging Markets - Dependent Variable: Sudden Stop Indicator

	(1)	(2)	(3)	(4)	(5)	(6)
predicted lag of uncertainty	2.593***	3.130***	3.094***	3.501***	3.432***	3.576***
	(0.59)	*(0.683)*	*(0.705)*	*(0.677)*	*(0.678)*	*(0.717)*
predicted lag of mean exp	-0.053	-0.277**	-0.309***	-0.281**	-0.281**	-0.300**
	(0.08)	*(0.11)*	*(0.114)*	*(0.115)*	*(0.113)*	*(0.119)*
predicted lag of RER vuln	16.142***	17.188***	16.971***	12.019*	9.938	12.477*
lag of DLD	2.952	-12.083**	-12.176**	-12.912**	-11.822**	-2.428
interaction RER vuln DLD	-22.008	12.921	15.717	46.79	52.266	27.906
Ex. Regime 5	-0.202***	-0.023	-0.026	-0.011	-0.027	0.043
lag res over CAD	0.036***	0.020***	0.021***	0.018**	0.018**	0.033***
lag M2 over reserves	0.069	0.12	0.145	0.187*	0.210*	0.132
lag credit growth	-1.167	-2.472	-2.121	-2.56	-2.717	-2.685
lag FDI/GDP	-21.971***	2.336	1.4	18.065	12.075	-13.036
country dummies	no	yes	yes	yes	yes	yes
month dummies	no	no	yes	yes	yes	yes
linear time trend	no	no	no	yes	yes	yes***
quadratic time tr.	no	no	no	no	yes	yes***
cubic time tr.	no	no	no	no	no	yes***
fourth order time tr.	no	no	no	no	no	no
time dummies	no	no	no	no	no	no
Constant	-3.545***	-3.139***	-2.957***	-2.720*	-4.399**	-31.161***
Observations	777	610	610	610	610	610

Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

Instruments are the six months lags of the uncertainty, of the mean of the expectations and of the vulnerability to real

The instruments are significant at least at the 10% level in the first stage regressions

Table 7: IV Estimation

Emerging Markets - Dependent Variable: Sudden Stop Indicator

Method	pooled probit		logit	conditional logit, fe	Chamberlain's panel probit
	(1)	(2)	(3)	(4)	(5)
lag uncertainty	1.157***	1.188***	2.072**	1.986**	1.188***
	(0.428)	*(0.459)*	(0.846)	(0.833)	(0.459)
lag of mean exp	-0.458***	-0.497***	-0.920***	-0.888***	-0.497***
	(0.076)	*(0.083)*	*(0.157)*	*(0.153)*	*(0.083)*
lag of RER vuln	-2.842	-2.23	-4.111	-3.863	-2.231
lag of DLD	-4.338	4.212	7.987	7.808	4.212
int. RER vuln DLD	76.98***	63.85***	118.33***	113.38***	63.85***
Ex. Regime 5	0.051	0.111	0.155	0.146	0.111
lag res over CAD	0.019***	0.127***	0.056***	0.054***	0.032***
lag M2 over reserves	0.295**	0.229*	0.399*	0.373	0.229*
lag credit growth	-3.105*	-3.484*	-7.421**	-7.466**	-3.484*
lag FDI/GDP	-0.788	-20.184	-36.482	-35.420	-20.184
country dummies	yes	yes	yes	no	no
month dummies	yes	yes	yes	yes	yes
linear time trend	yes	yes	yes***	yes***	yes***
quadratic time tr.	yes*	yes	yes***	yes***	yes***
cubic time tr.	no	yes	yes***	yes***	yes***
Constant	-2.45	-24.872***	-46.077***	no	-28.798***
Observations	689	689	689	689	837

*Standard errors in Parantheses, *significant at 10%, **significant at 5%, ***significant at 1%*

Table 8: Alternative Estimation Methods

A.12 List of Headline Crises

Focal crises - Headline crises - (large IMF packages, defaults, currency crises)

				Output		measures: Private Net Flows on Debt 5/	Net Private Capital Flows		Net Private Capital Flows plus Net Errors and Omissions	
Country	**year**	**What defined crises**	**IMF-supported Programs/Aid packages**	((GDPt - GDPt-1) /GDPt-1)*100	((GDPt+1 - GDPt-1) /GDPt-1)*100,	Global Development Finance 2/	WEO 3/	BOP YB 4/	WEO 3/	BOP YB 4/
the 70s										
Peru	1978	sovereign default, Currency crisis (FR), no banking crises	1978: IMF stabilization program+ multilateral rescheduling with official and private creditors	0.08	5.68	-6.89	-4.75	-5.93	-4.32	-4.77
Turkey	1978	sovereign default, no currency crises, fall in Central bank reserves, 1982-85 Systemic banking crisis		2.83	1.93	-5.89	-2.65	-1.61	-2.88	-2.01
United Kingdom	1974-76	Currency Crisis in 1976 (ERW), Borderline and smaller banking crisis		-1.70	-2.38		5.08	2.24	5.08	2.25
Zaire	1978	Sovereign default since 1976, Enormous amounts of external debt lead to Paris Club reschedulings in 1979 as well as 1981 and with a syndicate of commercial banks in 1980, Currency Crisis in 1979 (MR and BP), 1980s Systemic banking crisis		-5.30	-5.02	-0.21	-6.86		-6.69	
crises countries 80s										
Argentina 1982-88	1982	sovereign default, Currency Crises in 1981 (MR1, FR, GKR) and 82 (FR, BP, GKR), 1980-82 Systemic banking crisis, 1989-90 Systemic banking crisis, hyperinflation		-3.15	0.47	0.24	0.18	-0.11	0.16	-0.23
Bolivia	1980	sovereign default in 1980, hyperinflation, Spring 1984 suspension of interest payments to commercial banks, Currency Crises in 1980 (MR2), 1982 (MR, FR, BP, GKR), 83 (FR, BP, GKR), 84 (FR) and 85 (FR, BP, GKR),1986-88 Systemic banking crisis		0.61	1.54	-10.13	-12.29	-2.40	-19.60	-14.72
Brazil	1982	sovereign default 1983, Currency Crisis in 1982 (BP) and 83 (FR, BP, GKR), no banking crisis	Brady Plan: Brazil Parallel Financing agreement, terms announced Sep 1988	-4.36	-8.63	0.24	-0.69	-0.41	-1.12	-0.38
Bulgaria 1990	1989	No sovereign default but during second half of 80s build up of large external debt in order to finance enlarging current account deficit. no data on currency crises available, but exhaustion of foreign reserves. 1995-97 Systemic banking crisis	Brady Plan: Bulgaria Brady, terms announced Mar 1994	-0.50	-9.55	0.68	-0.30	-3.88	0.49	-2.01
Chile (Cline p. 287	1982	Sovereign default in 1983, Currency Crises in 1982 (MR, FR, GKR) and 83 (FR), 1981-86 Systemic banking crisis		-13.42	-16.44	-5.50	-9.57	-10.03	-9.95	-10.49
China	1990	Currency Crises 1990 (MR), 1991 Systemic banking crisis		3.80	13.35	1.14	-1.74	-0.21	-2.46	-0.95
Colombia (Cline p	1983	No Sovereign default, Currency Crises in 1983 (GKR) 1985 (BP and GKR), 1982-87 Systemic banking crisis		1.57	4.98	-1.88	-3.21	-2.56	-3.72	-3.33
Costa Rica	1981	Sovereign default, Severe balance of payment crisis, Currency Crises in 1981 (MR and FR), no banking crisis	Brady plan: Costa Rica Brady terms announced May 1990	0.80	-6.25	-8.41	-7.07	-10.07	-9.32	-7.19
Cote d'Ivoire	1984	Sovereign default, no Currency Crisis, Systemic banking crisis from 1988-91	Brady plan concluded in 1997	-2.00	1.55	0.38	-25.75	-13.32	-20.19	-12.80
Ecuador	1982	Sovereign default, Currency Crises in 1983 (MR2), 84 (MR1) and 86 (MR, FR),1980- 83 Systemic banking crisis	Brady plan:Ecuador Brady, terms announced May 1994	1.20	-1.63	-7.93	0.93	7.40	3.46	2.30
Korea (Sachs, p. 12	1980	No Sovereign default, but in 1981world's fourth largest debtor country. Currency Crisis in 1980 (MR, BP and GKR), Doubling of inflation from 14.4 % in 1978 to 28.7 % in 1980.		-2.09	4.24	-0.11	0.77	1.99	6.74	1.83
Jordan	1989	Sovereign default on loans to commercial banks, Currency Crisis (MR1, FR, BP), Non systemic banking crisis	Brady Plan: Jordan Brady, terms announced in July 1993	-13.45	-7.29	24.74	-41.37	-3.59	-34.87	-5.61

Focal crises - Headline crises - (large IMF packages, defaults, currency crises)

				Output		Private Net Flows on Debt 5/	Net Private Capital Flows		Net Private Capital Flows plus Net Errors and Omissions	
						measures				
Country	**year**	**What defined crises**	**IMF-supported Programs/Aid packages**	((GDPt - GDPt-1) /GDPt-1)*100	((GDPt+1 - GDPt-1) /GDPt-1)*100,	Global Development Finance 2/	WEO 3/	BOP YB 4/	WEO 3/	BOP YB 4/
the 90s till present										
Argentina	1995	Contagion from Mexican crisis, background currency board without deposit incsurance scheme and without lender of last resort: withdrawal of bank deposits, significant loss of central bank's gross reserves, liqidity crunch, surge in interest rates, output contraction, Systemic banking crisis	X / EFF	3.85	7.79	5.36	-1.16	-1.88	-1.91	-2.38
Argentina	2001-2	sovereign default, no data on currency crisis, 2001-present Systemic banking crisis		2.10	5.27		-7.19	-4.28	-5.02	-5.06
Brazil	1998	No sovereign default, Currency crises in 1999 (MR1), substantial curret account deficit, surge of interest rates, outflow of capital, Output contraction, 1994-9 Systemic banking crisis	X/ SBA/ SRF, new arrangement, 12/2/98, X / SBA/SRF, new arrangement, 9/14/01,	0.13	0.92	0.07	0.41	0.82	0.31	0.85
Ecuador	1999	El Nino crisis, default on external and internal debt, Currency Crises in 1999 (MR1), 1998-present Systemic banking crisis		-6.30	-3.67	-4.26	-16.63	-13.47	-14.09	-15.36
ERM	1992/1993	Currency Crises: Denmark 93 (GKR), Finland 92 (GKR, ERW), Ireland 92 (ERW), Italy 92 (ERW), Portugal 93 (MR1), Spain 92 (GKR) and 93 (GKR), Sweden 92 (ERW), UK 92 (ERW)		0.00	0.00					
Finland	1991-94	No sovereign default, Currency Crisis in 1991 (GKR) and 92 (GKR, ERW), Systemic banking crisis		-6.26	-9.37		-3.20	-5.88	-1.55	-4.19
Indonesia	1997-98	no sovereign default, consequence of unresolved capital account crisis, important short-term private sector external debt, depreciation, hyperinflation, runs on deposits, collaps of corporate balance sheets, sharp economic contraction, Currency Crisis in 1997 (MR2, BP, GKR), 1997-present Systemic bank crisis	X/ SBA, new arrangement, 11/5/97	4.54	-9.18	-2.92	-0.90	-3.71	0.95	-5.46
Korea	1997-8	No sovereign default, but high level of short term private foreign debt, Curreny Crisis in 1997 (MR2, FR, BP, GKR) and 98 (MR1)	X/ SBA/SRF, new arrangement, 12/4/97	5.01	-2.01	-6.32	-8.52	-4.54	-9.70	-5.72
Mexico	1994-5	Tequila crisis. No sovereign default, Currency Crisis in 1994 (BP, GKR) and 95 (MR), 1994-97 Systemic banking crisis	X / SBA, new arrangement, 2/1/95	-6.17	-1.33	0.10	-4.09	-4.32	-2.67	-2.90
Malaysia	1997-8	No sovereign default, interest rate surge, real GDP contraction, Currency Crisis in 1997 (FR, BP), 1998 (MR1), 1997-present Systemic banking crisis		7.32	-0.57	1.39	-7.82	-7.17	-7.55	-4.83
Norway 1987-93	1989	No sovereign default, currency crisis in 1986 (ERW), Systemic banking crisis		0.90	2.92		-2.69	-2.94	-2.85	-3.10
Pakistan	1999-2000	Sovereign default, Eurobond exchange, no Currency Crisis in 1999, 2000 n.a., no data on banking crisis		3.96	7.57	-0.72	-1.06	0.97	-0.49	0.57
Phillipines	1997	No sovereign default, Currency Crisis in 1997 (FR, GKR), 1998-present Systemic banking crisis	X/ EFF	5.19	4.58	2.55	-4.83	-4.82	-7.60	-7.54
Russia	1998	Sovereign default 1998-99, interest rate surge, Currency Crises in 1998 (GS), 1998-9 Systemic banking crisis	EFF/SFR/CCFF, Augmentation and Extension, 7/20/98	-4.90	0.24	2.90	0.26	1.46	-0.51	0.47
Sweden	1991	No sovereign default, Currency Crisis 1992 (GKR), Systemic banking crisis		-1.11	-2.83		-4.02	-9.30	-4.02	-4.67
Thailand	1997-8	No sovereign default, but roll over of short term debt stopped, Currency Crisis in 1997(MR2, FR, BP, GKR), 1997-present Systemic banking crisis	X/ SBA, new arrangement, 8/20/97	-1.37	-11.74	-7.11	-18.42	-12.75	-18.54	-13.05
Turkey	1994	No sovereign default, interest rate surge, Currency Crisis in 1994 (BP, GKR), Non systemic banking crisis	X/ SBA	-4.97	1.57	-9.47	-4.45	-6.19	-4.45	-4.23
Turkey	2000	No sovereign default, no data on currency crisis available, 2000-present Systemic banking crisis	X / SBA/SRF, augmentation, 5/15/01, SBA, new arrangement, 2/4/02	7.36	-0.69	1.18	-1.33	3.75	-1.33	1.53

Table 9: Headline Crises from the 1970-2000