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Abstract

By introducing the concept of conditional probability of joint failure (CPJF), and by proposing a new measure for the systemic impact of currency crises, we provide new insights into the different sources of currency crises. We conclude that financial openness helps to diminish the probability of a currency crisis even after controlling for the onset of a banking crisis, that systemic currency crises mainly exist regionally, and that monetary policy geared towards price stability reduces the probability of a currency crisis.

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Keywords: Systemic Crises, Systemic Impact, Exchange Market Pressure, Extreme Value Theory, Financial Openness.

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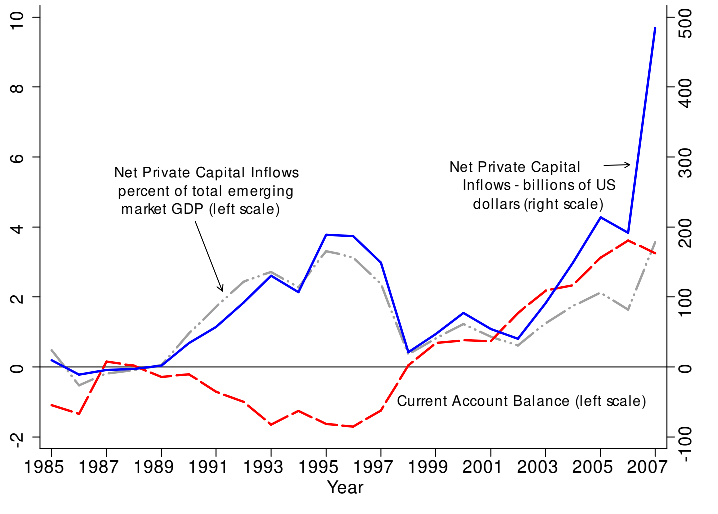
1 Introduction

The wave of capital flows running through many emerging market economies since the early 2000s up to the beginning of the "great contraction", brought renewed attention on how macroeconomic policies should respond to these flows, especially in light of current account balance positions (see Figure 1) and the degree of reserves accumulation (see Figure 2). Prior to the current downturn, these capital flows were associated with ample global liquidity and favorable worldwide economic conditions, in many cases they were (at least in part) a reflection of strengthened macroeconomic policy frameworks and growth-enhancing structural reforms.[1]

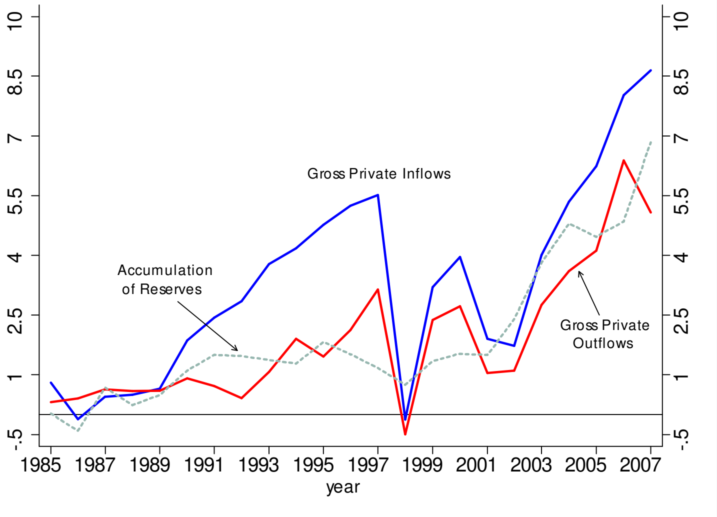
Figure 1: Net Capital Flows to Emerging Markets and Current Account Balances



However, capital inflows also generate important challenges because of their potential to generate overheating, loss of competitiveness, and increased vulnerability to crises. Accordingly, significant concerns about the stability of national and international financial systems stemming from the crises that occurred throughout the 1990s have been voiced throughout the last few years. Some economists view increasing financial openness and unregulated capital flows as a grave obstruction to global financial stability (see Bhagwati, 1998; Rodrik, 1998; Stiglitz, 2000, 2003; Rodrik and Subramanian, 2008), leading to calls for capital controls (such as “Tobin taxes”) on international asset trade. Other economists have argued that increased openness to capital flows has, in general, proven vital for countries aiming to leapfrog from lower- to middle-income status, while considerably

[1]Moreover, they help deliver the economic benefits of increased financial integration (see Garita, 2008).

Figure 2: Gross Capital Flows to Emerging Markets and the Accumulation of Reserves.



enhancing stability among industrialized countries (e.g. Fischer, 1998; Summers, 2000).[2] Moreover, the fear has re-emerged that in an environment of relatively free international capital markets currency crises are becoming more frequent and that such developments may easily spill over to other economies.

Interestingly, there is little empirical evidence supporting the view that financial openness by itself increases vulnerability to crises. However, while crisis episodes receive most of the attention, they are just (for the most part) spiky expressions of the more general phenomenon of macroeconomic volatility. As the foregoing discussion points out, the intensity and "time-clustering" of the crises has now forced both policy makers and academics to focus on systemic crises as a principal culprit. For example, during the 1990s developed and developing countries experienced severe financial difficulties, including balance-of-payments crises and systemic banking failures. Accordingly, the scale and impact of these events renewed interest in the existing "systemic risk" literature and stimulated a large volume of new theoretical and empirical work to explain and/or predict crises in order to provide countries with appropriate policy advice needed to avert any impending crises. In response to these events, several different theoretical models were developed showing how crises end up spreading across countries. For example, some of the major models of systemic crises are based on trade linkages and macroeconomic similarities (Gerlach and Smets, 1995; Eichengreen et al., 1996; Glick and Rose, 1999; van Rijckeghem and Weber, 2001), while

[2]This is evidently a matter of substantial policy significance, especially with economies like China and India having taken steps to open up their capital accounts; but also because of the current "financial crisis" engulfing the world economy.

other models are based on financial linkages, neighborhood effects, and exogenous shifts in investors' beliefs (Masson, 1999; Calvo and Mendoza, 2000; Kaminsky and Reinhart, 2000; Kodres and Pritsker, 2002).

In "first-generation" interpretations of currency crises,[3] the vitality (or lack thereof) of a fixed exchange rate is established by external fundamentals unconnected to how economic agents behave. For instance, in the aforementioned models, economic agents base their beliefs on the assumption that fiscal imbalances and/or domestic credit policies will not affected by their actions. By contrast, "second-generation" models of crises are based on the interface between expectations and actual outcomes, in which market expectations solidly influence macroeconomic policy, leading to self-fulfilling crises.[4] For example, in a country whose monetary authorities are committed to maintaining a fixed exchange rate but are willing to float their currency under "extraordinary circumstances" then foreign investors would face the possibility of a devaluation of that currency. This in turn would reduce the value of their claims if the country's loans from abroad were denominated in the borrowing nation's domestic currency. Moreover, if foreign investors considered the possibility of a devaluation to be very likely, they would charge a high-risk premium on their loans. This implies that the economies' borrowing costs would rise significantly, thereby reducing credit opportunities and restraining output growth. Given this scenario, the authorities would decide to devalue their currency in order to enhance aggregate demand, since they would consider the costs of maintaining "the fix" to be too high. Interestingly, the devaluation would validate the initial investors' expectations, which leads to self-fulfilling prophecies in that the expectations of devaluation lead to actions (a risk premium hike) that raise the opportunity cost of defending the fixed exchange rate.

As discussed by Pesenti and Tille (2000), the main advantage of resorting to such an interpretation of currency crises is the ability to differentiate between two types of volatility: "one related to financial markets and one related to macroeconomic fundamentals". Given this explanation, market sentiment plays an important role in the determination of a crisis, especially when it comes in the form of unexpected changes in expectations. Since we know that exchange rates (and other asset prices) are less predictable than they are in models with a unique outcome, as a result, second generation models are deemed to "square better with the stylized facts of global financial markets" (Masson, 1999). When speculators expect the occurrence of a crisis across countries, they have an incentive to

[3]The approach was pioneered by Krugman (1979), who adapted a model by Salant and Henderson (1978) to the analysis of currency crises. It was further developed by Flood and Garber (1984).

[4]The standard studies on self-fulfilling crises are Obstfeld (1986, 1994).

engage in financial market transactions that create links between otherwise "separate" markets; Kodres and Pritsker (2002) have called this process "cross-market rebalancing". That is, if speculators expect that a crisis in country i will be immediately followed by a crisis in country j, they have an incentive to be active in both (currency) markets in order to "benefit" from this joint correlation. When a crisis occurs in country i, it will change the wealth levels of these speculators and, therefore, change their actions in country $j\prime s$ currency market in a way that increases the probability of a crisis in the latter. The belief that joint crises will occur is "self-fulfilling": if investors expect there to be no correlation between the outcomes of the two markets, they will have no incentive to rebalance their portfolios, and join crises will not occur. This view is a simple theory of systemic risk in which a devaluation of one currency acts as a signal that coordinates expectations on the crisis equilibrium in another currency market.[5] The immediate source of joint crises equilibrium in this simple setting, is the fact that the same investors *can* be active in both markets, which generates a wealth channel through which crises are transmitted (see Kodres and Pritsker, 2002).

While joint crises can occur in other areas of an economy, the likelihood and harshness in financial systems is often regarded as considerably higher, since a full crisis in the financial system can have strong adverse consequences for general economic welfare. Moreover, because no open economy can fully insulate itself from its "surrounding environment", countries may need to adopt regionally and/or globally coordinated measures in order to prevent "systemic risks". However, despite the plethora of currency crises models, consensus does not exist with respect to the relevant channels and the implications for policy. For example, if the trade channel is relevant then countries may need to diversify their trade portfolio, and/or fix their exchange rates (collectively) in order to avoid speculative attacks following the loss of international competitiveness. If, on the other hand, the "financial integration" channel is relevant, then countries may need to impose capital controls on (short-term) capital flows.

Accordingly, we study whether financial openness and other channels help reduce the probability of a currency crises. To address this issue, the paper follows a three-step approach and answers three interrelated questions: (*i*) How can we best capture the systemic linkages of crises? (*ii*) Is the systemic risk of currency crisis a regional or a global phenomenon? (*iii*) By controlling for the "systemic impact" of currency crises, does "financial

[5]If two countries are highly integrated, of course, (through trade, etc.) it is not entirely surprising that a crisis in one would have strong effects on the other. The importance of expectations is most often stressed in cases where the two currencies are, at least in principle, not closely related.

openness" increase the probability of a currency crisis? Methodologically, we first employ an alternative statistical method known as extreme value theory (EVT) to identify the linkage between currency crises. This statistical technique is particularly well designed to address the extreme co-movements of financial market crises. In an univariate setting, this approach has been used to study the frequency of currency market (Koedijk et al., 1990; Hols and de Vries, 1991), stock market (Jansen and de Vries, 1991; Longin, 1996) and bond market (Hartman et al., 2004) crashes in industrial countries. By focusing on emerging and developing markets (Asia, Africa, and the Western Hemisphere) we extend the analysis of extreme exchange rate fluctuations to a bivariate setting, measuring the joint occurrence of currency market crashes through our newly created CPJF. Secondly, we propose a revised version of the "crises elsewhere" or "neighborhood variable that is often constructed in the contagion literature. By construction, the "crises elsewhere" variable found in the literature only considers whether one of the neighboring countries is suffering a crisis; however, this methodology gives the same weight and importance to the crises in (all) other economies, which is counterfactual in light of the fact that economies may have different links during crises periods. Accordingly, our second step is to incorporate the different levels of connections between countries by taking into account the conditional probability of joint failure (CPJF) to weight our crises indicators, which results in a new measure of systemic impact *vis-à-vis* currency crisis. In this manner we downweight those economies which are less connected, while giving a higher weight to those economies that are more highly interconnected. Thirdly, we estimate a panel probit model as in Eichengreen et al. (1996), to test the effects of other potential causes of currency crises, such as financial openness, by controlling for the "systemic impact" of currency crises.

Therefore, the research herein differs from the literature in at least two ways. First, the evaluation of systemic risk is undertaken by using extreme value theory (i.e. by taking into account extreme co-movements), which represents a significant deviation from prior work in this area. This new approach opens the opportunity to construct a new "crises elsewhere" variable, which quantitatively measures the systemic impact of currency crises. Secondly, we use an expanded data set representing many different regions of the world. This allows us to test the impact of financial openness (and the inflow of different types of capital) on a broader basis, while also allowing the systemic impact of currency crises to operate through the neighborhood or "cross-market rebalancing" channel.

Overall, our results indicate that currency crises are linked, but mainly within regions, contrary to what is often voiced by pundits. The probit results reveal that higher levels of *de facto* financial integration into world financial markets lowers the probability of a crises when controlling for the "systemic impact" of currency crises. Moreover, our results also indicate that the sudden stop of long-term capital flows (i.e. FDI) and their reversal exacerbates the probability of a crisis. We also show that monetary policy geared towards price stability reduces the probability of a currency crisis. Therefore, the answers to the aforementioned questions are: (*i*) the CPJF measures the systemic linkages of crises and helps in improving our understanding of systemic risk. Furthermore, by constructing the weighted systemic impact variables based on CPJF helps to provide a more informative measure for a specific country; (*ii*) yes, the systemic impact of currency crises does exist, but only regionally; and (*iii*) by accounting for the systemic impact of currency crises correctly (i.e. by reducing information asymmetry), financial openness helps reduce the probability of a currency crisis.

The remainder of the paper is divided as follows. Section 2 discusses the methodology and data sources. Section 3 discusses the tail dependence and/or independence of the economies in our sample *vis-à-vis* currency crises. Section 4 provides analysis of the empirical findings, while section 5 performs an out-of-sample investigation. Section 6 is entirely devoted to the discussion of our robustness checks. Last but not least, section 7 concludes.

2 Methodology and Data

In this section, we introducing our data and the procedure of constructing an exchange market pressure (EMP) index. We then use EVT to specify the crisis variables for each country. Thirdly, we present our general methodology for analyzing the effect of different sources on currency crises. In the end, we introduce our newly created "systemic impact" variable, which incorporates information on crises linkages.

2.1 Exchange Market Pressure Index

Following Girton and Roper (1977) and Eichengreen et al. (1996), we construct an exchange market pressure index as a weighted average of (nominal) exchange rate changes, international reserve changes, and interest rate changes, to measure speculative pressure on a country and its currency. A common feature of studies that try to comprehend the fundamental determinants of currency crises is the construction of a single composite index; that is, an index of exchange market pressure that will systematically identify the presence and harshness of currency crises or speculative attacks on a currency. In this light, studies such as Eichengreen et al. (1995, 1996), Sachs et al. (1996), and Kaminsky et al. (1998), have proposed different approaches to the construction of the EMP index. The EMP is a good index of currency crisis as it reflects different manifestations of speculative attacks, be they successful or not. The argument is that the central bank of a country may allow the currency to depreciate in response to intense speculative attack against its currency. In some other cases, the bank may defend the currency by running down its foreign exchange reserves or by raising interest rates. Therefore, our exchange market pressure for country i at time t is computed as follows:

$$EMP_{it} = \frac{1}{\sigma_e}\frac{\Delta e_{it}}{e_{it}} - \frac{1}{\sigma_r}\left(\frac{\Delta rm_{it}}{rm_{it}} - \frac{\Delta rm_{us,t}}{rm_{us,t}}\right) + \frac{1}{\sigma_{it}}\left(\Delta\left(i_{it} - i_{us,t}\right)\right) \tag{1}$$

where e_{it} are the units of country $i\prime s$ currency per U.S. dollar in period t; σ_e is the standard deviation of the relative change in the exchange rate $(\frac{\Delta e_{it}}{e_{it}})$; rm_{it} is the ratio of gross foreign reserves to money stock or monetary base for country i in period t; σ_r is the standard deviation of the difference between the relative changes in the ratio of foreign reserves and money (money base) in country i and the USA $\left(\frac{\Delta rm_{it}}{rm_{it}} - \frac{\Delta rm_{us,t}}{rm_{us,t}}\right)$; i_{it} is the nominal interest rate for country i in period t; $i_{us,t}$ is the nominal interest rate for the USA in period t; σ_{it} is the standard deviation of the nominal interest rate differential $(\Delta\left(i_{it} - i_{us,t}\right))$.[6] We construct the data set ranging from $1978 - 2007$.

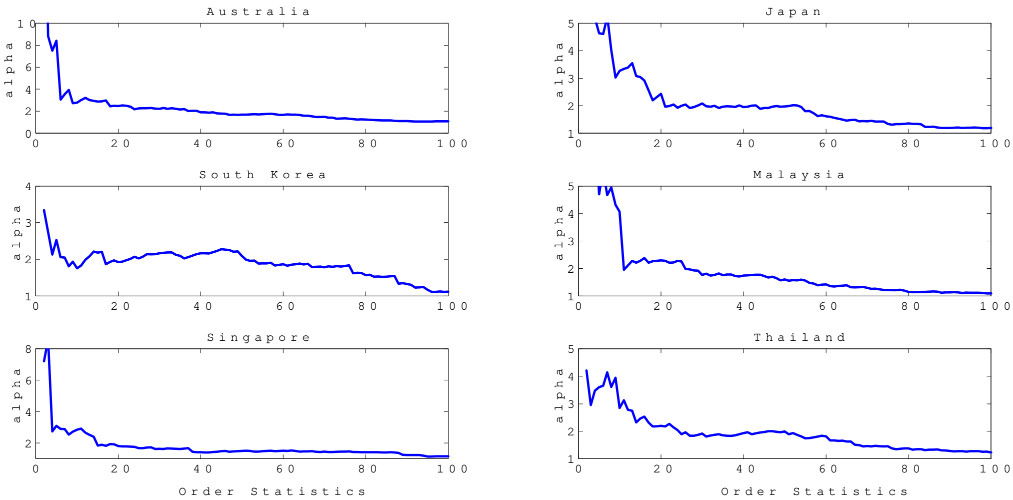
By definition, a currency crisis occurs when the realized exchange market pressure is "unusually large". The main problem with this terminology is in defining the threshold that determines the largeness of the index, and therefore, the approach used varies from study to study. In the literature, this is usually done by assuming a normal distribution of the EMP. More specifically, the customary manner of choice for the statistical threshold previously mentioned has involved arbitrary multiples of the standard deviation of the EMP above its mean (i.e. 1.5, 2, or 3 standard deviations are commonly used). There are at least two criticism on such a procedure. First of all, it relies on the EMP index being normally distributed. Secondly, by considering the EMP as a normally distributed variable, the threshold is arbitrarily chosen. Therefore, the conventional method of defining currency crises is statistically flawed and/or inaccurate in capturing the "true" dispersion of any given EMP series. In other words, the conventional method of employing the mean

[6] In theory, for a pure float, the change in the exchange rate would correspond exactly to the index of exchange market pressures. At the other extreme, for a peg, the exchange rate would be constant, and fluctuations in the EMP would be driven entirely by changes in reserves and/or interest rates through intervention.

and standard deviation may underestimate the frequency of speculative attacks.

In fact, the threshold chosen in the literature simply corresponds to a quantile at a "certain" probability level.[7] In order to define a crisis, we also use a quantile of the EMP series as our threshold choice; however, we do so without *a priori* specifying the distribution of the EMP. Moreover, for determining the level of probability for the threshold, we consider *extreme value theory* as the proper instrument. Similar to de Haan and de Ronde (1998), we estimate the tail index of the EMP distribution by using a Hill plot (see Hill, 1975), from which we choose the suitable threshold.

Figure 3: Hill Plots for Selected Asian Economies



We first calculate the Hill estimators against the number of high order statistics k, and then choose a level k around which the estimate, as shown in Figure 3, is stable. For all countries in our sample, $k \approx 45$; this level corresponds to a quantile with probability level $45/337 = 13.3\%$.[8] Formally, this means that for a certain country i, let us denote the EMP series as EMP_{it} at time t. Then we take its VaR at probability level 13.3% denoted by VaR_i as the suitable threshold for defining a tail event in country i.[9] We then construct

[7] In finance, the high quantile is the so-called Value-at-Risk (VaR). That is, for a risk factor X, its VaR at a given level p is defined as $VaR(p)$, which satisfies $P(X > VaR(p)) = p$. Therefore, by assuming a normally distributed EMP, the mean plus 1.5 standard deviation threshold corresponds to a VaR at probability level 6.7%.

[8] Given our time period, we have 348 months at our disposal. However, due to missing data for some months, at the end we can only work with 337 months.

[9] As previously mentioned, these are the 45th order statistics from the top.

a dichotomous tail event variable for country i at time t as

$$\begin{aligned} Crisis_{it} &= 1 \; if \;\; EMP_{it} \geq VaR_i \\ &= 0 \;\; otherwise. \end{aligned} \tag{2}$$

Here we use the notation "crisis", while the indicator is in fact measuring a tail event. As we will discuss later, within the extreme value theory setup, the linkages between crises of two economies can be extrapolated from the linkages between tail events. Thus, in the empirical sections, we will use the indicators of tail events for evaluating the linkages and extrapolate these tail events to the linkage between crises.

2.2 Econometric Approach

Once the decision has been made on how to choose the threshold in order to define the crisis variable, it is eventually employed either as a binary dependent index variable in logit/probit models, or instead as a continuous dependent variable in a more "structural" empirical model of currency crises. In this subsection we lay out the specifics of the model that we employ to test whether the probability of a crisis in an individual country is affected by events occurring elsewhere. According to a number of theoretical models mentioned in the introduction, currency crises may occur simultaneously among countries that have a trade channel, that have a similar macroeconomic fundamentals, that are more financially integrated into the world capital markets, and that are neighbors. Therefore, following Eichengreen et al. (1996) we estimate a panel probit model using monthly data for 23 emerging and developing economies (see Appendix A, B, and C for the list of sample countries, data descriptions, and descriptive statistics respectively) as follows:

$$Crisis_{it} = \theta D_{it}(Crisis) + \lambda I(L)_{it} + \varepsilon_{it} \tag{3}$$

where

$$\begin{aligned} D_{it}(Crisis) &= 1 \; if \;\; Crisis_{jt} = 1 \; for \; any \; j \neq i \; and \; j \; \& \; i \in (same \; region) \\ &= 0 \; otherwise \end{aligned}$$

In this model, $D(Crisis)$ is the "traditional" crises elsewhere variable, which considers other countries in the same region with the same importance; the vector $\lambda I(L)_{it}$ is an information set of macroeconomic control variables (see appendix B for a full description). This information set includes the growth rate of money ($M2$) as a percentage of international reserves, CPI inflation, domestic credit as a percentage of GDP, the growth rate of real GDP, the percentage of government budget (net) balance relative to GDP, and the percentage of the current account relative to GDP.[10] We also include variables that capture the different channels by which crisis may take place (or can be exacerbated). For instance, we include several *de facto* measures, such as *trade openness*, *financial integration*,[11] FDI inflows, portfolio inflows and debt inflows, in order to provide a better picture of the extent of a country's integration into global (financial) markets. Last but not least, we also augment our model by including a dummy variable capturing the *onset* of a banking crisis[12] in order to capture the link between banking and currency crises[13].

The choice of the control variables are justified in the literature; that is, these fundamental controls are included in line with the arguments of the first generation models of speculative attacks, which was first brought to light by Krugman (1979) and was later modified by Flood and Garber (1984). A number of papers have extended the Krugman-Flood-Garber model in other directions (see for example Agénor et al., 1992). Edwards (2005) looks at this issue using a "more sophisticated" measure of *de jure* financial openness that attempts to capture the intensity of capital controls. He looks at two manifestations of external crises; sudden stops of capital inflows, and current account reversals. He finds no systematic evidence that countries with higher capital mobility tend to have a higher incidence of crises, or tend to face a higher probability of having a crisis, than countries with lower mobility. In subsequent work, Edwards (2006) concludes that there is no evidence that the output costs of currency crises are smaller in countries that restrict capital mobility. In sum, there is little formal empirical evidence to support the often-cited claims that financial globalization (in and of itself) is responsible for the epidemic of financial crises that the world has seen in recent history.

[10] Each variable enters as deviation from the corresponding variable of the center country, which in our case it is the United States.

[11] *Trade openness* is the sum of exports and imports over GDP; we use *financial integration* following the nomenclature used by Lane and Milesi-Ferretti (2003) and Kose et al. (2006), which is the sum of financial assets and liabilities divided by GDP.

[12] Dates for the *onset* of banking crisis were taken from Laeven and Valencia (2008).

[13] This link has been thoroughly documented by, for example, Kaminsky and Reinhart (1999) and Glick and Hutchinson (2001).

2.3 Weighting Tail Events

As has been previously mentioned, the "crises elsewhere" variable constructed in the literature only considers whether at least one of the other countries in the same region is suffering a crisis. Hence, this procedure gives the same weight (i.e. the same importance) to crises in (all) other economies. Intuitively, however, countries may have different links during crises, or non-normal, periods. Therefore, in order to incorporate the different levels of connections between economies, we need, as a first measure, the dependence of the tail events of the EMPs between the different economies.

The traditional method employed to study interdependencies between different random events is the (pearson) correlation coefficient, since correlations characterize general interdependencies. However, there are two drawbacks to this measure for the purposes of this paper[14]. First, the correlation coefficient measures dependence during normal times (i.e. given "moderate levels"), and it is largely dominated by the moderate observations rather than the extreme observations. Second, the definition of the correlation coefficient depends on the assumption of finite variance; however, the distribution of asset returns (e.g. exchange rates) may not be normally distributed, that is, the tails of the return distributions can be "fat". For instance, by looking at the Hill plots (Figure 3), we cannot rule out the possibility that the tail index may be below 2, which means that the variance of the EMP index can be infinite; therefore, what we require is a measure of tail dependence.[15] We define the "conditional probability of joint failure" (CPJF) as follows[16]: given that at least one of two economies is in a crisis, the CPJF is defined as the conditional probability that the other country is also in a crisis. That is, suppose that EMP_i and EMP_j are the EMPs of countries i and j, then the corresponding VaR (value at risk) at probability level p of these two variables are $VaR_i(p)$ and $VaR_j(p)$. We then define:

$$CPJF_{i,j} = \lim_{p \to 0} P(EMP_i > VaR_i(p) \text{ and } EMP_j > VaR_j(p) | EMP_i > VaR_i(p) \text{ or } EMP_j > VaR_j(p)) \tag{4}$$

which can be rewritten as

[14] A classic reference is Forbes and Rigobon (2002), who show that by adjusting for heteroskedastic biases, "there was virtually no increase in unconditional correlation coefficients".

[15] We have at our disposal a few indicators that capture tail-dependence stemming from multivariate extreme value analysis (see Embrechts et al., 2000; Hartman et al., 2004).

[16] This measure is reminiscent of the correlation coefficient, in the sense that the asymptotic independence case corresponds to 0, while full dependence corresponds to 1.

$$CPJF_{ij} = E[\kappa|\kappa \geq 1] - 1 \tag{5}$$

where

$$E[\kappa|\kappa \geq 1] = \lim_{p \to 0} \frac{P(EMP_i > VaR_i(p)) + P(EMP_j > VaR_j(p))}{1 - P(EMP_i \leq VaR_i(p), EMP_j \leq VaR_j(p))} \tag{6}$$

is the dependence measure introduced by (Embrechts et al., 2000), and first applied by (Hartman et al., 2004). Notice that under the multivariate extreme value analysis framework, the limit in (4) and (6) exists (see de Haan and Ferreira, 2006, Ch. 7); hence, even for a finite level of p, as soon as p is at a "low level", the conditional probability is already close to its asymptotic value.[17] In other words, the CPJF will be stable when comparing the linkage between crises and tail events. Therefore, in order to estimate $CPJF_{i,j}$, we use the following estimator (see de Haan and Ferreira, 2006, Ch. 7):

$$\widehat{CPJF}_{i,j} = \frac{\sum_t Crisis_{it} Crisis_{jt}}{\sum_t Crisis_{it} + \sum_t Crisis_{jt} - \sum_t Crisis_{it} Crisis_{jt}} \tag{7}$$

A higher CPJF between two countries indicates that financial crises in these two countries are more likely to occur at the same time. Moreover, the CPJFs between one economy (e.g. A) and other economies (e.g. B, C, D) in the same region may vary, which highlights (as previously mentioned) the different linkages during crisis periods. Therefore, when constructing a systemic impact variable that accounts for the impact of crises in a region, it is necessary to use the CPJFs between economies as weights. In this manner we downweight those economies which are less connected, while giving a higher weight to those economies that are more interconnected; this accords with the "cross-market rebalancing" effect as derived by Kodres and Pritsker (2002). Therefore, our newly constructed "systemic impact" variable is given as:

$$W_{it}(Crisis) = \sum_{j \neq i} CPJF_{ij} Crisis_{jt}. \tag{8}$$

Therefore, by employing our new systemic impact variable, we will re-test our probit model as follows:

[17] Therefore, the choice of p for defining a crisis is insensitive when it is at a "low level".

$$Crisis_{it} = \gamma W_{it}(Crisis) + \lambda I(L)_{it} + \varepsilon_{it}. \qquad (9)$$

3 Tail Dependence or Independence?

As shown in section 2.3, we measure systemic risk in a bivariate setting through the conditional probability of joint failure (CPJF). The CPJF always lies between 0 and 1. If it is zero, then the probability of a joint tail event is negligible; however, if it is one, then a tail event in one economy will always go hand in hand with the "downfall" of the other economy. Therefore, our first step is to test $H_0 : CPJF = 0$ from the asymptotic distribution of the $CPJF$ estimator (for details of this test, see de Haan and Ferreira, 2006). The results are shown in Appendix D (Tables 13, 15, and 17), and are discussed in the following subsections.

3.1 Asia

Table 12 shows the regular dependence among Asian countries, and although a few negative numbers appear they are quite close to zero; moreover, the correlation coefficient between Asian economies indicates moderate dependence at best. For example, Pakistan, in general, can be considered as independent from the other countries, while Thailand can only also be considered independent from all other countries, except with Malaysia. Some other bilateral relationships worth highlighting are: Singapore-Malaysia ($\rho = 0.51$), Australia-Japan ($\rho = 0.40$) and Korea-Japan ($\rho = 0.37$). Compared to Table 12, Table 13 shows quite some different results for tail-dependence. For example, the aforementioned relationship between Australia and Japan now exhibits a much lower (non-significant) dependence level ($CPJF = 0.15$), indicating that these countries tend to be independent during crisis periods. As far as Singapore-Malaysia, and Korea-Japan , we can once again see a strong (highly significant) link during crisis periods ($CPJF = 0.27$, $CPJF = 0.22$, respectively). Moreover, Thailand-India are actually more dependent during crisis periods ($CPJF = 0.27$) than a standard correlation analysis would indicate. The above comparison shows that regular-dependence and tail-dependence are independent. Therefore, if we solely relied on the standard correlation coefficient, we would tend to misjudge the dependency during crisis periods in Asian economies.

3.2 Western Hemisphere

The regular dependence measure among western hemisphere economies, shown in Table 14, indicates low dependence. The only exceptions are Argentina-Brazil ($\rho = 0.40$), followed by Argentina-Mexico ($\rho = 0.18$). Table 15 exhibits the tail dependence in the Western Hemisphere region. Compared to the Asia results, tail dependence is weaker in "the west", as none of the CPJFs are significantly different from zero. Therefore, we can only conclude that economies in this region are independent from one another during currency crises.

3.3 Africa

Table 16 shows a very high regular dependence among African economies, while Table 17 continues to display extremely high CPJFs. For example, Burkina Faso, Côte d'Ivoire, Mauritius and Mali are highly dependent. Niger and Senegal show the highest tail dependence in this region ($CPJF = 0.91$). It is also worth pointing out that South Africa is in general independent from the other African economies in our sample during crises periods. Given the above observations, we can categorize the African economies into three groups: group 1: Burkina Faso, Côte d'Ivoire, Mauritius and Mali; group 2: Niger and Senegal; group 3: South Africa. This classification shows that dependence during a crisis is (in general) observed within groups; however, these groups can be considered independent from each other.

3.4 Global (in)dependence

One of the claims that is most often voiced in the literature and in the media is that systemic currency crises can travel across regions, where, for example, one of the most often heard claims is that the crises of the 1990s spread from Mexico to Asia during the Mexican crisis in 1994, and from Asia to Latin America during the 1997-1998 Asian crisis. moreover, that market turbulence was transmitted to Latin America following the 1998 Russian default. Tables 18-20 show the tail dependence across the three regions (Africa, Asia, and the Western Hemisphere), where we observe low levels of tail-dependence across regions. Therefore, we can only conclude that currency crisis are not very likely to spread from region to region.

4 Probit Estimation Results

4.1 Asia Sample

We begin this section by discussing the traditional "crises elsewhere" variable approach often used in the literature (see Table 1), then we will compare and contrast these results to our new approach based on the "systemic impact" variable (see Table 2). Since probit coefficients are not easily interpretable we also include the effects of a one standard deviation percentage change in the regressors on the probability of a crisis (mfx). The unweighted results for Asia are consistent with the existence of a regional effect (as captured by the "traditional" neighborhood dummy often used as a starting point in the literature).

Table 1, tells us that a speculative attack elsewhere in Asia is associated with an increased probability of a domestic currency crisis of around 9 percentage points. We also control for the *onset of a banking crisis*, where it is apparent from these results that the onset of a banking crisis is significantly correlated with a currency crisis in Asia, and only when we control for various types of capital flows (see specification 1.5), does this link disappear. The results in Table 1 also support some of the predictions of the first generation models of speculative attacks, where a currency crisis stems from inconsistencies between macroeconomic fundamentals and the exchange rate commitment. According to the results reported in Table 1, the probability of a currency crisis increases with an increase in CPI inflation, and the government budget deficit as a percentage of GDP (both significant at the 1%), all measured relative to the USA. This latter result shows that countercyclical fiscal policy[18] in the form of slower growth in government expenditure is strongly associated with lower exchange market pressure. Table 1 also shows that as GDP growth increases, the odds of a speculative attack increase by 1%, which hints at the fact that Asian economies, which have enjoyed tremendous and steady growth in GDP should be careful of the upside risk (e.g. overheating) associated with such "prosperity".

When we look at *financial integration* (column 1.2) and at *trade openness* (column 1.3), we do not find any particular effect *vis-à-vis* currency crises (specifications 1.2 and 1.3 respectively). Another way to look at *de facto* financial openness, is to discriminate between capital flows (i.e. between FDI, portfolio and debt), as we do in column 1.5 of Table 1. These results show that higher (and sustained) levels of FDI and portfolio-type

[18] Countercyclical in the sense of fiscal restraint during boom.

Table 1: Asian Sample Panel Probit Results; 1978M1 - 2006M12

	1.1	*mfx*	1.2	*mfx*	1.3	*mfx*	1.4	*mfx*	1.5	*mfx*
Diff in Dom. Credit	1.34		1.40		1.34		0.80		-0.28	
	(1.18)		(1.20)		(1.20)		(0.65)		(-0.25)	
Diff in Liquidity	0.004		−0.02		0.009		0.006		0.002	
	(0.03)		(−0.10)		(0.07)		(0.04)		(1.26)	
Diff in GDP growth	0.82	0.6	1.07	0.8	0.85	0.6	0.84	0.6	0.57	
	(1.91) *		(2.50) ***		(1.96) **		(1.66) *		(1.11)	
Diff in Gov. Budg.	−4.31	−0.9								
	(−2.71) ***									
Diff CPI Inflation	0.08	1.2	0.06	1.0	0.09	1.2	0.08	1.1	0.08	1.1
	(3.03) ***		(3.23) ***		(3.12) ***		(3.08) ***		(2.78) ***	
Diff Financial. Int.			−0.02							
			(−1.56)							
Diff Trade Open.					0.01					
					(0.38)					
Diff Current Acc.							−0.44	−3.3		
							(−3.16) ***			
FDI inflows									−0.27	−3.1
									(−2.26) **	
Portfolio inflows									−0.03	−1.6
									(−4.71) ***	
Debt inflows									0.007	0.3
									(1.85) ***	
Onset Bank. Crisis‡	0.30	6.0	0.32	6.3	0.30	6.1	0.27	5.1	0.17	
	(1.99) **		(2.24) **		(2.00) **		(1.69) *		(1.02)	
Regular Neighbor.‡	0.57	9.6	0.58	9.4	0.59	9.7	0.50	8.2	0.46	7.3
Dummy	(4.55) ***		(4.35) ***		(4.76) ***		(3.93) ***		(3.70) ***	
Observations	2854		2809		2861		2822		2402	
McFadden R^2	0.25		0.27		0.25		0.27		0.40	

Notes: Dependent variable is a crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% significant. levels respectively; robust z-statistic in parenthesis; Diff in liquidity = diff in (M2/Int. Reserves); mfx = (marginal effect*stand.dev)*100; ‡ = marginal effect calculated for a discrete change from 0 to 1 inflows are associated with a lower probability of a crisis (FDI inflows lower the probability of a currency crisis by 3.1%, while portfolio inflows lower it by 1.6% given a one standard deviation shock); on the other hand, debt inflows increase the probability of a currency crisis by 0.3% for a one standard deviation shock.

After employing the "traditional crises elsewhere" variable, we replace it by our newly constructed "systemic impact" variable. As discussed in Section 2.3, our CPJF weight captures the different links between crises of the underlying economy and its neighbors. Therefore, we argue that it also captures the expectations that investors form regarding the value of their assets, given that there is a crisis elsewhere in their (investment) region. In this view, the combination of our CPJF with the tail event indicators, which yields our "systemic impact" variable, summarizes the macroeconomic risk factor structure of asset values. According to the "cross-market rebalancing" argument, when speculators expect the occurrence of a crisis across countries, they have an incentive to engage in financial market transactions that create links between otherwise "separate" markets. Table 2 shows the results of substituting the traditional "neighborhood" dummy variable with our systemic impact variable. While most results remain similar to those presented in Table 1, we focus on comparing and contrasting the differences between the two tables.

As a first step, it is important to point out that by using our systemic impact variable, we improve the fit of the equations; moreover, our systemic impact variable enters quite strongly and highly significantly. The positive sign of the coefficient on this new variable indicates that the probability that the domestic economy will experience a currency crisis increases by around 6% for a one standard deviation increase in systemic risk[19]. We argue that, in line with the cross-market rebalancing effect, when market participants are hit by an idiosyncratic shock in one Asian economy, they transmit the shock abroad by "optimally" rebalancing their portfolio's exposure to macroeconomic risks through other countries' markets. We also control for the *onset of a banking crisis*, where it is important to note that once we control for systemic risk, then the onset of a banking crisis is now no longer significantly correlated with a currency crisis in Asia. We argue that this arises from the reduction of information asymmetry as provided by our new variable; thereby breaking the link between "the twin crises". When it comes to GDP growth, Table 2 now

[19] In our case, join crises only occurs within the same region, since as shown in section 3.4, currency crisis is not very likely to jump across regions. Furthermore, keep in mind that this new variable is continuous and we have applied a one standard deviation shock. If we evaluate this variable at the mean, then the marginal effect is about 24%.

Table 2: Weighted Asian Sample Panel Probit Results; 1978M1 - 2006M12

	2.1	*mfx*	2.2	*mfx*	2.3	*mfx*	2.4	*mfx*	2.5	*mfx*
Diff in Dom. Credit	1.02		1.09		1.06		0.67		-0.51	
	(0.83)		(0.87)		(0.87)		(0.49)		(-0.40)	
Diff in Liquidity	0.002		0.002		0.002		0.002		0.003	1.5
	(1.17)		(0.96)		(1.14)		(1.05)		(1.68) *	
Diff in GDP growth	0.65		0.95	0.6	0.66		0.75		0.42	
	(1.42)		(2.30) ***		(1.44)		(1.44)		(0.82)	
Diff in Gov. Budget	−4.95	−0.9								
	(−5.60) ***									
Diff CPI Inflation	0.12	1.6	0.10	1.3	0.12	1.6	0.12	1.6	0.11	1.4
	(3.67) ***		(4.29) ***		(3.64) ***		(3.67) ***		(3.35) ***	
Diff Financial. Int.			−0.02	−1.0						
			(−1.96) ***							
Diff Trade Open.					−0.06	−0.4				
					(−1.96) **					
Diff Current Acc.							−0.29	−2.1		
							(−3.13) ***			
FDI inflows									−0.21	
									(−1.56)	
Portfolio inflows									−0.04	−1.8
									(−4.94) ***	
Debt inflows									0.007	0.4
									(2.18) **	
Onset Bank.Crisis	0.18		0.19		0.18		0.16		0.07	
	(1.24)		(1.47)		(1.27)		(1.10)		(0.43)	
Systemic Impact	1.59	6.6	1.60	6.5	1.61	6.7	1.51	6.2	1.43	5.7
	(13.97) ***		(13.95) ***		(14.26) ***		(12.28) ***		(8.77) ***	
Observations	2854		2809		2861		2822		2402	
McFadden R^2	0.32		0.34		0.33		0.33		0.44	

Notes: Dependent variable is a Crisis Dummy; model includes a constant; *, **, *** are 10%, 5%, 1% significant levels; robust z-statistic in parenthesis; Diff in liquidity = diff in M2/Int. Reserves
mfx = (marginal effect*standard deviation)*100

shows that this variable does not enter significantly. Specification 2.2 indicates that, once we control for systemic impact, more *financial integration* (as proxied by the sum of financial assets and liabilities over GDP) is beneficial for Asian economies as far as reducing the probability of a currency crisis. This result differs from the arguments put forth by "financial globalization critics" who have argued that a "high-degree" of *financial integration* may be detrimental since it can be conducive to volatility in capital movements; thereby, leading to large reversals in capital flows, in turn leading to financial crises[20] (see Bhagwati, 1998; Rodrik, 1998; Rodrik and Subramanian, 2008; Stiglitz, 2000, 2003). Moreover, the link between capital controls and crises could also reflect the fact that some of the countries are more integrated in terms of *de facto* measures of integration and therefore that capital controls do not insulate them from crises.

However, as emphasized by Chang and Velasco (2000) and as previously mentioned, the likelihood of large reversals in short-term capital flows increases the possibility of "liquidity runs", which can be quite costly to borrowers. In general, movements in domestic economic fundamentals, as well as external factors such as world interest rates, influence the volatility of capital flows (Agenor, 1999).[21] Moreover, the fact that investor sentiment is constantly changing in response to new information creates the potential for markets to overshoot, thereby generating financial crises. Accordingly, the IMF (2007) has argued that episodes of very large capital inflows are associated with an acceleration of GDP growth, which suggests that for episodes of large capital inflows ending abruptly, it may take some time to recover fully from the economic slowdown associated with a "hard landing".

As far as the different types of capital flows, Table 2 corroborates the results found in Table 1 for short-term (debt) and medium-term (portfolio) flows. However, long-term capital flows (i.e. FDI) now do not have any effect. This latter result for FDI is not surprising given that this type of investment is more stable and persistent (see Sarno and Taylor, 1999), and therefore "less risky". At the very least, these results suggest that longer-term capital inflows (in-and-of-themselves) do not seem to have insidious side effects

[20] However, such an analysis may suffer from *selection bias.* Often it is countries with poor macroeconomic fundamentals that put controls in place in order to try to insulate themselves from crises. Glick et al. (2006) address this issue, and they find that capital account openness reduces the probability of currency crises, even after controlling for selection bias in terms of how macroeconomic policies influence the existence of capital controls.

[21] Domestic market distortions can also amplify the volatility of capital flows. For example, to the extent that private capital flows are channeled to the domestic economy through commercial banks, then inefficiencies in credit markets can amplify the effect of changes in world interest rates, and thereby lead to oscillations in domestic output that may have feedback effects on capital flows (see Agénor and Aizenman, 1999).

for Asian economies[22]. Therefore, policymakers should keep a close eye on short-term capital flows since they are more prone to sudden stops and quick reversals and therefore, can be particularly destabilizing for Asian economies. Table 2 also shows that the current account variable (specification 2.4) enters with the expected sign even after controlling for "systemic impact"; where an increase in the current account deficit (i.e. lower reserves) increases the probability of a currency crisis by 2.1%. It is worth mentioning that previous studies have been unsuccessful in linking current account deficits to currency crisis (see for example Eichengreen et al., 1996).

4.2 Western Hemisphere Results

The unweighted results[23] for the Western Hemisphere (see Table 21 in appendix E) show that a speculative attack elsewhere in the region is associated with an increased probability of a domestic currency crisis of around 5 percentage points, as measured by the "regular" neighborhood dummy variable. When we substitute the regular "neighborhood" variable with our new "systemic impact" variable, the results remain relatively similar to Table 21; that is, when the systemic impact variable is shocked by a standard deviation, the probability that the domestic economy will experience a currency crisis increases by around 3.7%. At first glance, this result seems to contradict our "tail-independence" conclusion of section 3.2; however, the results in section 3.2 are pairwise, while the regression results presented in this section takes into account the systemic impact within the entire Western Hemisphere region.

As far as the *onset of a banking crisis*, we find that when a western hemisphere economy has experienced a banking crisis, then the probability that this economy experiences a currency crisis increases by 13% on average,[24] even after controlling for "systemic impact".Moreover, according to the results reported in Table 3, the probability of a currency crisis increases by 4.8% on average with a standard deviation increase in CPI inflation, while the probability of a currency crisis increases by 2.5% for the same shock to the M2-to-international-reserves ratio (i.e. *liquidity*). Since this latter ratio captures the extent

[22] Garita (2009) shows that FDI inflows are beneficial for GDP growth through improvements in TFP growth.

[23] When we exclude Canada from the sample and consider only the Latin American countries, the results do not change. These are available upon request.

[24] This confirms the result found by Glick and Hutchinson (2001) that banking crises tend to preceed currency crises.

Table 3: Weighted Western Hemisphere Sample Panel Probit Results; 1979M4 - 2007M3

	3.1	*mfx*	3.2	*mfx*	3.3	*mfx*	3.4	*mfx*	3.5	*mfx*
Diff in Liquidity	0.004	2.5	0.004	2.2	0.004	2.5	0.004	2.5	0.005	2.8
	(1.96) **		(2.02) *		(1.79) *		(1.91) *		(4.41) ***	
Diff in GDP growth	−0.46	−1.7	−0.70	−2.5	−0.48	−1.8	−0.45	−1.7	−0.60	−1.9
	(−1.69) *		(−3.54) ***		(−2.02) **		(−1.64) *		(−2.34) ***	
Diff CPI Inflation	0.02	4.3	0.05	8.8	0.02	3.9	0.02	3.9	0.02	3.1
	(3.43) ***		(9.31) ***		(3.59) ***		(3.10) ***		(3.68) ***	
Diff Financial. Int.			−0.003	−1.7						
			(−2.35) ***							
Diff Trade Open.					−0.01					
					(-0.70)					
Diff in Current Acc.							−0.002	−1.1		
							(−3.11) ***			
FDI inflows									−0.36	−6.9
									(−3.07) ***	
Portfolio inflows									−0.08	
									(−1.57)	
Debt inflows									−0.06	
									(−1.25)	
Onset Bank. Crisis‡	0.56	14.2	0.53	12.8	0.56	13.9	0.57	14.4	0.44	9.8
	(2.55) **		(2.29) **		(2.44) **		(2.57) **		(1.64) *	
Systemic Impact	2.27	4.1	2.05	3.5	2.30	4.1	2.24	3.9	1.84	3.0
	(6.33) ***		(5.11) ***		(7.31) ***		(6.45) ***		(4.99) ***	
Observations	1473		1461		1467		1461		1296	
McFadden R^2	0.23		0.26		0.23		0.23		0.33	

Notes: Dependent variable is a crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% significant levels; Diff in liquidity = diff in (M2/Int. Reserves); Robust z-statistic in parenthesis; mfx = (marginal effect*standard deviation)*100; ‡ = mfx for a discrete change from 0 to 1 to which the liabilities of the banking system are backed by international reserves; then in the event of a currency crisis, individuals will start rushing to convert their domestic currency deposits into foreign currency. Therefore, this latter result shows that a higher ability of a central bank to withstand this demand pressure (i.e. a lower ratio) reduces the probability of a crisis. Furthermore, this effect can be associated with greater exchange market pressure because higher returns on domestic assets end up attracting more capital inflows and fueling upward pressures on the currency.

A major difference between Asian and western hemisphere economies, is that the latter economies have had a more difficult time in creating (sustained) GDP growth, and accordingly, our results show that western hemisphere economies need to grow in a more steady and sustained fashion in order to decrease the probability of a currency crisis. That is, a one standard deviation increase in GDP growth will decrease the probability of a crisis by 2% on average for these economies. As far as *financial integration* (see Table 3, column 3.2), we find that the marginal effect on the probability of a currency crisis is negative, implying a decrease of almost 2% (once again, this result runs counter to what the financial globalization critics have long argued). Additionally, specification 3.3 shows that the current account balance exerts a negative effect on the probability of a currency crisis for these economies.

The literature on the benefits of FDI has argued that "total" foreign direct investment may bring new technology and management techniques that increase the efficiency of *acquired* firms and generate economy-wide spillovers (see for example Garita, 2008). For example, Mishkin (2006) has argued that developing countries can import greater efficiency by allowing foreign investors to take controlling stakes in domestic financial firms, and thereby bring in state-of-the-art financial intermediation practices.[25] When we discriminate between capital flows, the results found in column 3.5 show that higher (and sustained) levels of FDI inflows are associated with a decrease in the probability of a currency crisis of 7% (given a one standard deviation shock); while portfolio and debt inflows have no effect.

4.3 Africa Results

As far as African economies, the unweighted results in Tables 22 (see Appendix E) show that a speculative attack elsewhere in the African region is associated with an increased

[25] In a recent study, Garita (2008) shows that FDI helps improve TFP for both developed and developing economies

probability of a domestic currency crisis of around 20 percentage points, as measured by the regular "neighborhood" variable. Turning to our systemic impact variable (see Table 4), we see that it improves the fit of the equations for African economies, but that it also shows a strong effect *vis-à-vis* currency crises. As was shown in Section 4.3, African economies are highly tail dependent, and therefore the occurrence of joint crises is very likely in this region. This indicates that when market participants in this region experience an idiosyncratic shock in one economy, they transmit the shock abroad by "optimally" rebalancing their portfolios' exposure to macroeconomic risks through other countries' markets. As far as the link between the onset of a banking crisis and currency crisis, for these sample of African countries we do not find any association between these two variables even after controlling for systemic impact. The intuition for this result follows the a similar reasoning as given for the Asian economies in section 4.1.

Table 4 also shows that the probability of a currency crisis increases with an increase in CPI inflation and a higher M2-to-international reserves ratio (i.e. for African economies, increases in "domestic credit" increase the probability of a currency crisis). This latter result corroborates the argument of "first generation" models that the defense of the exchange rate in a country with expansionary monetary policy and a fixed-exchange rate will cause domestic credit to expand, which will tend to surpass the growth in demand for the domestic currency. Therefore, economic agents who are accruing excess liquidity have a preference to swap domestic currency for foreign-denominated securities or domestic interest-bearing assets; both settings lead to a drop in value of the domestic currency. In the former case, increased demand for foreign securities leads to "pressure"; while in the latter, market participants will sell domestic securities due to increases in domestic bond prices, and will buy higher yielding foreign assets due to falling domestic yields. The domestic central bank must conform to the increased demand for foreign currency by reducing its foreign reserves since it is committed to keeping the exchange rate fixed. In sum, the loss of reserves for African economies stems from the process of domestic credit expansion.

We point out that when taking the systemic impact variable into account, *financial integration* becomes insignificant (see specifications 4.2); however, the insignificancy of the *onset of a banking crises* variable remains. Combining these these two results shows that the strong systemic impact underlying African economies is the main source of currency crises. In other words, it is not necessarily the integration into financial markets that can

Table 4: Weighted Africa Sample Panel Probit Results; 1979M2 - 2007M9

	4.1	*mfx*	4.2	*mfx*	4.3	*mfx*	4.4	*mfx*	4.5	*mfx*
Diff in Dom. Credit	2.93	1.9	2.99	1.9	2.96		2.91	1.9	3.05	2.0
	(1.71) *		(1.79) *		(0.47)		(1.74) *		(1.68) *	
Diff in Liquidity	0.001	2.6	0.001	2.6	0.001	3.9	0.001	2.6	0.001	2.6
	(3.65) ***		(3.34) **		(19.71) ***		(3.43) ***		(3.51) ***	
Diff in GDP growth	1.45		1.53		1.08		1.44		1.99	
	(1.04)		(1.10)		(0.59)		(1.03)		(1.13)	
Diff in Gov. Budget	−0.14		−0.12		−0.16					
	(−0.66)		(−0.59)		(−0.98)					
Diff CPI Inflation	0.05	1.2	0.05	1.2	0.15	6.3	0.05	1.23	0.06	1.4
	(2.13) **		(2.18) **		(2.67) ***		(2.17) ***		(2.05) **	
Diff Financial. Int.			−0.08							
			(−0.61)							
Diff Trade Open.					−0.002	−3.63				
					(−1.67) *					
Diff in Current Acc.							−0.07			
							(−0.46)			
FDI inflows									−2.84	-2.8
									(−4.52) ***	
Portfolio inflows									0.47	1.40
									(1.73) *	
Debt inflows									0.21	
									(0.25)	
Onset Bank. Crisis‡	0.34		0.34		1.89	65.16	0.34		0.30	
	(1.30)		(1.28)		(24.25) ***		(1.29)		(1.15)	
Systemic Impact	2.49	13.3	2.49	13.3	1.97	17.3	2.48	13.27	2.44	13.4
	(6.67) ***		(6.67) ***		(9.67) ***		(6.46) ***		(6.79) ***	
Observations	1908		1908		499		1908		1773	
McFadden R^2	0.46		0.46		0.30		0.46		0.46	

Notes: Dependent variable is a crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% significant levels; robust z-statistic in parenthesis; Diff in liquidity = diff in (M2/Int. Reserves); mfx = (marginal effect*standard deviation)*100; ‡ = marginal effect for a discrete change from 0 to 1 cause a problem; rather it is information asymmetry that can create and exacerbate the problem. However, *trade openness* does enter significantly and with the expected sign, implying that a standard deviation increase in trade openness will reduce the probability of a currency crisis by 3.6% on average. As far as the different types of capital flows, only FDI inflows are associated with a reduction in the likelihood of a speculative attack by about 3% (see column 4.5), while portfolio inflows increase the probability of a currency crisis by 1.4% for a standard deviation shock.

5 Out-of-Sample Analysis

As we have previously explained, our systemic impact variable was constructed based on the conditional probability of joint failures (CPJF), which stems from "the same dataset" used in the probit regressions. However, it is worth pointing out that the CPJF matrix identifies the tail linkages across countries in the same region, which does not change dramatically between periods. Therefore, in order to check for any potential endogeneity, we now construct our systemic impact variable at a certain point in time t, by using the data in $[t-240, t-1]$ to re-estimate the CPJF's (hence the CPJF estimation is now based on a moving window period all of the same length).

As was discussed in section 2, when constructing the CPJF it is necessary to specify the number of high order statistics k (recall from Section 2 that we choose $k = 45$ when using the entire sample of 337 months). In this out-of-sample case, by using an identical procedure as in section 2, we find that $k = 40$.[26] We then compare the real data at time t with the thresholds, and identify which countries experience a tail event (i.e. this leads to the variables $Crisis_{it}$). The next step is to use equation (6) to calculated our systemic impact variable, which is now entirely constructed from past information, thereby eliminating any potential endogeneity in our probit model. We distinguish between the approach in this out-of-sample section and the entire sample approach of section 4, by referring to them as the *"out-of-sample"* and the *"in-sample"* approach respectively. Before proceeding with the results, we must mention that the *onset of a banking crisis* variable could not be included in this out-of-sample analysis due to collinearity with the constant, since during this new sampling period there are no *onsets of banking crisis*, thereby, rendering the model unidentified.

[26] It is quite remarkable that the corresponding probability level is $40/240 = 16.7\%$, which is quite close to the one used for the entire sample 13.3%. The Hill plots for these new results are available upon request.

Table 5: Panel Probit for all three regions with Moving Window CPJF; 1999M2 - 2007M9

	Asia				Western Hemisphere				Africa			
	5.1	*mfx*	5.2	*mfx*	5.3	*mfx*	5.4	*mfx*	5.5	*mfx*	5.6	*mfx*
Diff Dom. Credit$_t$	3.26		3.67						7.84	1.4	7.26	1.8
	(0.44)		(0.56)						(3.84) ***		(5.10) ***	
Diff in Liquidity$_t$	0.006		0.02	2.6	-0.006		0.002		-0.04	-26.3	-0.04	-26.3
	(0.98)		(2.12) **		(-1.51)		(0.57)		(-7.92) ***		(-3.45) ***	
Diff GDP growth$_t$	0.75		1.42	0.3	4.21		3.58		4.39		2.72	
	(0.85)		(1.79) *		(1.61)		(1.21)		(0.68)		(0.53)	
Diff CPI Inflation$_t$	0.12		0.18		0.33	19.6	0.24	18.6	0.07		0.07	
	(0.89)		(1.32)		(5.35) ***		(10.5) ***		(0.65)		(0.75)	
Diff Financial. Int.$_t$	-0.07	-0.8			-0.01				0.51	1.5		
	(-1.73) *				(-1.10)				(2.53) **			
Diff Gov. Budget$_t$									-4.51			
									(-1.29)			
FDI inflows$_t$			0.21				-0.26				-1.65	-1.0
			(0.84)				(-1.23)				(-4.01) ***	
Portfolio inflows$_t$			-0.03	-0.5			0.16	1.7			1.06	
			(-4.60) ***				(2.85) *				(0.70)	
Debt inflows$_t$			0.02				0.09				-2.35	
			(4.61) ***				(1.02)				(-0.61)	
Systemic Impact$_{[t-240,t-1]}$	1.38	1.0	1.52	1.1	-1.14		-1.37		2.80	3.4	2.59	4.3
	(3.09) ***		(2.90) ***		(-0.79)		(-0.82)		(5.30) ***		(4.50) ***	
Observations	713		713		470		470		504		504	
McFadden R^2	0.07		0.08		0.12		0.13		0.52		0.50	

Notes: Dependent variable is a Crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% sig. levels;
robust z-statistic in parenthesis; Diff in liquidity = diff in (M2/Int. Reserves); mfx = (marginal effect*standard deviation)*100

For the sake of conciseness, Table 5 only presents the results for our *de facto* measures of *financial integration* (all other results are available upon request). First of all, our systemic impact variable is still highly significant for Asia and Africa, but not for the Latin American economies, corroborating the pattern found in section 4. When it comes to *financial integration* (assets plus liabilities over GDP), we confirm our previous findings that Asian economies benefit from integrating into world capital markets, whereas Latin American economies are not hurt nor do they benefit from *financial integration*. Previously, we had found that *financial integration* did not have any effect on currency crises for African economies; however, Table 5 (specification 5.5) now indicates that this variable has a positive and significant effect even after controlling systemic impact, indicating that these "developing" economies are clearly not ready to integrate into world capital markets. When it comes to the different types of capital flows, the patter found in section 4 remains the same.

We also analyze the possible predictive power of our model by lagging our exogenous variables. We follow the methodology described above by including the "out-of-sample" systemic impact variable, and by only focussing on *de facto* financial integration into world capital markets. The results found in Table 6, indicate that, for all regions, we can confirm that our (lagged) systemic impact variable does have predictive power *vis-à-vis* future currency crises. Lagged *financial integration* does not have any predictive power in relation to the probability of a currency crisis in Asia and the Western Hemisphere; however, as was found in Table 5, for African economies a one standard deviation increase in *financial integration* in the previous period $(t-1)$ will increase the probability of a currency crisis (in period t) by over 2%. The consequences of different types of capital inflows are varied, depending on the region. For example, for Asian economies a large inflow of portfolio-type capital in the previous period $(t-1)$, will reduce the probability of a currency crisis in period t. The result that medium-term capital flows can be beneficial for Asian economies, since these economies will benefit from the further development of bond markets, as recently argued by, for example, the IMF. For the Western Hemisphere economies, the results reported in column 6.4 in Table 6 indicate that FDI inflows help reduce the probability of a currency crisis. We also find that a large inflow of portfolio-type capital will increase the probability of a currency crisis one period in the future for Western Hemisphere economies.

Table 6: Panel Probit for all three regions with all variables lagged by one period (i.e. one month); 1999M2 - 2007M9

	Asia				Western Hemisphere				Africa			
	6.1	*mfx*	6.2	*mfx*	6.3	*mfx*	6.4	*mfx*	6.5	*mfx*	6.6	*mfx*
Diff Dom. Credit$_{t-1}$	5.88		5.42						1.60		1.96	
	(0.96)		(0.92)						(1.60)		(1.59)	
Diff in Liquidity$_{t-1}$	0.01	1.8	0.02	2.9	-0.007		0.003		-0.01		-0.03	-39.5
	(2.60) ***		(4.14) ***		(-1.48)		(0.75)		(-1.58)		(-3.56) ***	
Diff GDP growth$_{t-1}$	1.70		1.74		1.74		0.69		-9.40	-2.5	-10.41	-2.1
	(0.57)		(0.62)		(0.85)		(0.40)		(-2.36) ***		(-3.56) ***	
Diff CPI Inflation$_{t-1}$	-0.18		-0.20		0.38	24.5	0.32	19.6	0.10		0.08	
	(-1.13)		(-1.20)		(2.24) **		(3.32) ***		(1.05)		(0.93)	
Diff Financial. Int.$_{t-1}$	-0.06				-0.008				0.23	2.2		
	(-1.44)				(-0.50)				(2.13) ***			
Diff Gov. Budget$_{t-1}$											-8.81	-25.2
											(-2.06) **	
FDI inflows$_{t-1}$			-0.23				-0.38	-2.2			-3.36	-2.2
			(-1.05)				(-2.79) ***				(-3.96) ***	
Portfolio inflows$_{t-1}$			-0.03	-0.3			0.36	2.6			0.07	
			(-4.07) ***				(3.07) ***				(0.05)	
Debt inflows$_{t-1}$			0.002				0.07				-0.72	
			(0.31)				(0.51)				(-0.18)	
Systemic Impact$_{[t-240,t-1]_{t-1}}$	1.10	0.8	1.14	0.8	3.07	1.3	3.24	1.3	1.12	4.3	0.77	2.2
	(1.99) **		(2.15) **		(2.57) ***		(4.66) ***		(9.22) ***		(5.59) ***	
Observations	713		713		470		470		623		504	
McFadden R^2	0.08		0.09		0.15		0.16		0.12		0.22	

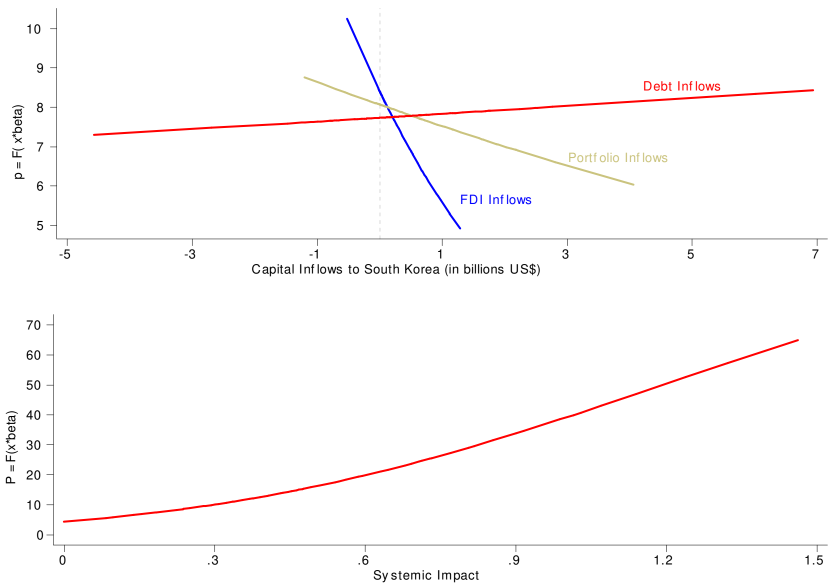
Notes: Dependent variable is a crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% significant levels respectively; robust z-statistic in parenthesis; Diff in liquidity = diff in (M2/Int. Reserves); mfx = (marginal effect*standard deviation)*100

Even though not reported in Table 6, for Asian economies, the *trade openness* variable is negatively significant (at the 10%) with a marginal effect of 1%, which indicates that these economies benefit from more trade openness in the previous period, since it helps reduce the probability of a currency crisis "today". For Western Hemisphere economies, we also find that the *trade openness* variable is highly significant but this time at the 1%, with a marginal effect of 13.5%.[27]

6 Robustness

Our analysis in Section 4 was regional, where the choice of pooling data is reasonable since systemic risk is, as far as we find, regional. Nonetheless, as a robustness check we reproduce the same analysis as in section 4 but this time at the country level. In general, the results do not change for each region. For example, the significance of the different types of capital inflows still holds at the country level, but only for South Korea, Malaysia, and Singapore, while our systemic impact variable remains highly significant at the country level (see Figure 4, based on South Korea, for a graphical example of the aforementioned results). However, for Western Hemisphere economies we find that our systemic impact

Figure 4: Predicted Probability of a Currency Crisis, Capital inflows, and Systemic Impact to South Korea.



[27]Excluding Canada does not change the results. These and other results are available upon request.

variable is only significant for Argentina and Mexico. This result mirrors the conclusions reached through Table 15, namely that linkages between crises in the Western Hemisphere economies is in general weak. Interestingly, this is in contrast to the results found in Section 4.2, where we found that that the systemic impact variable is significant. The difference might due to the data pooling effects.

We also conduct a second robustness check by changing the threshold level. As we explained in Section 2.3, when we construct the CPJF, we choose, according to the Hill plots, the top 13.3% order statistics, which we use to construct our systemic impact variable. Theoretically speaking, multivariate extreme value theory ($MEVT$) ensures that the estimation of the CPJF is insensitive to the choice of threshold. However, this property does not necessarily ensure a stable result for the probit model; it is thus necessary to check the robustness by changing the threshold.

For our new threshold we choose a level of 6.7%, which is the threshold used by Eichengreen et al. (1996) under normality assumptions ($\mu + 1.5\sigma$). Obviously, such a threshold choice is more restrictive vis-à-vis the definition of a tail event (i.e. it leads to an under-estimation of "risk"). It is worth pointing out that by shifting the threshold level, the dependent variable as well as our systemic impact variable also change; however, changing the threshold does not change any of the other control variables. The results from this last exercise point to three major differences: Firstly, our systemic impact variable is no longer significant for Western Hemisphere economies. This result, alongside the evidence stemming from the individual country results, confirms the fact that pooling data for the Western Hemisphere bears potential estimation problems, especially since (as we have previously argued) the economies in this region of the world are tail independent in terms of currency crises. Hence, we cannot consider the significance of the systemic impact in section 4.2 as robust. Our second major difference relates to *financial integration*, which is now not significant for any of the regions in our sample. This insignificancy indicates that when we consider a more restrictive level of tail events, we can only benefit from *financial integration* policies by reducing information asymmetry (i.e. by taking into account systemic impact). The third major difference relates to the effects of the various types of capital flows. More specifically, if we solely relied on the 6.7% threshold results, we would conclude that African economies could benefit from all types of capital flows, since they all enter significantly and negatively, which of course points to a different direction as compared to the results in section 4. Accordingly, we can only conclude that our systemic impact variable is insensitive to the choice of threshold. Therefore, in order to gain a better understanding on the consequences of open capital markets in relation to the reduction of currency crises, it is imperative to specify the risk level precisely as we have done in this paper.

7 Conclusion

This paper has contributed to the understanding of systemic impact *vis-à-vis* currency crises, by further exploring the effect of other channels such as financial openness. Throughout the paper we have argued that *cross-market rebalancing* is an important source of joint crises; however, until now, the systemic impact of crises in other countries has proved difficult to measure empirically. For example, the standard approach to capturing systemic impact only considers whether at least one of the other economies in the same region is suffering a crisis. Intuitively, however, countries may have different links during crises periods; therefore, in order to incorporate the different levels of connections between countries, we need as a first measure, the dependence of the EMPs between different countries during periods of extreme values. Accordingly, we constructed the conditional probability of joint failure (CPJF), which is a new and more informative measure of "tail-dependence". The CPJF has three major advantages: (1) it identifies tail events using a relatively more objective method based on extreme value theory; (2) it proxies for expectations, since it allows us to construct our proxy for systemic impact; and (3) the estimation of the CPJF is insensitive to the definition of a tail event.

By employing monthly data for 23 emerging and developing economies spanning different regions of the world for the period 1978-2007, a battery of statistical and empirical tests reject, at high levels of confidence, tail-independence at the regional level. However, at the global level (i.e. joint crises across regions), we can only conclude tail independence. Furthermore, the degree of within region dependency can be ranked in the sense that Africa economies show the most dependence, followed by Asia. Interestingly, we find that the Western Hemisphere economies are the most independent when it comes to the transmission of currency crisis. We then used probit models to compare our newly-constructed systemic impact variable with the standard approach in the literature of treating all neighboring economies equally. Firstly, our systemic impact variable helps to improve the fit of the model. Secondly, our variable displays higher economic significance in evaluating the possibility of a currency crisis, particularly in regions demonstrating strong or at least some tail-dependence such as in Asia and Africa. In a more tail-independent region such as the Western Hemisphere, the effect is still present and significant; however, the effect is weaker. Therefore, our probit estimation results confirm that the probability of a currency crisis in a given economy increases significantly due to the systemic impact of crises in a region, especially in regions that are more "tail-dependent".

One of the main objectives of the paper was also to find out whether integration into world (capital) markets increases financial instability, as has been argued by many. By taking systemic impact into account, we observe that *de facto financial integration* and *trade openness* both help to reduce the occurrence of currency crises, but the former effect is only applicable for more developed emerging markets. When it comes to the different types of capital flows, we find that all regions benefit from "persistent" FDI inflows, and that Asia is the only region that benefits from a steady increase in portfolio-type inflows. We also found that higher exchange market pressure is associated with a stronger acceleration of CPI inflation, and expansionary fiscal policy. Western Hemisphere economies, behave differently from Asian economies in relation to the impact of GDP growth, since Western Hemisphere economies can reduce the probability of a currency crisis by increasing their GDP growth in a more stable fashion. Furthermore, lack of international reserves and higher levels of CPI inflation can have quite damaging effects as far as excessive pressure in their respective currencies. For African economies we find that an improvement in inflation, the government budget balance, and international reserves, can certainly benefit these economies. We also controlled for the *onset of banking crises*, and our results have shown that for more tail-dependent regions such as Asia and Africa, currency crises are mainly driven by speculative attacks rather than by the *onset* of local banking crises. On the other hand, for a more independent region such as the Western Hemisphere, the *onset of a banking crisis* is a significant source of currency crises. All in all, our systemic impact variable, by accounting for information asymmetry and the "level of speculative attacks" in a given region, provides us with a proper instrument for evaluating currency crises**.**

At the onset of the paper we asked three interrelated questions: (*i*) How can we best capture the systemic linkages of crises? (*ii*) Is the systemic risk of currency crisis a regional or a global phenomenon? (*iii*) By controlling for systemic impact, do other mechanisms like *financial openness* increase the probability of a currency crisis? The answers to those questions are now clear: (*i*) the CPJF measures the systemic linkages between currency crises and helps to improve our understanding of this effect. Furthermore, our systemic impact variables, which is based on the CPJF, provides a more informative measure for the systemic impact to a specific country; (*ii*) Yes, systemic risk does exist, but only from (regional) neighbors; (*iii*) By taking into account systemic impact (i.e. by reducing information asymmetry), *de facto financial integration* into world capital markets helps reduce the probability of a currency crisis.

Given these answers, several important policy implications emerge from the empirical results presented in this article. First, once a crisis begins in a given region, the international community should be prepared to support other economies in the region that “have good economic fundamentals”. Secondly, there is a need for governments to undertake transparent monetary and fiscal policies, in order to reduce information asymmetry especially *vis-à-vis* the private sector, and help the latter form expectations that are closer to those of the monetary and fiscal authorities. Third, the results indicate that countries must pursue monetary policy aiming at "price stability" in order to mitigate a currency crisis. Lastly, though countries can prevent the onset of a currency crisis by pursuing polices that result in sound internal and external macroeconomic balances, currency crisis can still spread to such countries; therefore, the prevention, resolution, and management of the systemic impact of the crises may require more thoroughly coordinated actions among the different regional economies.

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Appendix A - Country Sample

Table 7: Regions and Countries in Sample

Region	Country	Region	Country
Africa	Burkina Faso	Asia	Australia
	Cote d'Ivoire		India
	Mali		Indonesia
	Mauritius		Japan
	Niger		Korea
	Senegal		Malaysia
	South Africa		New Zealand
Western Hemisphere	Argentina		Pakistan
	Brazil		Philippines
	Canada		Singapore
	Mexico		Thailand
	Venezuela		

Appendix B - Data Sources and Variables

- Period-average exchange rate: Local Currency Unit per US dollar (IFS line rf)
- Short-term interest rate given by money market rate (IFS line 60r) if available, or the discount rate (IFS line 60) otherwise. However, for India we use the call money rate (IFS line60b) and supplemented with the inter-bank lending rate (IFS line60p). For New Zealand, we supplemented with the T-bill rate (IFS line60c). For Indonesia, we use the call money rate (IFS line60b) and supplemented with the 3-month deposit rate (IFS line60l). For Morocco, we supplemented with the discount rate (IFS line60).
- Total non-gold International Reserves in US dollars (IFS line 1L.D)
- Domestic credit in national currency (IFS line 32)
- M1 in national currency (IFS line 34)
- M2 in national currency (IFS, M1 plus line 35)
- GDP in national currency (IFS line 99b)
- CPI (IFS line 64)
- Current Account Balance (net) in national currency (IFS, line 78ALD) – is the sum of the balance on goods, services, and income, plus current transfers, credit
- Overall Budget Balance in US dollars (IFS line 78CBD) – is the sum of the balances on the current account, the capital account, the financial account, and net errors and omissions.
- Financial Assets (IFS line11) in national currency
- Financial Liabilities (IFS line16c) in national currency
- Merchandise Exports (IFS line70) & Merchandise Imports (IFS line71); both in US dollars
- FDI Inflows (IFS line78BED) – this category includes equity capital, reinvested earnings, other capital and financial derivatives associated with various inter-company transactions between affiliated enterprises.

- Portfolio Inflows (IFS line 78BGD) – includes transactions with non-residents in financial securities of any maturity such as corporate securities, bonds, notes, and money market instruments, other than those included in direct investment, exceptional financing, and reserve assets.
- Debt Inflows (IFS line 78BID) – include all transactions not included in direct investment, portfolio investment, financial derivatives, or other assets. Major categories are trade credits, loans, transactions in currency and deposits, and other assets.

Table 8: Construction of Variables (in millions of USA dollars)

Variables		Construction
Annual growth rate of domestic credit	=	Difference in logs from IFS line32
Government Budget as % of GDP	=	(IFS line 78cbd) / (IFS line 99b/IFS line rf)
Current Account as % of GDP	=	(IFS line 78ald/IFS line rf) / (IFS line 99b/IFS line rf)
Ratio M2 to international reserves	=	((IFS line 34+35)/IFS line rf) / (IFS line .1ld)
CPI Inflation	=	Difference in logs from IFS line64
Financial Openness	=	[(assets + liab.)/IFS line rf] / (IFS line 99b/IFS line rf)
Trade Openness	=	(exports + imports) / (IFS line 99b/IFS line rf)

Appendix C - Descriptive Statistics

Table 9: Descriptive Statistics for Asian Economies

Variable	Obs	Mean	Std. Dev.	Min	Max
Diff in Domestic Credit Growth	3810	0.005	0.04	-0.73	0.71
Diff in Liquidity	3810	-71.68	37.07	-213.93	54.17
Diff in GDP growth	3660	0.004	0.04	-0.12	0.91
Diff in Current Account	3626	0.27	0.47	-0.76	2.81
Diff Government Budget	3658	0.001	0.01	-0.07	0.05
Diff CPI Inflation	3122	0.14	0.88	-4.50	12.82
Diff in Financial Integration	3609	2.05	2.51	-0.02	12.18
Diff in Trade Openness	3651	0.09	0.48	-0.23	2.29
FDI Inflows‡	3305	0.23	0.72	-15.34	10.43
Portfolio Inflows‡	3305	0.74	3.23	-25.60	40.98
Debt Inflows‡	3305	0.18	3.50	-46.44	21.01
Neighborhood Dummy	3685	0.52	0.50	0	1.00
Systemic Impact	3685	0.21	0.27	0	1.95
Onset banking Crisis	3817	0.04	0.21	0	1
Moving Window Systemic Impact	1045	0.10	0.15	0	0.85

note: ‡ = in billions of US dollars

Table 10: Descriptive Statistics for West. Hemisphere Economies

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Diff in Domestic Credit Growth	1599	0.03	0.07	-0.23	0.82
Diff in Liquidity	1659	-69.18	31.31	-211.06	38.01
Diff in GDP growth	1473	0.02	0.20	-0.11	3.30
Diff in Current Account	1470	-0.38	3.27	-35.93	0.14
Diff Government Budget	1470	-0.008	0.44	-5.22	1.25
Diff in Financial Integration	1463	15.01	28.01	-1.05	429.48
Trade Openness	1469	4.58	2.98	0.06	38.52
Diff CPI Inflation	1671	3.79	9.80	-2.19	196.39
FDI Inflows‡	1503	0.70	1.11	-2.23	10.69
Portfolio Inflows‡	1503	0.52	1.30	-2.99	13.28
Debt Inflows‡	1503	0.10	1.37	-11.04	8.95
Neighborhood Dummy	1680	0.39	0.49	0	1
Systemic Impact	1680	0.06	0.09	0	0.48
Onset banking Crisis	1680	0.05	0.22	0	1
Moving Window Systemic Impact	480	0.03	0.06	0	0.34

note: ‡ = in billions of US dollars

Table 11: Descriptive Statistics for African Economies

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Diff in Domestic Credit Growth	2399	0.0008	0.05	-0.38	0.36
Diff in Liquidity	2264	-37.58	131.60	-211.83	1727.79
Diff in GDP growth	2345	0.002	0.02	-0.18	0.33
Diff in Current Account	2177	0.27	0.24	-0.84	0.76
Diff Government Budget	2177	-0.02	0.30	-2.81	2.30
Diff in Financial Integration	2352	1.50	0.74	0.13	3.78
Diff CPI Inflation	2294	0.14	1.75	-17.04	15.18
FDI Inflows‡	2177	0.02	0.07	-0.04	0.61
Portfolio Inflows‡	2033	0.04	0.20	-0.25	1.82
Debt Inflows‡	2177	0.01	0.08	-0.16	0.75
Neighborhood Dummy	2359	0.39	0.49	0	1
Systemic Impact	2359	0.20	0.37	0	1.94
Onset Banking Crisis	2408	0.03	0.18	0	1
Moving Window Systemic Impact	679	0.15	0.31	0	1.81

note: ‡ = in billions of US dollars

Appendix D - Conditional Probability of Joint Failure

Table 12: Correlation within Asia; 1978M1-2006M12

	Aus	India	Indo	Jap	Kor	Malay	New Z.	Pak	Philip	Sing	Thai
Australia	1	0.13	0.15	0.40	0.19	0.27	0.25	0.13	-0.02	0.30	0.12
India	0.13	1	0.11	0.18	0.16	0.26	0.05	0.00	0.15	0.24	0.19
Indon	0.15	0.11	1	0.22	0.29	0.32	0.10	0.00	0.16	0.19	0.18
Japan	0.40	0.18	0.22	1	0.37	0.32	0.24	0.15	0.08	0.39	0.09
Korea	0.19	0.16	0.29	0.37	1	0.38	0.13	0.17	0.16	0.40	0.11
Malaysia	0.27	0.26	0.32	0.32	0.38	1	0.20	0.13	0.29	0.51	0.33
New Z.	0.25	0.05	0.10	0.24	0.13	0.20	1	0.05	0.12	0.14	0.15
Pakistan	0.13	0.00	0.00	0.15	0.17	0.13	0.05	1	0.05	0.15	-0.01
Philip	-0.02	0.15	0.16	0.08	0.16	0.29	0.12	0.05	1	0.15	0.06
Singap	0.30	0.24	0.19	0.39	0.40	0.51	0.14	0.15	0.15	1	0.11
Thailand	0.12	0.19	0.18	0.09	0.11	0.33	0.15	-0.01	0.06	0.11	1

Table 13: CPJF in Asia; 1978M1-2006M12

	Aus	India	Indo	Jap	Kor	Malay	New Z.	Pak	Philip	Sing	Thai
Australia	1	0.10	0.18	0.15	0.14	0.17	0.20	0.13	0.08	0.17	0.13
India	0.10	1	0.10	0.15	0.15	0.18	0.11	0.07	0.14	**0.23**	**0.27**
Indonesia	0.18	0.10	1	**0.22**	0.15	0.11	**0.22**	0.11	0.08	0.15	0.08
Japan	0.15	0.15	**0.22**	1	**0.22**	**0.25**	0.15	0.14	0.13	**0.22**	0.18
Korea	0.14	0.15	0.15	**0.22**	1	0.18	0.10	0.08	0.14	0.15	0.14
Malaysia	0.17	0.18	0.11	**0.25**	0.18	1	0.17	0.13	0.18	**0.30**	**0.27**
New Z.	0.20	0.11	**0.22**	0.15	0.10	0.17	1	0.14	0.08	0.18	0.11
Pakistan	0.13	0.07	0.11	0.14	0.08	0.13	0.14	1	0.15	0.10	0.11
Philip	0.08	0.14	0.08	0.13	0.14	0.18	0.08	0.15	1	0.15	0.10
Singap	0.17	**0.23**	0.15	**0.22**	0.15	**0.30**	0.18	0.10	0.15	1	0.20
Thailand	0.13	**0.27**	0.08	0.18	0.14	**0.27**	0.11	0.11	0.10	0.20	1

Bold indicates tail dependence is significant at better than 10%

Table 14: Correlation in West. Hemisphere; 1978M1-2006M12

	Argentina	Brazil	Canada	Mexico	Venezuela
Argentina	1	0.40	0.10	0.18	0.11
Brazil	0.40	1	0.11	0.08	0.05
Canada	0.10	0.11	1	0.08	0.05
Mexico	0.18	0.08	0.08	1	0.06
Venezuela	0.11	0.05	0.05	0.06	1

Table 15: CPJF in West. Hemisphere; 1978M1-2006M12

	Argentina	Brazil	Canada	Mexico	Venezuela
Argentina	1	0.15	0.10	0.17	0.07
Brazil	0.15	1	0.08	0.18	0.14
Canada	0.10	0.08	1	0.11	0.08
Mexico	0.17	0.18	0.11	1	0.06
Venezuela	0.07	0.14	0.08	0.06	1

Table 16: Correlation in Africa; 1979M2-2007M9

	Burkina F.	Côte d'Ivoire	Mali	Maurit	Niger	Senegal	S. Africa
Burkina Faso	1	0.73	0.92	0.35	0.08	0.09	0.01
Côte d'Ivoire	0.73	1	0.78	0.30	0.06	0.06	0.01
Mali	0.92	0.78	1	0.37	0.04	0.04	0.02
Mauritius	0.35	0.30	0.37	1	0.06	0.05	0.07
Niger	0.08	0.06	0.04	0.06	1	0.99	0.25
Senegal	0.09	0.61	0.04	0.05	0.99	1	0.25
South Africa	0.01	0.01	0.02	0.07	0.25	0.25	1

Table 17: CPJF in Africa; 1979M2-2007M9

	Burkina F.	Côte d'Ivoire	Mali	Maurit	Niger	Senegal	S. Africa
Burkina Faso	1	**0.50**	**0.76**	**0.25**	0.13	0.11	0.08
Côte d'Ivoire	**0.50**	1	**0.58**	**0.23**	0.13	0.11	0.11
Mali	**0.76**	**0.58**	1	**0.25**	0.14	0.13	0.08
Mauritius	**0.25**	**0.23**	**0.25**	1	0.11	0.11	0.10
Niger	0.13	0.13	0.14	0.11	1	**0.91**	0.20
Senegal	0.11	0.11	0.13	0.11	**0.91**	1	0.18
South Africa	0.08	0.11	0.08	0.10	0.20	0.18	1

Bold indicates tail dependence is significant at better than 10%

Table 18: CPJF between Asia and Africa

	Burkina F.	Côte d'Ivoire	Mali	Maurit	Niger	Senegal	S. Africa
Australia	0.14	0.18	0.18	0.17	0.10	0.10	0.13
India	0.14	0.17	0.17	0.15	0.06	0.07	0.11
Indonesia	0.18	0.17	0.14	0.08	0.08	0.08	0.10
Japan	**0.29**	**0.23**	**0.25**	0.18	0.15	0.13	0.10
Korea	0.17	**0.22**	0.20	0.14	0.13	0.11	0.10
Malaysia	0.17	0.15	0.15	0.15	0.14	0.11	0.10
New. Z.	0.14	0.15	0.11	0.17	0.14	0.14	0.13
Pakistan	0.10	0.10	0.10	0.14	0.05	0.05	0.03
Philippines	0.11	0.13	0.10	0.07	0.10	0.10	0.07
Singapore	0.15	0.18	0.17	0.13	0.11	0.10	0.08
Thailand	0.17	0.15	0.18	0.05	0.06	0.06	0.06

Bold indicates tail dependence is significant at better than 10%

Table 19: CPJF between Asia and West. Hemisphere

	Argentina	Brazil	Canada	Mexico	Venezuela
Australia	0.10	0.06	0.13	0.18	0.08
India	0.15	0.13	0.15	0.17	0.07
Indonesia	0.13	0.08	0.05	0.17	0.10
Japan	0.17	0.10	0.15	0.18	0.10
Korea	0.11	0.14	0.08	0.13	0.08
Malaysia	0.10	0.13	**0.22**	0.17	0.08
New. Z.	0.13	0.06	0.13	0.14	0.05
Pakistan	0.05	0.08	0.08	0.08	0.07
Philippines	0.13	0.11	0.11	0.11	0.03
Singapore	0.11	0.11	0.20	0.14	0.13
Thailand	0.10	0.11	0.13	0.17	0.10

Bold indicates tail dependence is significant at better than 10%

Table 20: CPJF between West. Hemisphere and Africa

	Burkina F.	Côte d'Ivoire	Mali	Maurit	Niger	Senegal	S. Africa
Argentina	0.10	0.18	0.11	0.11	0.11	0.13	0.20
Brazil	0.03	0.08	0.06	0.05	0.07	0.08	0.10
Canada	0.10	0.13	0.11	0.13	0.08	0.07	0.06
Mexico	0.10	0.14	0.10	0.13	0.08	0.10	0.17
Venezuela	0.05	0.03	0.05	0.05	0.10	0.10	0.05

Appendix E - Unweighted Results for WH and Africa

Table 21: Western Hemisphere Sample Panel Probit Results; 1978M1 - 2006M12

	21.1	mfx	21.2	mfx	21.3	mfx	22.4	mfx	22.5	mfx
Diff in Liquidity	0.004	2.5	0.004	2.2	0.004	2.5	0.004	2.5	0.005	2.8
	(2.35) **		(1.78) *		(2.16) **		(2.28) **		(3.97) ***	
Diff in GDP growth	-0.45	-1.7	-0.69	-2.5	-0.48	-1.8	-0.45	-1.7	-0.56	-1.9
	(-1.68) *		(-3.62) ***		(-2.06) **		(-1.65) *		(-2.33) **	
Diff CPI Inflation	0.02	4.9	0.05	8.8	0.02	3.9	0.02	3.9	0.02	2.9
	(3.65) ***		(8.67) ***		(3.90) ***		(3.35) ***		(3.94) ***	
Diff Fin. Open.			-0.003	-1.7						
			(-2.40) **							
Diff Trade Open.					-0.02					
					(-0.89)					
Diff Current Acc.							0.002	-0.9		
							(2.93) ***			
FDI inflows									-0.37	-7.1
									(-3.01) ***	
Portfolio inflows									-0.08	-2.0
									(1.66) *	
Debt inflows									-0.06	
									(-1.37)	
Onset Bank. Crisis‡	0.56	14.1	0.53	12.9	0.55	13.8	0.57	14.3	0.43	
	(2.50) ***		(2.26) **		(2.39) **		(2.53) **		(1.55)	
Regular Neighbor	0.42	8.5	0.37	7.2	0.43	8.7	0.41	8.3	0.37	6.9
Dummy‡	(5.19) ***		(4.79) ***		(5.83) ***		(5.26) ***		(5.04) ***	
Observations	1473		1461		1467		1468		1296	
McFadden R^2	0.22		0.26		0.23		0.23		0.33	

Notes: Dependent variable is a crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% sig. levels respectively; Robust z-statistic in parenthesis; Diff in liquidity = diff in (M2/Int. Reserves); mfx = (marginal effect*standard deviation)*100; ‡ = mfx is based on a discrete change from 0 to 1

Table 22: Africa Sample Panel Probit Results; 1979M2 - 2007M9

	22.1	mfx	22.2	mfx	22.3	mfx	22.4	mfx	22.5	mfx
Diff in Dom. Credit	2.31	1.7	2.39	1.9	3.21		2.28	1.7	2.30	
	(1.67) *		(1.65) *		(0.52)		(1.71) *		(1.48)	
Diff in Liquidity	0.001	2.6	0.001	2.6	0.001	3.9	0.001	2.6	0.001	2.6
	(5.82) ***		(5.24) ***		(7.71) ***		(5.30) ***		(5.29) ***	
Diff in GDP growth	1.26		1.37		-1.46		1.15		1.42	
	(1.05)		(1.21)		(-0.84)		(0.95)		(0.95)	
Diff in Gov. Budget	-0.37		-0.35		-0.31					
	(-1.59)		(-1.60)		(-1.31)					
Diff CPI Inflation	0.04	1.2	0.04	1.2	0.14	6.1	0.04	1.1	0.05	1.4
	(2.04) **		(2.07) **		(3.36) ***		(1.96) **		(2.17) **	
Diff Fin. Open			-0.13	-1.6						
			(-3.17) ***							
Diff Trade Open.					0.009					
					(1.47)					
Diff Current Acc.							-0.70	-2.8		
							(-4.62) ***			
FDI inflows									-4.26	-4.8
									(-4.30) ***	
Portfolio inflows									-0.21	
									(-0.32)	
Debt inflows									0.99	
									(0.47)	
Onset Bank. Crisis‡	0.06		0.06		1.71	60.3	0.06		-0.01	
	(0.23)		(0.22)		(25.12) ***		(0.23)		(-0.05)	
Regular Neighbor	1.25	25.1	1.25	24.9	0.76	19.4	1.21	23.9	1.23	25.0
Dummy‡	(5.21) ***		(5.24) ***		(4.17) ***		(4.96) ***		(5.37) ***	
Observations	1908		1908		449		1908		1773	
McFadden R^2	0.32		0.33		0.80		0.33		0.20	

Notes: Dependent variable is a crisis dummy; model includes a constant; *, **, *** are 10%, 5%, 1% sig. levels respectively; Robust z-statistic in parenthesis; Diff in liquidity = diff in (M2/Int. Reserves); mfx = (marginal effect*standard deviation)*100; ‡ = mfx is based on a discrete change from 0 to 1