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Abstract

We identify the benefits and costs of financial openness in terms of currency crises based on a novel quantification of the systemic impact of currency (financial) crises. We find that systemic currency crises mainly exist regionally, and that financial openness helps diminish the probability of a currency crisis after controlling for their systemic impact. To clarify further the effect of financial openness, we decompose it into the various types of capital inflows. We find that the reduction of the probability of a currency crisis depends on the type of capital and on the region. Finally yet importantly, we find that monetary policy geared towards price stability, through a flexible inflation target that takes into account systemic impact, reduces the probability of a currency crisis.

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1 Introduction

The wave of capital flows running through many emerging market economies 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 and the high degree of reserves accumulation. Prior to the current downturn, these capital flows were associated with ample global liquidity and favorable worldwide economic conditions; and in many cases they were a reflection of strengthened macroeconomic policy frameworks and growth-enhancing structural reforms. Economists have also argued that increased openness to capital flows has, in general, proven vital for countries aiming to leapfrog from lower- to middle-income status (e.g. Fischer, 1998; Summers, 2000).

However, significant concerns about the stability of national and international financial systems, stemming from the crises that occurred since 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 for example Bhagwati, 1998; Rodrik, 1998; Stiglitz, 2000, 2003; Rodrik and Subramanian, 2008). Moreover, because capital inflows have the potential to generate overheating, and a loss of competitiveness, there have been calls for a reconsideration of the use of capital controls on international asset trade (see for example Ostry et al., 2010). Therefore, the fear has re-emerged that in an environment of relatively free international capital markets financial crises are becoming more frequent, and that such developments may easily spill over to other economies.[1]

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 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, the vitality (or lack thereof) of a fixed exchange rate is established by external fundamentals unconnected to how economic agents behave (see Salant and Henderson, 1978; Krugman, 1979; Flood and Garber, 1984). In these models, economic agents base their beliefs on the assumption that fiscal imbalances and/or domestic credit policies

[1] Interestingly, there is little empirical evidence supporting the view that financial openness by itself increases vulnerability to crises.

will not be 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 (see Obstfeld, 1986, 1994). 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.

Therefore, 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; 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 speculators and, therefore, change their actions in country j'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 joint 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.[2] 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 Aghion et al. 2001; Kodres and Pritsker 2002). 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). Furthermore, and 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".

As the foregoing discussion points out, the intensity and time-clustering of financial crises has now forced both policy makers and academics to focus on "systemic risk" as a principal culprit; especially given that a full joint crisis in the financial system can have strong adverse consequences for the real economy and general economic welfare. More-

[2] If two countries are highly integrated (e.g. through trade), then 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.

over, because no open economy can fully insulate itself from its surrounding environment, economies may need to adopt, either regionally and/or globally, coordinated measures in order to prevent "systemic risks" (which thus far has proved difficult to quantify). 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 openness" channel is relevant, then countries may need to impose capital controls on capital flows.[3]

In this paper we study the effects of financial openness and its decomposition on the probability of a currency crisis. To address this issue, the paper follows a three-step approach and answers three interrelated questions: (*i*) How can we best capture the systemic impact of crises? (*ii*) Is the systemic impact (risk) of currency crises a regional or a global phenomenon? (*iii*) By controlling for the systemic impact of currency crises, does financial openness and its decomposition into the various types of capital inflows, increase or decrease the probability of a currency crisis?

Methodologically, we start by using extreme value theory (EVT) to identify the linkage between currency crises; this statistical technique is well suited to address the extreme co-movements of financial markets. 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. Therefore, the research herein differs and contributes to the literature in at least three ways. By focusing on 23 economies from Africa, Asia, and the Western Hemisphere, we extend the analysis of extreme exchange rate fluctuations to a bivariate setting by taking into account the extreme co-movements of asset prices. We do this by measuring the joint occurrence of currency market crashes through our newly created conditional probability of joint failure (CPJF). Secondly, we propose a new and revised version of the "crises elsewhere" or "neighborhood" variable that is often constructed in the contagion literature. By construction, the standard "neighborhood" variable only considers whether one of the neighboring countries is suffering a crisis; however, this gives the same weight and importance to the crisis in (all) other economies. This is counterfactual given that economies experience different links during crises periods. Accordingly, our second step is to incorporate the different levels of connections between economies

[3] The literature always discusses "capital flows" in general. In our opinion, this is quite misleading since not all capital is created equal (see also Garita, 2008).

by using the CPJF to weight our crises indicators; this yields a new measure of systemic impact *vis-à-vis* financial crises. In this manner, we weight down those economies that are less connected, while giving a higher weight to those economies that are more highly interconnected. Thirdly, by using an expanded data set representing different regions of the world we test, through a panel probit model as in Eichengreen et al. (1996), the impact of financial openness and its decomposition into different types of capital inflows on the probability of a currency crisis. We also allow the systemic impact of currency crises to operate through the "cross-market rebalancing" channel.

Overall, our results indicate that currency crises are linked, but mainly within regions. The probit results reveal that higher levels of *de facto* financial openness lowers the probability of a currency crisis, after controlling for the systemic impact of currency crises. When we decompose financial openness into its various types of capital inflows, we find that African and Western Hemisphere economies benefit from "persistent" FDI inflows; while Asia is the only region that benefits from a steady increase in portfolio-type inflows (i.e. by seeking and developing their bond markets). We also find that monetary policy geared towards price stability, through a flexible inflation target that takes into account systemic risk, reduces 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 introduce our data and the procedure for 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. Finally, we introduce our newly created "systemic impact" variable, which incorporates information on the different 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 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 an exchange market pressure (EMP) index. The EMP is a good index of currency crises 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 central 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:

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

where e_{it} are the units of country $i's$ 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 $\left(\Delta\left(i_{it} - i_{us,t}\right)\right)$.[4] 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 has usually done by assuming a normal distribution of the EMP. More specifically, the customary manner of choice for the statistical threshold

[4] In theory, for a pure float, the change in the exchange rate would correspond exactly to the index of exchange market pressure. 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.

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 and standard deviation will, more often than not, underestimate the frequency of speculative attacks.

In fact, the threshold chosen in the literature simply corresponds to a quantile at a "certain" probability level.[5] In order to define a crisis, we also use a quantile of the EMP series as our threshold choice, but without *a priori* specifying the distribution of the EMP. We determine the level of the tail probability that corresponds to the threshold by using extreme value theory. Extreme value theory analyzes the tail behavior of extreme observations by assuming that the extreme observations can be approximated by a Pareto distribution. By plotting the estimates of the shape parameter of the Pareto distribution against the number of high order statistics k used in estimation, the proper threshold[6] can be chosen from the first stable region in the plot (see Hill, 1975); such a procedure has been employed by, for example, de Haan and de Ronde (1998). In this paper we follow the same methodology, and find that for all countries in our sample, $k \approx 45$. Since we have 337 observations for each country, this yields a quantile with probability level $45/337 = 13.3\%$.

Formally, for country i at time t let us denote the EMP series as EMP_{it}. 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. We then construct 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"; however, the indicator is in fact measuring a tail event. As we will discuss later, within the extreme value theory setup, the linkages between crises

[5] In finance, the high quantile is the 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 normality, the mean plus 1.5 standard deviation threshold corresponds to a VaR at probability level 6.7%.

[6] Given the selfsimilarity of the Pareto distribution, tail properties above such a threshold can be extrapolated to the situaion when an even higher threshold is imposed.

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

In this subsection we lay out the specifics of our econometric model used to test whether the probability of a crisis in an individual economy is affected by events occurring elsewhere. According to a number of theoretical models mentioned in the introduction, currency crises may occur simultaneously among economies that have a trade channel, that have similar macroeconomic fundamentals, that are more financially integrated into the world capital markets, and/or that are neighbors. Therefore, following Eichengreen et al. (1996) we estimate a panel probit model using monthly data for 23 economies from around the world (see Appendices A and B for the list of sample countries, data descriptions, and descriptive statistics) 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" crisis elsewhere variable, which gives the same importance to other economies in the same region. The vector $\lambda I(L)_{it}$ is an information set of macroeconomic control variables (see appendix A for a full description), which 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.[7] We also include variables that capture the different channels by which crises may take place (or can be exacerbated). For instance, we include several *de facto* measures, such as trade openness, financial integration,[8] FDI inflows,

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

[8] *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.

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[9] in order to capture the link between banking and currency crises, as documented by Kaminsky and Reinhart (1999) and Glick and Hutchinson (2001).

The control variables are 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 claim that financial globalization (in and of itself) is responsible for the epidemic of financial crises that the world has seen in recent history.

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[10]. First, the correlation coefficient measures dependence during normal times

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

[10] 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".

(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 be heavy-tailed. Therefore, given that the exchange rate is a component of the EMP, then the EMP may inherit this heavy-tail feature. In our case, the variance of the EMP index can be infinite since we cannot rule out the possibility that the tail index may be below 2; therefore, what we require is a measure of tail dependence (see Embrechts et al., 2000; Hartman et al., 2004). We define the "conditional probability of joint failure" (CPJF) as follows[11]: 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

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

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). Therefore, as soon as p is at a "low level" the conditional probability is already close to its asymptotic value, even for a finite level of p.[12] In other words, the CPJF will be stable when comparing the linkage between crises and tail events. In order to estimate the $CPJF_{i,j}$, we use the following estimator (see de Haan and Ferreira, 2006, Ch. 7):

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

[11] 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.

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

A higher CPJF between two economies 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 underscores the different linkages during crisis periods, as previously mentioned. 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 those economies that are less connected are weighted down, 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:

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

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

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

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 equals zero, then the probability of a joint tail event is negligible; however, if equals one, then a tail event in one economy will always go hand in hand with the "downfall" of the other economy. 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 C (Tables 13, 15, and 17), and are discussed in the following subsections.

3.1 Asia

Table 12 shows the regular dependence among Asian countries through their correlation coefficient.[13] 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:

[13] Although a few negative numbers appear, they are not significantly different from zero.

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 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 spread across regions. However, as can be discerned from Tables 18-20, the tail dependence across the three regions is low. Therefore, we can only conclude that extreme exchange market pressure, in and of itself, is not very likely to spread from region to region. That is, currency crises are regional.

Thus far, we have identified the tail dependence (independence) among currency crises, at both the regional and global level based on the CPJF. Accordingly, the results in the previous section provide an overview of the potential systemic impact of currency crises stemming from regional neighbors. In the next section, we go a few steps further, by controlling for systemic impact. This allows us to investigate the pros and cons of financial openness, among other economic policies.

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 results found in Table 1 indicate that a speculative attack elsewhere in Asia increases the probability of a domestic currency crisis by around 9 percentage points (as captured by the "traditional" neighborhood dummy often used as a starting point in the literature). 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. 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 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 standard deviation shock. Table 1 also gives some support to the predictions of the first generation models of speculative attacks; that is, the probability of a currency crisis rises with higher

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 levels of 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 in the form of slower growth in government expenditure is strongly associated with lower exchange market pressure. Moreover, 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). Additionally, the onset of a banking crisis is significantly correlated with a currency crisis in Asia; however, this link disappears when we include the various types of capital flows (see specification 1.5).

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[14]. This shows that when market participants are hit by an idiosyncratic shock in an Asian economy, they transmit the shock abroad by "optimally" rebalancing their portfolio’s exposure to macroeconomic risks through other countries’ markets, which is in line with the cross-market rebalancing effect.

[14]It is important to keep in mind that our new variable is continuous, and that we have applied a one standard deviation shock. If we evaluate this variable at the mean, then the marginal effect is about 24% for an increase in systemic risk.

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

Specification 2.2 indicates that 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. Interestingly, Glick et al. (2006) also found 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. Turning to the different types of capital flows, specification 2.5 indicates that debt and FDI inflows do not have any effect *vis-à-vis* the probability of a currency crisis. 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 do not seem to have insidious side effects for Asian economies[15]. However, portfolio-type inflows do help reduce the probability of a currency crisis. This result indicates that economies in Asia must develop their bond markets, since local bond issues assist in the reduction of currency and maturity mismatches on balance sheets. Notwithstanding the benefits linked to the provision of another source of funding, a rushed enlargement of bond markets could be potentially risky. In this respect, our result that portfolio inflows reduce the probability of a currency crisis makes perfect sense, especially when we control for systemic impact. That is, the development of these markets without minimal institutional support to deal with asymmetric information and other capital market deficiencies could cause havoc on the market, thereby slowing the expansion of such markets over the medium term. The policy response for Asia is clear. In order to rebalance their economies and reduce the probability of a currency crisis, these economies need to encourage FDI and the development of bond markets; however, they should keep a very close watch on short-term capital (debt) inflows.

Table 2 also shows that the current account (specification 2.4) enters with the expected sign even after controlling for "systemic impact"; that is, 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). When it comes to GDP growth, Table 2 now shows that this variable does not enter significantly. We also control for the onset of a banking crisis, where it is important to note that, once we control for systemic risk, 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".

[15] Garita (2008) shows that FDI inflows are beneficial through improvements in TFP growth.

4.2 Western Hemisphere Results

The unweighted results for the Western Hemisphere (see Table 21 in appendix D)[16] show that a speculative attack elsewhere in this 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; however, when the systemic impact variable is shocked by a standard deviation, the probability that a western hemisphere economy will experience a currency crisis increases by around 3.7% (the effect is much larger if we evaluate this variable at the mean). 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 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% after controlling for systemic impact. 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. Moreover, according to 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 to which the liabilities of the banking system are backed by international reserves; individuals will start rushing to convert their domestic currency deposits into foreign currency in the event of a currency crisis. Therefore, this latter result shows that a higher ability of a central bank to withstand this demand pressure 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.

One major difference between Asian and Western Hemisphere economies is that the latter have had a more difficult time in sustaining GDP growth. 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; a one standard deviation

[16] When we exclude Canada from the sample the results do not change.

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 increase in GDP growth will decrease the probability of a crisis by 2% on average for these economies. Additionally, specification 3.3 shows that the current account balance exerts a negative effect on the probability of a currency crisis for these economies. We also find, similarly to Glick and Hutchinson (2001), that currency crises tend to follow banking crises but, in our case, only for the western hemisphere economies. That is, if an economy in this region experiences a banking crisis, then the probability that this same economy will experience a currency crisis increases by 13% on average, even after controlling for "systemic impact".

4.3 Africa Results

For African economies, the unweighted results in Tables 22 (see Appendix D) show that a speculative attack elsewhere in the African region is associated with an increased 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, and it also shows a strong effect *vis-à-vis* currency crises. Since African economies are highly tail dependent, 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.

Interestingly, when taking our systemic impact variable into account, financial integration now becomes insignificant (see specifications 4.2). 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. For 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.

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. That is, for African economies, higher levels of "domestic credit" increase the probability of a currency crisis. This latter result once again 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

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 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 accommodate 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. As far as the link between the onset of a banking crisis and currency crisis, we do not find any association between, even after controlling for systemic impact. The intuition for this result follows the reasoning as given for the Asian economies in section 4.1. Combining this result with the non-significance of financial integration indicates 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 cause a problem; rather it is information asymmetry that can create and exacerbate the problem.

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, potentially leading to endogeneity. However, we argue that the CPJF matrix, which identifies the tail linkages across countries in the same region, does not change dramatically between periods. Nonetheless, in order to check for any potential endogeneity, we now construct our systemic impact variable at time t by using data in $[t-240, t-1]$ to re-estimate the CPJF's.

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). By using an identical procedure as in section 2, we find that $k = 40$ in the out-of-sample case.[17] We then compare the real data at time t with the thresholds and identify which countries experience a tail event; this leads to the variables $Crisis_{it}$. The next step is to use equation (6) to calculate our systemic impact variable, which is now entirely constructed from past information, thereby eliminating any

[17]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 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.

For the sake of conciseness, Table 5 only presents the results for our *de facto* measures of financial openness. First, our systemic impact variable is still highly significant for Asia and Africa but not for the Western Hemisphere economies; this corroborates the pattern found in section 4. When it comes to financial integration, we confirm our previous findings that Asian economies benefit from integrating into world capital markets, whereas Western Hemisphere 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) indicates that this variable has a positive and significant effect even after controlling for systemic impact This indicates 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 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. Through Table 6 we can confirm, for all regions, that our lagged systemic impact variable does have predictive power for 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, 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%; as was found in Table 5.

The effects of the different types of capital inflows vary by region. 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 still stands, since these economies will benefit from the further development of bond markets. For the Western Hemisphere economies, the results reported in column 6.4 indicate that FDI inflows help reduce the probability of a currency crisis; while a large inflow of portfolio-type capital will increase this probability one period in the future. Similarly, African economies benefit from higher and more sustained levels

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 of FDI. Though not reported, for Asian economies the lagged value of trade openness is negatively significant (at the 10%-level) with a marginal effect of 1% *vis-à-vis* reducing 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 1%, with a marginal effect of 13.5% (excluding Canada does not change the results).

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. 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. However, for Western Hemisphere economies we find that our systemic impact 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 plot procedure, the top 13.3% order statistics, which we then use to construct our systemic impact variable. Theoretically, 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 underestimation 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: First, 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 insignificance 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 financial openness in terms of currency crises. Throughout the paper we have also argued that "cross-market rebalancing" is an important source of joint crises, where 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 between different economies during periods of extreme values. Accordingly, we derived the conditional probability of joint failure (CPJF), which is an informative measure of "tail-dependence".

By employing monthly data for 23 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 only find tail independence. Furthermore, the degree of within region dependency can be ranked: African economies show the most tail-dependence, followed by Asia. Interestingly, we find that the Western Hemisphere economies are the most tail-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 weaker but still significant. 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 to find out whether integration into world (capital) markets increases financial instability. By taking systemic impact into account we observe that *de facto* financial openness helps to reduce the occurrence of currency crises. In order to clarify further the pros and cons of financial openness, we decomposed it into the different types of capital inflows. This decomposition shows that African and Western Hemisphere economies benefit from "persistent" FDI inflows; while 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 lower inflation, improvements in the government budget balance, and higher levels of international reserves, benefit these economies by helping reduce the probability of a currency crisis. We also controlled for the onset of banking crises, and our results indicate 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 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 a proper instrument for evaluating the systemic impact of financial crises.

In the introduction to this 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 financial crises and helps to improve our understanding of this effect. Furthermore, our systemic impact variable, which is based on the CPJF, provides a more informative measure for the systemic impact of crises to a specific country; (*ii*) systemic risk does exist, but only from (regional) neighbors; (*iii*) by taking into account the systemic impact of crises, *de facto* financial openness 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. Second, there is a need for governments to undertake transparent monetary and fiscal policies in order to reduce information asymmetry, especially in relation to the private sector, and help the latter form expectations that are closer to those of the monetary and fiscal authorities. Third, using a one-size-fits-all approach to capital account management is not advisable, since the effects of different types of capital vary by region. We have shown that all capital is not created equal, and that the effects vary by region. If capital controls are to be used, they should be targeted at short-term capital, while at the same time allowing medium to long-term capital into an economy. This approach will, at the very least, help reduce economic imbalances. Fourth, the results indicate that countries must pursue monetary policy aiming at "price stability" through, for example, a flexible inflation target that takes into account systemic risk, 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 and Data Description

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		

Data Sources and Variables

- Period-average exchange rate: Local Currency Unit per US dollar (IFS line rf)
- Short-term interest rate is the money market rate (IFS line 60r) if available, otherwise the discount rate (IFS line 60). For India we use the call money rate (IFS line60b), 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) supplemented with the 3-month deposit rate (IFS line60l).
- 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)
- Overall Budget Balance in US dollars (IFS line 78CBD)
- Financial Assets (IFS line11) in national currency
- Financial Liabilities (IFS line16c) in national currency
- Merchandise Exports (IFS line70) & Imports (IFS line71); both in US dollars
- FDI Inflows (IFS line78BED)
- Portfolio Inflows (IFS line 78BGD)
- Debt Inflows (IFS line 78BID)

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 B - 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 C - 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 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 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 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 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 D - 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