Number 00-9

On Currency Crises and Contagion

Marcel Fratzscher

- December 2000 -

ON CURRENCY CRISES AND CONTAGION

Marcel Fratzscher
Visiting Fellow

This paper analyzes the role of contagion in the currency crises in emerging markets during the 1990s. It employs a non-linear Markov-switching model to conduct a systematic comparison and evaluation of three distinct causes of currency crises: contagion, weak economic fundamentals, and sunspots, i.e. unobservable shifts in agents' beliefs. Testing this model empirically through Markov-switching and panel data models reveals that contagion--a high degree of real integration and financial interdependence among countries--is a core explanation for recent emerging market crises. The model has a remarkably good predictive power for the 1997-98 Asian crisis. The findings suggest that in particular the degree of financial interdependence and also real integration among emerging markets are crucial not only in explaining past crises but also in predicting the transmission of future financial crises.

The author would like to thank Michael Artis, Roger Farmer, Philipp Hartmann, Gary Hufbauer, Søren Johansen, Ramon Marimon, Grayham Mizon, John Williamson as well as the participants of the 12th World Congress of the International Economic Association, the Royal Economic Society 2000 conference and seminars at the European Central Bank, the European University Institute and the Institute for International Economics for helpful comments on earlier versions of the paper.

INTRODUCTION

Many economists have started to concede in recent years that contagion and self-fulfilling beliefs of investors have played a crucial role in the emerging market financial crises of the 1990s.[1] Despite the progress on the theoretical side, however, empirical models of currency crises have been shown to perform poorly (Berg and Pattillo 1998) and many economists and policy institutions have been struggling to develop adequate models to predict future financial crises (Kaminsky et al. 1997, Goldstein et al. 2000).

Much of the empirical literature on financial crises, however, still focuses on country-specific macroeconomic factors and has ignored or at least underestimated the importance of contagion--the possibility that the origin of a crisis may lie in the occurrence of a crisis elsewhere in the world rather than with weak domestic fundamentals. As a consequence, economists still lack the answer as to why many crises of the 1990s clustered within regions and affected a broad range of countries almost simultaneously. In other words, the question that remains is how and why crises occurring in different economies are linked and interdependent.

The aim of this paper is to help find an answer to this question. The use of a non-linear Markov-switching model, based on the seminal work by Hamilton (1989, 1990), is suggested in order to enable a systematic comparison of three competing explanations for financial crises: weak economic fundamentals, sunspots--exogenous shifts in agents' beliefs--and contagion. Contagion in this paper is defined as the transmission of a crisis that is not *caused* by the affected country's fundamentals (although, of course, the transmission has an impact on the country's fundamentals ex post) but by its "proximity" to the country where a crisis occurred.

The paper suggests and develops a new methodology to measure three types of "proximity", or channels of contagion. The first one measures the real interdependence among economies through trade competition. A second one analyzes to what extent countries are competing for bank lending in third markets. And the third channel measures the degree of stock market integration across countries.

The paper then conducts three complementary tests on the relative importance of fundamentals, contagion and sunspots. First, the use of Markov-switching models reveals that country-specific

[1] For instance, Krugman (1999, 8-9) admits: "[T]he power of contagion in the last two years settles a long-running dispute about currency crises in general: the dispute between 'fundamentalists' and 'self-fulfillers'. ... I hereby capitulate. I cannot see any way to make sense of the contagion of 1997-98 without supposing the existence of multiple equilibria, with countries vulnerable to self-validating collapses in confidence, collapses that could be set off by events in faraway economies that **somehow** served as a trigger for self-fulfilling pessimism." (bold added). The collection of papers in Agenor, Miller, Vines and Weber (eds., 1999) provides a compelling overview of the controversies surrounding financial crisis.

fundamentals generally fail to explain the timing as well as the severity of financial crisis in individual countries. Including contagion in the model, however, improves the explanatory power of the model significantly in most cases and even eliminates the need for regime shifts in the Markov-switching framework for some countries. Second, a panel data analysis confirms the robustness of these results for a sample of 24 open emerging markets. The results suggest that the Latin American crisis in 1994-95 and the Asian crisis of 1997 spread across emerging markets not primarily due to the weakness of those countries' fundamentals but rather to a high degree of financial interdependence among affected economies. Third, the model's ability to predict the Asian crisis is tested. It is shown that taking contagion factors into account would have permitted quite an accurate prediction of countries to which the crisis spread. Overall, these results emphasize that only if we take into account the systemic character of financial crises will we be able to improve our understanding and better predict the occurrence of future crises.

The paper starts by briefly reviewing the literature on contagion. It then develops the Markov-switching model and discusses its underlying assumptions. Data definitions and the contagion methodology are then outlined. The empirical results for the Markov-switching and panel data models follow. Finally, the paper concludes by outlining some general policy implications.

RECENT LITERATURE ON CURRENCY CRISES AND CONTAGION

The question of how to define the term contagion is still a controversial one. Contagion in this paper is defined in the following way:[2]

> *Contagion is the transmission of a crisis to a particular country due to its real and financial interdependence with countries that are already experiencing a crisis.*

On the contrary, other authors, like Forbes and Rigobon (1999), adopt a narrower definition in which such interdependencies need to intensify during crises, and the increase may not be related to similarities in fundamentals across countries in order to constitute contagion. To understand and evaluate these differences in definition, one needs to analyze the different transmission channels of currency crises. They can be grouped into three categories: financial interdependence, real interdependence, and

[2] This definition follows one of the earliest papers on the issue of contagion by Calvo and Reinhart (1996), who call spillovers due to interdependence "fundamentals-based contagion" and other spillover channels, for instance through herd behavior, "true contagion".

sunspots--exogenous shifts in agents' beliefs.

Financial interdependence across countries can have at least two different causes. First, a crisis may be transmitted due to direct financial linkages--the fact that financial institutions may have large cross-border holdings. Second, indirect financial linkages, in particular the presence of a common lender and decisions by institutional investors, have received a lot of attention in recent years. A crisis in one country may induce the common lender to call loans and refuse to provide new credit, not just to those countries that have already experienced a crisis but also to other countries, thus spreading the crisis across countries (Van Rijckeghem and Weder 1999, Kaminsky and Reinhart 2000, Caramazza, Ricci and Salgado 2000).

Similarly, institutional investors may be forced to withdraw funds not only from a crisis country but also from other markets in order to raise cash for margin calls and to rebalance portfolios (Goldfajn and Valdes 1997, Calvo 1998, Kodres and Pritzker 1999). Analyzing data on country funds, Frankel and Schmukler (1998), for instance, find evidence that herding behavior and institutional factors were partly responsible for the spread of the Mexican crisis in 1994-95 to other emerging markets.

Real interdependence can either be explained through bilateral trade or through trade competition in third markets. A crisis in one country is more likely to spread to another economy if the two have a large degree of bilateral trade (income effects) or are strong competitors in third markets (price effects) because the latter economy loses competitiveness and thus can not avoid devaluation. Gerlach and Smets (1995) provide a theoretical model analyzing these links, while Eichengreen, Rose and Wyplosz (1996), Glick and Rose (1999), and Fratzscher (1998) find some empirical evidence for the importance of real linkages in spreading recent crises across markets.

Exogenous shifts in investor beliefs (or sunspots) are usually attributed to herd behavior in financial markets. Shifts in investor beliefs are exogenous in the sense that they are neither related to country-specific or common fundamentals nor to interdependencies across economies. Calvo and Mendoza (2000) show how herding can be rational as the globalization of financial markets reduces the incentive for investors to collect first-hand information and encourages them to follow common investment strategies. A related argument by Goldstein (1998) is that a crisis in one country may constitute a "wake-up call" for investors to reassess fundamentals in other countries, thus raising the degree of financial market comovements and possibly spreading the crisis across economies.

Some of the literature has defined only this third type as contagion and referred to the first two of these categories as merely interdependence or spillovers (e.g. Forbes and Rigobon 1999, Masson 1998).

However, whatever terminology one may chose to adopt, it should be emphasized that the central goal of this paper is to analyze whether the *normal* degree of real and financial interdependence across economies during tranquil periods (included in the definition of contagion in this paper) can help us understand and predict countries to which a crisis will spread and whether it can explain the crisis' severity.

EMPIRICAL METHODOLOGY: LINEAR INFECTION FUNCTIONS AND NON-LINEAR MARKOV-SWITCHING VAR MODELS

Infection Function: Fundamentals versus Contagion

The most commonly used empirical model in the literature is to pin down the role of country-specific economic fundamentals in causing currency crises by using a linear function of the form

$$y_{i,t} = \alpha_i + \beta_X ' x_{t-1} + u_{i,t} \tag{1}$$

with $y_{i,t}$ as a measure of currency crises in country i, x_{t-1} a vector of fundamentals and β_X as the vector of coefficients. Economists have been trying hard to test an ever wider range of fundamentals and to raise the number of crises under consideration in order to increase the explanatory power of their models. However, as Berg and Pattillo (1998) show convincingly, the explanatory power and in particular the predictive power of such models have remained small.

One reason for the poor performance of fundamentals-based models is that fundamental causes of currency crises may differ sharply across countries and across crises episodes, thus making it extremely difficult, if not impossible, to find a single set of fundamentals underlying all crises. However, fundamentals-based models have tended to ignore one important element that has been common to many financial crises of the 1990s: the almost simultaneous occurrence of crises in various countries. What this suggests is that recent crises may contain a strong systemic element in that they may have been transmitted due to the countries' financial and real interdependence rather than their economic fundamentals. To formalize this hypothesis, the following linear *infection function* is defined

$$y_{i,t} = \alpha_i + \beta_X ' x_{t-1} + \beta_R ' \sum_{j \neq i} \left(y_{j,t-1} \times REAL_{ij} \right) + \beta_F ' \sum_{j \neq i} \left(y_{j,t-1} \times FIN_{ij} \right) + u_{i,t} \tag{2}$$

with $y_{j,t}$ measuring the severity of a crisis in country *j* and $REAL_{ij}$ and FIN_{ij} indicating the degree of real and financial interdependence between economies *i* and *j*. Thus, this *infection function* allows for two sources of a crisis: weak economic fundamentals x_{t-1} and contagion.

The important feature of this *infection function* is that it allows exchange market movements y_j in *all* countries *j* to influence the pressure on the home currency y_i. The extent to which the home economy *i* is affected by exchange market movements or crises in other countries *j* depends on its degree of real integration ($REAL_{ij}$) and financial interdependence (FIN_{ij}) with these economies. It should be emphasized that both integration parameters are time-invariant and are measured during tranquil periods in order to account for the possibility that integration may intensify during crisis periods, i.e. in order to ensure that the integration variables are exogenous in the model.

Unlike many other papers on contagion, the *infection function* of equation (2) explicitly incorporates *cascading effects*, i.e. the possibility that shocks may be transmitted not only from a single country where a crisis originated, but also from other countries that were affected subsequently. Given the systemic nature of many currency crises of the 1990s, such as in the ERM in 1992-93, in Latin America in 1994-95, in Asia in 1997-98 and through Russia in 1998, it seems imperative to explicitly allow and test for such *cascading effects*.

Markov-switching VAR Methodology

It is crucial to emphasize that finding statistically significant coefficients from models (1) or (2) does not necessarily imply that these models provide a satisfactory explanation of crises. Indeed the fit of a model with fundamentals and contagion may still be poor despite finding some significant coefficients. An important shortcoming of the linear infection function of equation (2) is that it ignores the possibility that changes in expectations and private sector beliefs, which are explained neither by fundamentals nor by contagion, may also be the cause of a crisis or at least exacerbate it (Calvo and Mendoza 2000, Goldstein 1998). It is extremely difficult, however, to develop a proper empirical test for the role of changes in investors' expectations because determinants of these changes (such as herd behavior, fund managers' incentives or beliefs about future fundamentals) tend to be unobservable.

Due to the unobservable nature of changes in expectations (or sunspots), I employ a non-linear Markov-switching VAR (MS-VAR). The MS-VAR model used here is based on the one first developed by Hamilton (1989, 1990) for the analysis of US business cycles.[3] The basic rationale for using an MS-

[3] See also Kim and Nelson (1998), Krolzig (1997), and Diebold, Lee and Weinbach (1994) for a thorough theoretical discussion of Markov-switching VAR models and different empirical applications.

VAR methodology for the analysis of currency crises is that it allows a comparison of the role of observables (fundamentals and contagion variables) with the importance of unobservable factors (sunspots). If unobservable factors in the model are dominant, then the observable factors in the model are not very useful in explaining crises. If, however, the MS-VAR model shows that observable variables are more important than unobservables by eliminating regime shifts due to unobservables, then the model may be a good one in explaining and anticipating currency crises.[4]

The starting point for the MS-VAR model is the observation that the parameters Ω of a VAR process may not be time-invariant, as assumed by standard OLS models, but that they vary over time. More precisely, the MS-VAR model makes a very specific assumption about the behavior of the parameters Ω of the system: Ω are time-invariant as long as a particular regime prevails but they change once the regime changes. With M as the discrete and finite number of feasible regimes s_t, the conditional probability density of a vector y_t can be written as

$$p(y_t | Y_{t-1}, s_t) = \begin{cases} f(y_t | Y_{t-1}, \Omega_1) & if \quad s_t = 1 \\ \vdots & \\ f(y_t | Y_{t-1}, \Omega_M) & if \quad s_t = M \end{cases} \tag{3}$$

where Y_{t-1} is the set of past observations of the vector y_t, Ω_m is the VAR parameter vector for regime $m=1...M$, and $f(.)$ describes the density function of the normal distribution.

The question that arises now is what constitutes the *regime-generating process*, i.e. what determines which regime s_t prevails at any one point in time. If the timing of switches across regimes were observable, one could easily solve this problem by using indicator functions and appropriate dummies to condition the system. However, for the analysis of exchange rates it is not clear *when* and *whether* regime switches occur. In other words, in the framework of equation (2) it is not clear whether movements in the exchange rate (the dependent variable) are due to changes in observables (contagion and fundamentals) or due to unobservables (sunspots).

Therefore, the regime-generating process is assumed to follow an unobservable Markov chain with transition probability p_{kl} of the form

[4] The use of Markov-switching regimes models to analyze foreign exchange markets is still rather new. Martinez-Peria (1998), Gomez-Puig and Montalvo (1997) and Engel and Hakkio (1994) estimate a Markov-switching model for ERM currencies. Jeanne (1997) and Jeanne and Masson (2000) find that a Markov-switching model with two regimes performs better for the French franc in 1987-93 than a linear OLS estimation.

$$\Pr\left(s_t = k \middle| s_{t-1} = l, s_{t-2} = n, \ldots\right) = \Pr\left(s_t = k \middle| s_{t-1} = l\right) = p_{kl} \tag{4}$$

$$\sum_{k=1}^{M} p_{kl} = 1 \quad \forall k, l, n \in \{1, \ldots, M\}$$

where p_{kl} is the probability of being in regime k in period t if the regime l prevailed in period $t\text{-}1$. The Markovian chain of equation (4) therefore states that the probability of being in state k in period t is solely dependent on which regime prevailed in the previous period $t\text{-}1$. Accordingly, the Markovian transition matrix P can be written as

$$P = \begin{bmatrix} p_{11} & \cdots & p_{1l} & \cdots & p_{1M} \\ \vdots & \ddots & & & \vdots \\ p_{k1} & & p_{kl} & & p_{kM} \\ \vdots & & & \ddots & \vdots \\ p_{M1} & \cdots & p_{Ml} & \cdots & p_{MM} \end{bmatrix} \tag{5}$$

so that every row describes a different state k in period t and each column stands for a different regime l in $t\text{-}1$. An important further condition for the Markov chain to describe the regime-generating process is that there is no absorbing state, i.e. there is no p_{kl} s.t. $p_{kl} = 1$.

So far, the assumptions underlying the *regime-generating process* of the system have been described. We now need to specify the assumptions underlying the *data-generating process* of the VAR process. In its most general form the VAR process of order p [*MS(M)-VAR(p)*] for any given regime s_t can be written in state-space form as

$$y_t = v(s_t) + A_1(s_t) y_{t-1} + \ldots + A_p(s_t) y_{t-p} + \Sigma(s_t) u_t \tag{6}$$

or equivalently

$$y_t = \begin{cases} v_1 + A_{11} y_{t-1} + \ldots + A_{p1} y_{t-p} + \Sigma_1^{1/2} u_t & if \quad s_t = 1 \\ \vdots & \\ v_M + A_{1M} y_{t-1} + \ldots + A_{pM} y_{t-p} + \Sigma_M^{1/2} u_t & if \quad s_t = M \end{cases} \tag{7}$$

with $u_t \sim NID\ (0,I_K)$.

As the *MS(M)-VAR(p)* model of equations (6) and (7) illustrates, exogenous regime switches can have four separate origins: changes in the intercept v, in the autoregressive coefficients A, in the mean, and in the error variance Σ (heteroskedastic errors). For empirical applications, it is often useful to allow only for some of the parameters of the model to be conditioned on the state of the Markov chain while other parameters are regime-invariant. Due to the restricted number of time-series observations and thus the limited degrees of freedom, I model exogenous shifts in beliefs as switching intercepts v_i and changes in the error variance Σ.[5]

Extending equation (6) in order to also include a set of exogenous fundamentals and contagion variables in the spirit of the infection function of equation (2), the state-space form of the Markov-switching model of order $p=1$ for country i becomes:

$$\begin{aligned} y_{i,t} \quad = \quad & v_i(s_t) + \beta_R' \sum_j \left(y_{j,t-1} \times REAL_{ij} \right) + \beta_F' \sum_j \left(y_{j,t-1} \times FIN_{ij} \right) \\ & + \beta_X' x_{t-1} + \Sigma_i^{1/2}(s_t) u_{i,t} \end{aligned} \tag{8}$$

where s_t indicates the state in period t, and $u_{i,t} \sim NID\ (0,I_K)$. The reformulation of the linear infection function of (2) as a non-linear Markov-switching model of (8) therefore enables us now to distinguish between and empirically test for three causes of currency crises: weak fundamentals, contagion, and sunspots.[6] Equation (8) is the benchmark equation to be used in the empirical analysis in the remainder of the paper.

---

[5] See Krolzig (1997, 1998) for a thorough discussion of the specifications of alternative types of regime shifts.

[6] It should be noted that one important model assumption is that regime switches reflect changes in expectations that are unrelated to fundamentals or contagion. In other words, sunspots solely reflect unobservable factors. A potential problem with this assumption is that in reality, of course, sunspots may reflect unobservable fundamentals or contagion factors. The empirical investigation of these and other issues will be addressed below.

Building on the methodology developed by Krolzig (1998), the Markov-switching model is implemented empirically by applying the expectation maximization (EM) algorithm, programmed in Ox. With this, maximum likelihood estimates for the regime-switching models can be obtained.

DATA AND DEFINITIONS: CURRENCY CRISES AND CONTAGION

Since the central objective of this paper is to analyze the question whether contagion has played a role in the recent emerging market crises, the focus of the empirical analysis is exclusively on 24 *open* emerging markets, as defined by the IFC plus some transition economies, for the period 1986 to 1998.[7] The reason for choosing this sample and time period is that contagion and crises can affect countries only where capital flows are relatively free and markets are relatively open.

Definition of Currency Crises

The two most commonly used measures of currency crisis $y_{i,t}$ have been based on a binary definition in which a currency crisis is defined only if the change in the exchange rate is larger than two or three standard deviations in a particular period (e.g. Frankel and Rose 1996) or have been defined as continuous exchange market pressure (*EMP*), which is a weighted average of the changes in the exchange rate *e*, the interest rate *i,* and the foreign exchange reserves *R*:

$$EMP_t = \eta(\Delta e_{i,t}) + \varphi(\Delta(i_{i,t} - i_{US,t})) - \psi(\Delta R_{i,t}) \qquad (9)$$

with i and i_{US} as the domestic and US interest rates, respectively, Δ as the change of a variable, and η, φ, ψ as weights.[8]

The intuition for using this measure is that when facing pressure on its currency, a government has the option of either devaluing the currency, raising interest rates and/or running down reserves. Hence *EMP* is a fairly good proxy for the strength of the pressure against the currency regime. Importantly, it also captures speculative attack episodes that fail to cause a devaluation. Since the aim of this paper is to understand not only the timing of a crisis but also its severity, this continuous definition will be used in the estimations below.

[7] See the appendix for a list of the 24 countries, data sources and also for the definitions of included fundamentals.

[8] Each of the three measures is weighted by its relative precisions, calculated as the inverse of the series' standard deviation in the past. It has been employed in various studies of currency crises, including Eichengreen, Rose and Wyplosz (1996) and Sachs, Tornell and Velasco (1996).

Defining Real Integration Contagion

Attempts to measure real transmission channels for financial crises have been undertaken by Glick and Rose (1999), Caramazza, Ricci and Salgado (2000) and Fratzscher (1998). These papers find some evidence that trade linkages may have played a role in recent financial crises, although the first two papers ignore cascading effects, differences in size of countries' exports as well as the composition of trade. The measure used here builds on Fratzscher (1998) and attempts to account for these difficulties.

The basic idea to be captured through a measure of real interdependence is that a crisis is more likely to spread to a country that is competing and trading strongly with countries that have been experiencing a crisis. Therefore, the importance of country *j* as a trade competitor for the home economy *i* is measured as

$$REAL_{ij} = \sum_{c} \sum_{d} \left(\frac{X^{c}_{jd}}{X^{c}_{\cdot d}} \times \frac{X^{c}_{id}}{X_{i\cdot}} \right) + \sum_{c} \left(\frac{X^{c}_{ij} + X^{c}_{ji}}{X^{c}_{\cdot i} + X^{c}_{i\cdot}} \right) \tag{10}$$

The first term indicates the degree of competition of country *j* for the home economy *i* in the export market of commodity *c* (X^c) in the third market *d*. The intuition for this measure is that country *j* is a stronger competitor for country *i* (a) the larger the export market share of country *j* in region *d* $\left(X^{c}_{jd} / X^{c}_{\cdot d}\right)$, and (b) the higher the share for country *i* of total exports of that commodity *c* to region *d* ($X^{c}_{id} / X_{i\cdot}$). The second term measures the degree of bilateral trade between the two countries, implying that country *i* will be affected more by a devaluation in country *j* the greater the amount of bilateral trade between them.

The source of the trade data is the *World Trade Analyzer*, which measures commodities at the 3-digit SITC level and excludes agriculture and natural resources. Table 1 shows that the degree of real integration is particularly high for economies of the same region. Due to the large economic size and trade volume, Southeast and East Asian countries are the strongest competitors outside their own region, although the degree of competition with these economies is mostly much smaller than with those within the same region. The degree of trade competition proved robust to the choice of weights between bilateral and third market trade. Due to the small size of bilateral trade, excluding it from the measure did not alter the results significantly.

Table 1: Real Integration of Regions

$REAL_{ij}$ country i: / country j:	Average Real Integration: L. America	Asia	SE&E Asia	S Asia	Others
Latin America	0.357	0.078	0.099	0.013	0.044
Asia:	0.038	0.400	0.499	0.103	0.049
Southeast & East Asia	0.042	0.413	0.537	0.039	0.041
South Asia	0.026	0.360	0.382	0.294	0.073
Others	0.037	0.132	0.165	0.034	0.225

Note: Real Integration for 1996, scaled to lie between 0 and 1.
Others: Eastern Europe, Middle East, Africa.

Defining Financial Integration Contagion

How to measure financial integration contagion is a more difficult and controversial matter. The issue I am interested in here for the purpose of measuring contagion in the financial sector is how an investment decision (bank lending and portfolio flows) in one emerging market affects investment decisions in other emerging markets, i.e. to what extent underlying asset prices and investment decisions are interdependent. As discussed above, the literature has emphasized two separate channels through which a crisis may be spread through the financial sector across markets: by the refusal of banks to roll over loans or provide new funds, and by the decision of investors to withdraw portfolio investments. To capture this distinction, this section therefore develops two measures of financial integration: one measuring the competition for bank funds across countries, and the other being based on the correlation of asset returns in equity markets.

Bank Contagion

Van Rijckeghem and Weder (1999), Kaminsky and Reinhart (2000), and Caramazza, Ricci and Salgado (2000) argue that a crisis is more likely to spread across economies that have the same common lender. Rather than using a common lender dummy, which is more common in the literature, Van Rijckeghem and Weder (1999) create a continuous variable that indicates how strongly a country competes for bank funds with the country where a crisis originated. Their measure, however, uses the same methodology of the trade measure by Glick and Rose (1999), and therefore shares the difficulty of ignoring cascading effects and differences in the size of bank lending. To avoid these difficulties, a methodology similar to equation (10) above is used:

$$BANKCOMP_{ij} = \sum_{d} \left(\frac{F_{dj}}{F_{d\cdot}} \times \frac{F_{di}}{F_{\cdot i}} \right) \tag{11}$$

where F_{di} indicates the flow of bank loans from lender country d to borrower i. The argument is analogous to the measure of trade competition above: (a) the higher the share of bank loans received from country d is for country i, and (b) the larger the share of total bank loans (to emerging markets) that go from d to country j, the more likely will a crisis be transmitted from country j to country i through lender d. The explanation is that the more funds a lender d lends to a single country j, the more likely will it be that if country j experiences a crisis d will be forced to withdraw funds or refuse to roll over debt also to other economies i. The more heavily country i has borrowed from d, the more strongly will a recall of funds by d affect i. The data source is the BIS, and includes bank lending from 18 of the main developed countries d.

Table 2: Competition for Bank Loans

$BANKCOMP_{ij}$	**Average Competition for Bank Loans**				
country i: / country j:	L. America	Asia	SE&E Asia	S Asia	Others
Latin America	0.478	0.307	0.423	0.076	0.230
Asia:	0.267	0.496	0.698	0.094	0.221
Southeast & East Asia	0.259	0.541	0.765	0.095	0.213
South Asia	0.282	0.406	0.564	0.091	0.236
Others	0.304	0.388	0.534	0.096	0.397

Note: Measure for 1997, scaled to lie between 0 and 1.
Others: Eastern Europe, Middle East, Africa.

Table 2 shows the strong regional focus of competition for bank lending and confirms Southeast Asia as the dominant emerging market region that absorbs a large share of total bank lending to emerging markets. Finally, it should be noted that $BANKCOMP_{ij}$ is an *indirect* measure of financial linkages, because it analyzes how a crisis in country *j* may spread to country *i through* decisions made by lenders in country or region *d*. Data for a *direct* measure of financial linkages, such as bilateral bank lending, is hard to obtain for emerging markets, but it is also unlikely to have played a major role as most of the funding for emerging markets comes from a few developed countries.

Equity Market Contagion

Many emerging markets are not only dependent on bank funds but also on portfolio capital inflows to finance their demand for foreign exchange. To measure the extent to which the similarity in the dependence on portfolio flows may have worked as a contagion channel for recent financial crises, I will employ correlation measures of stock market returns as indicators for the degree of financial market integration. The underlying hypothesis is that the higher the degree of financial market integration between two emerging markets, the more likely a financial crisis will spread from one to the other.

Using correlations of stock market returns is certainly not the ideal way and but is an indirect way of measuring financial integration related to portfolio flows. Including data on direct portfolio flows would improve the quality of a measure of financial interdependence but are unfortunately not available for a broader set of countries and for a longer period of time. Nevertheless, using correlations of asset returns should provide a good first proxy for such financial interdependence. It also has the advantage of including factors of interdependence that are not directly observable through portfolio flow data.

As a first measure, I use the monthly averages of the correlation of weekly stock market returns across emerging markets.[9] Since a high correlation of returns may be partly explained by similarities in fundamentals or by the exposure to common external shocks in developed markets, I control for these factors by regressing the country return index r_i on country-specific fundamentals as well as on weighted returns of the S&P 500, FTSE 100 and NIKKEI (*GRET*):

$$r_{i,t} = \beta_1 + \beta_2 TB_{i,t} + \beta_3 i_{i,t} + \beta_4 P_{i,t} + \beta_5 S_{i,t} + \beta_6 GRET_t + \mu_{i,t} \qquad (12)$$

[9] Baig and Goldfajn (1998) also look at cross-country correlations of exchange rates, interest rates and sovereign risk spreads during the Asian crisis. None of these three measures is appropriate in the context of this paper because the first two were a policy tool under managed exchange rates prior to the crisis and sovereign risk spreads reflect the market perception of the default risk rather than the interdependence of financial markets.

with the independent variables as the trade balance (*TB*), the change in a country's interest rate (*i*), the rate of inflation (*P*) and the spot exchange rate (*S*) for each country *i*. The second measure of financial interdependence then is the correlation of the residual μ, which should give a reasonably good idea about the true interdependence of various emerging stock markets:[10]

$$FINCORR1_{ij} = CORREL(r_{i,t}, r_{j,t}) \tag{13}$$

$$FINCORR2_{ij} = CORREL(\mu_{i,t}, \mu_{j,t}) \tag{14}$$

Table 3: Financial Interdependence of Regions

	Avg. Return Residual Correlations: $FINCORR1_{ij}$					Avg. Return Correlations: $FINCORR2_{ij}$				
	L. America	Asia	SE&E Asia	S Asia	Others	L. America	Asia	SE&E Asia	S Asia	Others
Latin America	0.301					0.349				
Asia:	0.147	0.294				0.159	0.165			
Southeast & East Asia	0.131	0.361	0.572			0.179	0.199	0.312		
South Asia	0.173	0.183	0.119	0.472		0.124	0.107	0.122	0.264	
Others	0.187	0.100	0.139	0.035	0.233	0.066	0.095	0.100	0.086	0.198

Note: Correlations are for the period of 1992/Q1-1996/Q4.
Others: Eastern Europe, Middle East, Africa.

Again note that the measures of integration are time-invariant and measured during tranquil periods in order to ensure that the integration variables are exogenous in the model. Table 3 confirms that financial market interdependence is significantly higher among regional markets. Two results, however, stand out from Table 3: first, controlling for global and country-specific factors often raises the degree of financial interdependence; and second, the residual correlations are particularly high among Southeast and East Asian markets. This suggests that financial integration contagion is stronger both within regions and particularly in Southeast and East Asia.

[10] Wolf (1998) shows that another potential bias, apart from similarities in fundamentals, may result from the similarity of the sectoral composition of countries' stock market indices, i.e., if the sectoral composition of two indices is similar, then it is possible that comovements of these indices are caused by changes in one particular sector which in turn may be due to global developments. However, Wolf finds that the correlation of returns in many cases is higher after controlling for such similarities, thus confirming the importance of contagion.

Evaluating and Comparing Different Sources of Contagion

Tables 1-3 above show the degree of integration and interdependence across regions while Table 4 below ranks the three contagion variables in ten countries. Mexico and Thailand (i.e. the countries that were the first victims of the Latin American crisis in 1994-95 and the Asian one in 1997) were the strongest real competitors and had the highest degree of financial integration. Comparing the three different contagion variables yields a number of important results.[11]

First, integration and interdependence have a very strong regional character, with countries of the same region being much more integrated and competing more strongly with each other than countries of different regions. Second, Southeast and East Asian countries tend to be the dominant emerging markets. The reason for this dominance is the larger relative size of these economies, and the greater degree of openness (both real and financial) of the economies of that region.

Table 4: Comparison of Most Integrated Countries with Mexico and with Thailand

	with MEXICO			with THAILAND		
ranking	$REAL_{ij}$	$BANKCOMP_{ij}$	$FINCORR2_{ij}$	$REAL_{ij}$	$BANKCOMP_{ij}$	$FINCORR2_{ij}$
1	Venezuela	Peru	Argentina	Pakistan	Indonesia	Malaysia
2	Chile	Colombia	Colombia	China	Malaysia	Philippines
3	Colombia	Venezuela	Chile	Mexico	China	Mexico
4	Brazil	Argentina	Malaysia	Malaysia	India	Indonesia
5	Korea	Chile	Brazil	Sri Lanka	Korea	Korea
6	Thailand	Bolivia	Venezuela	Philippines	Hungary	South Africa
7	Peru	Brazil	Philippines	Indonesia	Philippines	Chile
8	Pakistan	Philippines	Korea	India	Czech Republic	Argentina
9	Argentina	South Africa	Indonesia	Korea	South Africa	Brazil
10	Malaysia	Poland	Pakistan	Poland	Pakistan	India

Note: REAL is defined in equation (10), BANKCOMP in equation (11), FINCORR2 in equation (14). Mexico and Thailand are country j in each of the equations, therefore the table indicates which countries are the most likely victims based on the strength of the contagion measures.

Third, Table 4 ranks the countries by integration with Mexico and Thailand. The results are mostly intuitive and confirm that both Mexico and Thailand tend to be more integrated with countries of the same region. However, it is striking that the three countries with the strongest degree of *real* competition with Thailand and with Mexico were countries that escaped the crises relatively unscathed.

[11] One potential problem that could constitute a bias in an econometric analysis is the possibility that the different contagion variables may be highly correlated, if they are picking up similar elements of integration. However, Table 5 (see appendix) shows that the correlation of the contagion variables is low (except for the two stock market correlation measures), thus there should be no significant bias due to multicollinearity stemming from contagion.

This provides a first indication that real integration contagion may not provide a very good explanation or at least not be the sole explanation for the dynamics of the two financial crises of 1994-95 and 1997.

In contrast, the rankings for the two *financial* contagion variables correspond much more closely with the list of countries that became the main victims of either the Latin American crisis or the Asian crisis, thus suggesting that the crises were more likely to have spread through financial interdependence. For instance, South Asian markets have a low degree of financial interdependence with Southeast and East Asia (Table 3) despite having a relatively high degree of real integration with that region (Table 1). Thus the lack of their financial market integration and financial openness may offer an explanation as to why contagion did not hit South Asia during the 1997-98 Asian financial crisis.

EMPIRICAL RESULTS: EXPLAINING CURRENCY CRISES

To distinguish empirically between the role of contagion and the importance of country-specific fundamentals and sunspots, a three-pronged testing strategy is followed. First, the univariate Markov-switching model of equation (8) is employed below to analyze the extent to which exchange rate movements in emerging markets in the 1990s are explained by contagion versus by fundamentals and sunspots. Second, a panel data analysis then investigates how robust these results are for a broad sample of 24 emerging markets. And third, the predictive power of the model is tested.

Contagion Versus Fundamentals in a Univariate Markov-switching Framework

To obtain information about the relative importance of contagion, I proceed in two steps. In the first step, I exclude contagion from the analysis and compare the linear model of equation (2) with the non-linear Markov-switching model of equation (8). The idea is that if fundamentals are of key importance in explaining exchange market movements and currency crises, then its coefficients should be significant and there should be no need for regime shifts that are independent of fundamentals. In the second step, the contagion variables are also included to check whether the inclusion of contagion improves the explanatory power of the model and helps explain the occurrence of currency crises.

Starting with the first step, fundamentals perform modestly in explaining the exchange rate dynamics of most emerging markets in the 1990s, in particular when large jumps in exchange rates occur (see Figure 1(a), and regressions 2 of Table 6 in the appendix). On the contrary, the Markov-switching model with two or three regimes performs well for most countries if the contagion variables are not included (see Figure 1(b) and regressions 2 of Table 6).

This finding is intuitively convincing because when looking at the data on exchange market pressure, one can detect three regimes for most countries: a tranquil one where the exchange market pressure is around zero; a second one where there is a high degree of exchange market pressure and low credibility as during times of speculative attacks and crises; and a third one where there is a negative exchange market pressure, i.e. a currency appreciates, interest rate differentials fall and reserves rise, which often occurs immediately after devaluations.

Turning to the second step, when including contagion, the coefficients for financial contagion--and sometimes also for real contagion--are mostly large and significant and the fit of the model is improved, indicated by the drop in the variances and log-likelihoods (regressions 3 and 4, Table 6). More importantly, the inclusion of contagion often eliminates the existence of regime shifts, which can be seen from the fact that the linear model (regressions 3) performs as well as the non-linear Markov-switching model (regressions 4) for a number of countries. This suggests that contagion in many cases explains regime shifts that cannot be accounted for by fundamentals.

This finding that regime shifts are eliminated when contagion is included, i.e. the fact that the linear model of equation (2) performs about as well as the non-linear Markov-switching model of (8), is a crucial one. It is crucial because it indicates that the factors that explain currency crises, i.e. the regime shifts, are not unobservable but in many cases are captured through the inclusion of contagion variables. On the contrary, in cases where regime shifts persist, one cannot make any meaningful inference about the cause of a crisis because the regime shift in the Markov-switching model is unobservable, i.e. one has no information about which unobservable factors (e.g. expectations about future fundamentals or elements of contagion not included in the model) have caused the crisis.

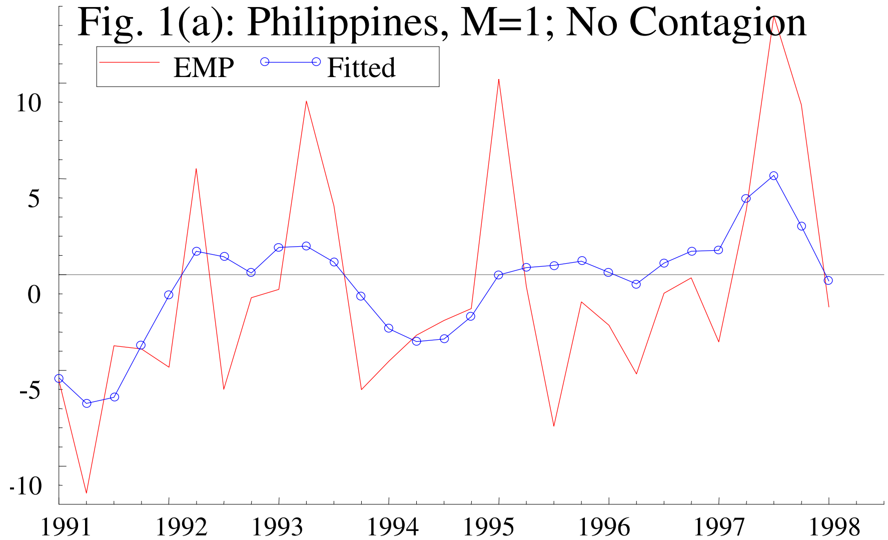

Fig. 1(a): Philippines, M=1; No Contagion

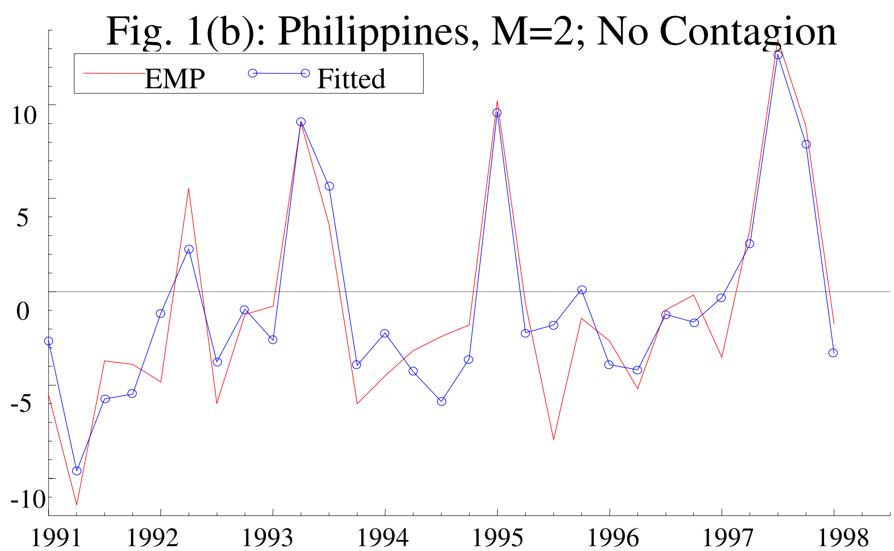

Fig. 1(b): Philippines, M=2; No Contagion

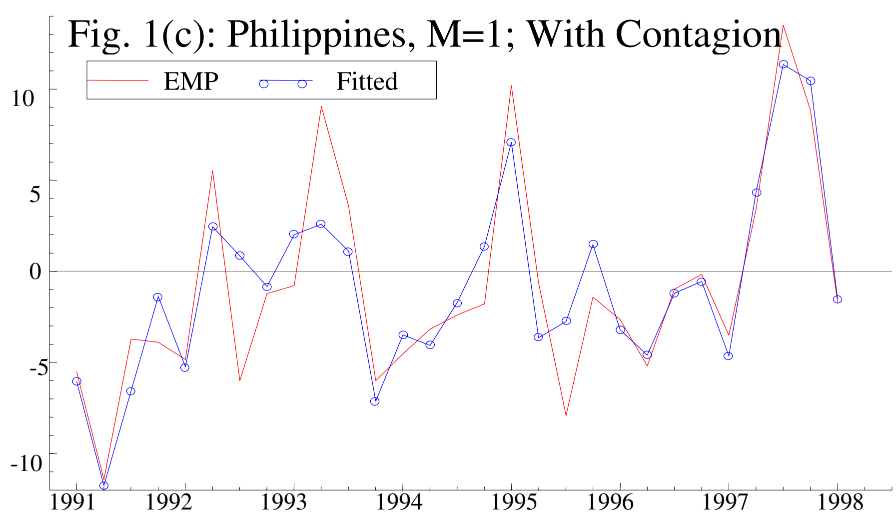

Fig. 1(c): Philippines, M=1; With Contagion

The case of the Philippines provides a good example: a Markov-switching model with two regimes and no contagion (Fig. 1(b)) performs much better than the linear model (Fig. 1(a)), with the solid line showing the actual exchange market pressure (dependent variable) and the dotted line in Fig. 1(a) indicating what is explained by fundamentals alone. The linear model with no regime change but with contagion (Fig. 1(c)), however, performs about as well and thus eliminates the need for regime shifts that are not due to changes in fundamentals. Note that contagion not only helps to explain the countries' increased exchange market pressure during the Asian crisis and Latin American crisis but also during tranquil periods. Similar conclusions apply to some other countries that were victims of either of these two crises (Korea, Indonesia, Mexico; see Table 6) while contagion does not explain regime shifts for other countries that were affected less by the crises (Chile, India).

Although there is no single economic fundamental variable that is significant in the analysis for *all* countries over time, these findings do not imply that fundamentals are worthless in explaining crises. For most countries, either the large size of foreign debt, fast domestic credit expansion ("Lending Boom") or an overvalued exchange rate is important in understanding movements in foreign exchange markets. Thus, looking at these three fundamental variables *together* should indeed improve our understanding of developments in foreign exchange markets. Nevertheless, not knowing which fundamental variable is relevant for which country and under what circumstances makes it very difficult, if not impossible, to find a common explanation for different crises and makes it even harder to predict crises reliably with fundamentals alone.

A number of robustness checks were conducted. For instance, other fundamentals than those listed in Table 6 did not prove significant, such as external variables (growth and interest rates in industrialized countries) and other domestic variables (government deficit, capital flows). It is also important to emphasize the shortcoming of the Markov-switching methodology of tending to "over-fit" the data, i.e. the model with multiple regimes has a good fit but also in some cases produces coefficient estimates that do not make sense (showing either a large change in the coefficient or the wrong sign). Otherwise the Markov-switching model appears sound from various test statistics, such as the switching probabilities p_{kl}. The Markov transition matrices confirm that the probability of remaining in a particular state is usually about 50% or higher (see Table 6). Only very few regimes are characterized by one or two events, and most regimes are reached at least three times over the time span of ten or eleven years.

Contagion Versus Fundamentals in a Panel Data Framework

The key purpose of the panel data analysis is to test whether the results for individual countries outlined above are robust across countries and whether one can detect factors that were common to the majority of countries and crisis episodes. In particular, the weakness of the analysis for individual countries is that it fails to explain why some countries with more healthy fundamentals were affected so severely while others with worse economic conditions manage to escape unscathed. This subsection presents the results for a panel data analysis with random effects based on the infection function of equation (2).[12]

The key result of the panel data estimation (Table 7) is that contagion has been a key driving force behind exchange market movements in emerging markets. The primary channel of contagion was the channel of financial sector interdependence (in particular equity market interdependence), whereas the coefficient of trade integration is smaller, though still significant. The importance of contagion is underlined when comparing the Full Model (including both fundamentals and contagion variables) with the Fundamentals Model (with only fundamentals) and the Contagion Model (with only contagion) and their log-likelihoods: the Full Model has a much better fit than the Fundamentals Model.

[12] The ordinary panel data model with random effects or with fixed effects does not explicitly allow for exogenous shifts in beliefs as the Markov-switching model does. The reason for why an MS-VAR analysis can not be conducted in this panel data context is that regime shifts across the set of 24 emerging markets are very distinct. Although comovements and common regime shifts exist for some regional groups, such as in Southeast Asia, no common regime shifts are present for countries of different regions because there are few similarities across currencies to be found within regimes. For example, a particular regime may indicate an appreciation and high volatility for some countries while at the same time showing depreciating currencies and low volatility for others.

Table 7: Panel Estimation: Random Effects Model (MLE) for 24 Emerging Markets Worldwide, 1989/Q1-1998/Q2

	Continuous Contagion						Crisis Contagion			
	FUNDAMENT. MODEL		**FULL MODEL**		**CONTAGION MODEL**		**FULL MODEL**		**CONTAGION MODEL**	
	(1)		(2)		(3)		(4)		(5)	
	Coef.	Std Err.	Coef.	Std Err.	Coef.	Std Err.	Coef.	Std Err.	Coef.	Std Err.
Capital Flows	0.045	0.046	* 0.085	0.040			* 0.067	0.036		
Short-Term Capital Flows	0.001	0.001	0.003	0.005			0.001	0.001		
Lending Boom	7.021	4.808	* 9.124	4.456			5.637	3.984		
Foreign Debt	** 10.708	3.827	** 10.468	3.732			* 7.451	3.549		
Short-Term Debt	* 4.719	2.373	* 3.150	1.628			* 4.941	1.999		
Overvaluation	** 6.225	1.941	* 5.303	1.970			* 3.388	1.722		
Reserves	-0.559	0.401	-0.531	0.386			-0.246	0.366		
Trade Balance	2.141	3.168	3.845	2.871			3.373	2.825		
Real Contagion			** 1.741	0.590	** 1.890	0.623	* 2.575	1.217	* 2.858	1.706
Equity Market Contagion			** 12.864	2.639	** 13.009	2.774	** 14.959	4.182	** 15.923	5.855
Bank Contagion			** 1.139	0.114	** 1.832	0.659	** 12.148	3.332	** 12.308	4.547
Constant	** -4.639	1.391	* -3.362	1.310	-0.401	0.288	** -4.336	1.185	-0.455	0.350
Log Likelihood	-1778		-1296		-1419		-1570		-1956	

Note: Regressions for "Crisis contagion" include contagion variables only for the crisis episodes of 1994/Q4-1995/Q2 and 1997/Q3-1997/Q4. ** and * denote statistical significance of coefficients at the 99% and 90% level, respectively.

Second, contagion seems to be of particular importance during crisis periods (the 1994-95 Latin American crisis and the 1997-98 Asian crisis) as indicated by the increase in the size of the coefficients (regressions 4, 5 in Table 7). There is a particularly strong increase in the coefficient for bank contagion during crisis episodes, suggesting that decisions by banks to withdraw funds and refuse the rollover of debt may have played a significant role in the transmission of recent emerging market crises. However, contagion variables are still relevant during tranquil periods, suggesting that exchange market movements are transmitted not only during crises.

Third, the fundamentals that are significant are the level of total and short-term foreign debt/GDP, a prior change in the ratio of domestic credit expansion to GDP ("Lending Boom"), and the overvaluation of the exchange rate. Many other variables were tested but did not show any significance (such as changes in the US dollar value vis-à-vis the mark and the yen, a country's government deficit, the current account, the trade balance).

Finally, the results are robust to changes in variable definitions and the time span but are sensitive to country groupings. To test for differences across regions, I employ an analysis of variance (ANOVA) methodology, which takes for each country *i*, analogously to equation (2), the following form:

$$y_{i,t} = \alpha_i + \gamma_i z_{i,t-1} + u_{i,t} \tag{15}$$

with z as the vector of fundamentals and contagion variables. The null hypothesis of interest is that the coefficient for an individual country (γ_i) is equal to the coefficient for the country grouping as a whole (β):

Table 8: Analysis of Variance (ANOVA) of Panel Estimation for Full Model (EMP)

	Global		Asia		Latin America		Others	
	Global Coef.	ANOVA H_0	Regional Coef.	ANOVA H_0	Regional Coef.	ANOVA H_0	Regional Coef.	ANOVA H_0
Capital Flows	* 0.085	11 / 24	0.116	4 / 9	0.041	4 / 8	0.042	3 / 7
Short-Term Capital Flows	0.003	11 / 24	0.008	4 / 9	-0.008	2 / 8	0.007	2 / 7
Lending Boom	* 9.124	13 / 24	1.107	4 / 9	* 15.71	5 / 8	5.703	3 / 7
Foreign Debt	** 10.46	13 / 24	* 14.54	5 / 9	2.573	3 / 8	* 9.873	3 / 7
Short-Term Debt	* 3.150	11 / 24	* 4.431	5 / 9	* 2.968	5 / 8	2.086	2 / 7
Overvaluation	* 5.303	10 / 24	0.717	4 / 9	* 8.851	5 / 8	* 4.517	4 / 7
Reserves	-0.531	10 / 24	-0.306	3 / 9	-0.514	4 / 8	-1.703	3 / 7
Trade Balance	3.845	9 / 24	7.143	4 / 9	-14.40	2 / 8	1.343	2 / 7
Real Contagion	** 1.741	12 / 24	* 1.971	6 / 9	1.235	4 / 8	0.597	2 / 7
Equity Market Contagion	** 12.86	14 / 24	* 14.56	7 / 9	* 8.384	6 / 8	* 11.41	4 / 7
Bank Contagion	** 1.139	15 / 24	* 1.456	7 / 9	* 1.189	6 / 8	0.938	2 / 7

Note: ANOVA shows how many of the countries' coefficients are statistically equal to their group's coefficient at the 90% significance level. The contagion variables are continuous variables as defined in the infection function of equation (2). ** and * denote statistical significance of coefficients at the 99% and 90% level, respectively.

$$H_0 : \quad \gamma_i = \beta$$

The results reveal significant differences in the size and significance for most coefficients across regional groups. On the contrary, the size of the coefficients for the contagion variables are reasonably robust within those regional groups as indicated by the acceptance of H_0 for usually more than half of the countries within the same region (Table 8). Another important finding is that financial contagion seems to have been particularly strong across Asian countries and less significant, though still positive, in Latin America. On the contrary, the overvaluation of the exchange rate was more of a driving force in Latin America than in Asia.

Overall, the results of the panel data estimation and its analysis of variance largely support and strengthen the results of the Markov-switching analysis for individual countries. In particular, while crises have diverse causes and no single fundamental variable is significant for every country and every time period, looking at the size of foreign debt, the rate of domestic credit expansion and the competitiveness of a country *together* helps in getting a good understanding of the movements in foreign exchange markets. But even after controlling for fundamentals, real integration contagion and in particular financial integration contagion still seem to have played a major role in the foreign exchange markets of many emerging markets.

EMPIRICAL RESULTS: PREDICTING CURRENCY CRISES

Empirical models of currency crises have been subject to the critique that they are often a "data-mining" exercise: they test a wide variety of fundamental variables till they find statistically significant results without knowing whether there really exists a causal relationship between the variables and the occurrence of currency crises. Berg and Pattillo (1998) confirm this critique by showing that models which are good in explaining crises *ex post* have failed to predict the 1997 Asian crisis. The models they analyze tend to predict crises in countries that were relatively unscathed and often failed to anticipate crises where they did occur.[13] Therefore, a model that fails to predict crises has very little value for policy-makers whose aim is to implement policies that prevent or at least lessen the impact of future crises.

The approach used in this paper is equally open to the data-mining critique. A wide variety of fundamentals were tested and Tables 6-8 present only those that proved significant in the estimations. The defense of this approach in this paper is twofold: first, to confirm Berg and Pattillo's finding that fundamentals alone fail to predict crises out-of-sample, and second, to analyze whether including contagion improves the predictive power of the model. The findings confirm that contagion variables are important not only in explaining but also in predicting the transmission of crises.

[13] They evaluate and compare the predictive power of three of the most cited models, each representing a different type of model: Kaminsky, Lizondo and Reinhart's (1997) signalling approach which identifies when fundamentals provide signals for potential future crises, Frankel and Rose's (1996) panel data analysis with probit techniques reaching back to the 1970s, and Sachs, Tornell and Velasco's (1996) cross-sectional approach, which focuses on a set of 20 open emerging markets during the Latin American crisis in 1994-95.

Table 9: Prediciting the Spread of the 1997-98 Asian Crisis: Comparison of the Model of Equation (2) and of Alternative Models

MODEL EQUATION (2)

country:	Actual Crisis Index rank	Actual Crisis Index size	Full Model rank	Full Model size (1)	Fundament. Model rank	Fundament. Model size (2)	Contagion Model rank	Contagion Model size (3)
Indonesia	1	42.0	4	14.2	19	-2.7	3	13.7
Korea	2	32.6	5	8.6	16	-0.4	8	4.3
Thailand	3	27.4	3	19.2	10	1.4	2	15.3
Malaysia	4	27.0	1	26.7	6	3.5	1	18.5
Philippines	5	22.4	2	20.8	2	4.8	4	13.1
Colombia	6	9.1	7	6.2	5	3.7	22	-2.2
Russia	7	4.5	8	5.9	9	1.9	18	0.4
Sri Lanka	8	4.3	6	7.6	3	4.7	10	3.5
India	9	2.6	16	3.5	17	-0.8	9	3.8
Poland	10	1.6	13	4.0	11	1.3	13	2.3
Jordan	11	1.4	17	3.4	1	5.8	20	-0.4
South Africa	12	1.1	10	5.2	18	-2.1	7	6.8
Brazil	13	0.6	21	0.0	14	0.3	19	0.3
Pakistan	14	0.1	15	3.5	21	-2.7	12	3.2
Chile	15	-0.6	14	3.7	8	2.7	5	8.7
Hungary	16	-1.3	20	1.4	15	0.0	16	1.5
Peru	17	-2.4	11	4.2	7	2.9	21	-0.5
Argentina	18	-3.4	19	2.4	13	0.4	11	3.3
China	19	-4.5	9	5.7	4	3.7	15	1.6
Mexico	20	-5.9	18	3.0	22	-4.0	6	8.0
Venezuela	21	-6.9	22	-0.4	20	-2.7	17	0.5
Turkey	22	-9.0	12	4.0	12	1.1	14	1.6
Spearman correlation			0.738		0.228		0.411	
P-value			0.000		0.309		0.057	
R^2			0.464		0.407		0.441	

ALTERNATIVE MODELS

country:	Sachs et al. (1996) Actual Crisis Index	Sachs et al. (1996) Model 3 rank (4)	Sachs et al. (1996) Model 4 rank (5)	Frankel&Rose(1996) Actual Crisis Index	Frankel&Rose(1996) Model 2 rank (6)	Frankel&Rose(1996) Model 4 rank (7)
Indonesia	1	14	9	2		7
Thailand	2	7	5	3	7	11
Korea	3	12	11			
Malaysia	4	6	6			
Zimbabwe	5	23	12			
Philippines	6	1	1	7		8
Turkey	7	9	13	1	3	2
Colombia	8	18	4	8	8	6
Taiwan	9	11	22			
Pakistan	10	17	20	6	11	9
Uruguay	11	3	3	4	2	1
South Africa	12	15	16			
India	13	5	19	14	13	
Brazil	14	4	21	10	6	5
Sri Lanka	15	16	17	11	14	13
Chile	16	19	14	15	9	10
Jordan	17	20	15			
Mexico	18	21	18	12	4	
Israel	19	10	8			
Peru	20	8	23	9	1	4
Venezuela	21	22	13	5	10	12
Bolivia	22	13	10	13	12	
Argentina	23	2	7	16	5	3
Spearman correlation		0.110	0.230		0.330	0.120
P-value		0.612	0.295		0.253	0.694
R^2		0.010	0.050		0.110	0.020

Note: R^2 is obtained from a regression of predicted on actual values of EMP.
Predictions are out-of-sample, using 1997/Q3-Q4 for the Asian crisis as the crisis period for the Model of Equation (2).
Source: Berg and Pattillo (1998), Table 14, p. 54, for the predictions of the models by Frankel and Rose (1996) and Sachs et al. (1996).

Table 9 shows that the predictive power of the Full Model for the Asian crisis (model 1) is superior in terms of ranking to all of the models tested by Berg and Pattillo (models 4, 5, 6, 7), based on a comparison of the Spearman rank correlations. The superiority mostly stems from the inclusion of the contagion variables in the Full Model because the Fundamentals Model alone does not have a much better predictive power than the other models by Frankel and Rose (1996) and by Sachs, Tornell and Velasco (1996), which are both built entirely on fundamentals.

The Full Model does not only forecast accurately the *ranking* of how strongly countries were affected by the Asian crisis, but it also performs relatively well in forecasting the *degree* of severity. Indonesia and Korea are the only countries for which the Full Model underestimates the degree of the crises substantially, indicating that fundamentals and the extent of real and financial interdependence did not seem to warrant the severity with which these countries were hit.[14] The overall results prove robust to various sensitivity analyses, such as altering the forecasting horizon and using in-sample prediction to test for parameter constancy, and altering the size of the country sample to check for the impact of individual countries.

What makes one believe that the model presented in this paper is a superior model? First, the Full Model presented in this paper has the advantage of being able to estimate both the rankings of countries as well as the absolute severity of a crisis, i.e. it allows one to understand not only why some countries are affected more than others, but also why a particular country is hit so severely. Including a time dimension in addition to a cross-sectional dimension as in the model here has the added advantage of allowing a better understanding of the dynamics of exchange rate changes. The results confirm that variables that help explain exchange rate movements during tranquil periods may become even more important during crises. This was shown to be the case in particular for contagion through bank loan competition among economies.

CONCLUSIONS

This paper has argued that the main reason for the poor performance of standard models of currency crises lies in their neglect of the role of contagion - the fact that crises may be transmitted across countries through their interdependence with others. The empirical analysis, using Markov-switching models and panel data models, found compelling evidence that the Latin American crisis of 1994-95 and the Asian crisis of 1997-98 were indeed contagious, spreading across countries that were not only vulnerable economically but also closely linked financially. The model performs remarkably well in predicting the

[14] Political factors were probably another important reason for why Indonesia was the main victim of the Asian crisis. Such factors are not analyzed in this paper and are difficult to include on a cross-sectional basis; a discussion of the role of political factors can be found in Drazen and Masson (1994).

spread of the Asian crisis. The results therefore suggest that one of the most important indicators for predicting which countries will be affected by a particular crisis are the degree of real and financial interdependence with already affected countries.

It is imperative to emphasize that the empirical findings of this paper do not imply that the financial crises of the 1990s were entirely the result of fickle capital flows and nervous investors. It would be wrong to deny that countries that were hit by recent crises were vulnerable and showed weaknesses in their economic foundations. It would be equally wrong, however, to deny that rapid capital account liberalization and the opening to international markets, which lead to increased real and financial interdependence among emerging markets, played a crucial role in explaining both the timing as well as the severity of those crises.

The central lesson from the findings of this paper is that no open emerging market, even one with relatively sound fundamentals and policies, is capable of insulating itself from events in the rest of the world. The powerful role of contagion suggests that the most effective measures for crisis prevention and resolution require a global, coordinated policy approach. Only few such policy proposals, such as calls for the creation of a global lender of last resort, the imposition of certain capital controls, contingency funds and debtor-in-possession financing (e.g. Eichengreen et al. 1995, Radelet and Sachs 1999, Rodrik 1998), have been implemented so far. Therefore, the difficult challenge still faced by emerging markets is how best to reap the benefits of a more open economy while minimizing the risk of becoming the victim of a potentially devastating financial crisis inherent in the liberalization process.

REFERENCES

Agenor, Pierre-Richard, Marcus Miller, David Vines and Axel Weber (eds.). 1999. *The Asian Financial Crisis. Causes, Contagion and Consequences.* Cambridge University Press.

Baig, Taimur, and Ilan Goldfajn. 1998. Financial Market Contagion in the Asian Crisis. International Monetary Fund Working Paper 155. Washington: IMF.

Berg, Andrew, and Catherine Pattillo. 1998. Are Currency Crises Predictable? A Test. International Monetary Fund Working Paper 154. Washington: IMF.

Calvo, Guillermo A. 1998. *Capital Market Contagion and Recession: An Explanation of the Russian Virus*. College Park, MD: University of Maryland.

Calvo, Guillermo A., and Enrique Mendoza. 2000. Rational Contagion and the Globalization of Securities Markets. *Journal of International Economics* 51: 79-113.

Calvo, Sara, and Carmen Reinhart. 1996. Capital Flows to Latin America: Is there Evidence of Contagion Effects? World Bank Policy Research Working Paper 1619. Washington: World Bank.

Caramazza, Francesco, Luca Ricci, and Ranil Salgado. 2000. Trade and Financial Contagion in Currency Crises. International Monetary Fund Working Paper 55. Washington: IMF.

Chang, Roberto, and Andres Velasco. 1998. The Asian Liquidity Crisis. NBER Working Paper 6796. Cambridge, MA: National Bureau of Economic Research.

Cole, Harold L., and P. Kehoe. 1996. A Self-Fulfilling Model of Mexico's 1994-1995 Debt Crisis. *Journal of International Economics* 41, 3-4: 309-30.

Diebold, Francis, Joon-Haeng Lee and Gretchen Weinbach. 1994. Regime Switching with Time-Varying Transition Probabilities. In *Nonstationary Time Series Analysis and Cointegration,* ed. Colin Hargreaves. Oxford University Press.

Drazen, Allan, and Paul Masson. 1994. Credibility of Policies versus Credibility of Policymakers. *Quarterly Journal of Economics* 109: 735-54.

Eichengreen, Barry, Andrew Rose, and Charles Wyplosz. 1996. Contagious Currency Crises. EUI Working Paper EUF No. 96/2. Florence, Italy: European University Institute.

Eichengreen, Barry, James Tobin, and Charles Wyplosz. 1995. Two Cases for Sand in the Wheels of International Finance. *Economic Journal* 105: 162-72.

Engel, E., and C.S. Hakkio. 1994. The Distribution of Exchange Rates in the EMS. NBER Working Paper 4834. Cambridge, MA: National Bureau of Economic Research.

Flood, Robert P., Nancy P. Marion. 1998. Perspectives on the Recent Currency Crises Literature. NBER Working Paper 6380. Cambridge, MA: National Bureau of Economic Research.

Forbes, Kristin and Rigobon, Roberto. 1999. No Contagion, only Interdependence. NBER Working Paper 7267. Cambridge, MA: National Bureau of Economic Research.

Frankel, Jeffrey A., and Andrew K. Rose. 1996. Currency Crashes in Emerging Markets: An Empirical Treatment. *Journal of International Economics* 41: 351-66.

Frankel, Jeffrey, and Sergio Schmukler. 1998. Crisis, Contagion, and Country Funds: Effects on East Asia and Latin America. In *Managing Capital Flows and Exchange Rates: Perspectives from the Pacific Basin,* ed. Reuven Glick. Cambridge University Press.

Fratzscher, Marcel. 1998. Why are Currency Crises Contagious? A Comparison of the Latin American Crisis of 1994-1995 and the Asian Crisis of 1997-1998. *Weltwirtschaftliches Archiv* 134 (4): 664-91.

Fratzscher, Marcel. 1999. What Causes Currency Crises: Sunspots, Contagion or Fundamentals?, European University Institute Working Paper 99/39. Florence, Italy: European University Institute.

Gerlach, Stefan and Frank Smets. 1995. Contagious Speculative Attacks. *European Journal of Political Economy* 11: 5-63.

Glick, Reuven, and Andrew Rose. 1999. Contagion and Trade: Why are Currency Crises Regional? *Journal of International Money and Finance* 18 (4): 603-18.

Goldfajn, Ilan, and Rodrigo O. Valdes. 1997. Capital Flows and the Twin Crises: The Role of Liquidity. International Monetary Fund Working Paper 87. Washington: IMF.

Goldstein, Morris. 1998. The Asian Financial Crisis: Causes, Cures, and Systematic Implications. Policy Analysis in International Economic No. 55. Washington: Institute for International Economics.

Goldstein, Morris, Graciela L. Kaminsky and Carmen M. Reinhart. 2000. *Assessing Financial Vulnerability: An Early Warning System for Emerging Markets*. Washington: Institute for International Economics.

Gomez-Puig, Marta, and Jose G. Montalvo. 1997. A New Indicator to Assess the Credibility of the EMS. *European Economic Review* 41: 1511-35.

Hamilton, James D. 1989. A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica* 57: 357-384.

Hamilton, James D. 1990. Analysis of Time Series Subject to Changes in Regime. *Journal of Econometrics* 45: 39-70.

Jeanne, Olivier. 1997. Are Currency Crises Self-fulfilling? A Test. *Journal of International Economics* 43: 263-86.

Jeanne, Olivier, and Paul Masson. 2000. Currency Crises, Sunspots and Markov-Switching Regimes. *Journal of International Economics* 50: 327-50.

Kaminsky, Graciela, Saul Lizondo, and Carmen M. Reinhart. 1997. Leading Indicators of Currency Crises. International Monetary Fund Working Paper 79. Washington: IMF.

Kaminsky, Graciela, and Carmen Reinhart. 1999. The Twin Crisis: The Causes of Banking and Balance-of-Payments Problems. *American Economic Review* 89, no. 3: 473-500.

Kaminsky, Graciela, and Carmen Reinhart. 2000. On Crises, Contagion, and Confusion. *Journal of International Economics* 51: 145-68.

Kim, Chang-Jin, and Charles Nelson. 1998. *State-Space Models with Regime-Switching: Classical and Gibbs-sampling Approaches with Applications*. MIT Press.

Kodres, Laura and Matthew Pritzker. 1999. A Rational Expectations Model of Financial Contagion. FEDS Working Paper 48. The Federal Reserve Board.

Krolzig, Hans-Martin. 1997. *Markov Switching Vector Autoregressions. Modelling, Statistical Inference and Application to Business Cycle Analysis*. Berlin: Springer.

Krolzig, Hans-Martin. 1998. Econometric Modelling of Markov-Switching Vector Autoregressions using MSVAR for Ox. Oxford University. Manuscript.

Krugman, Paul. 1979. A Model of Balance of Payments Crises. *Journal of Money, Credit, and Banking* 11: 311-25.

Krugman, Paul. 1999. Balance Sheets, The Transfer Problem, and Financial Crises. Massachusetts Institute of Technology. Mimeo.

Martinez-Peria, Maria Soledad. (1998). A Regime-Switching Approach to the Study of Speculative Attacks: A Focus on EMS Crisis. World Bank Research Paper 2132. Washington: World Bank.

Masson, Paul. 1998. Contagion: Macroeconomic Models with Multiple Equilibria. *Journal of International Money and Finance* 18 (4): 587-602.

Obstfeld, Maurice. 1996. Models of Currency Crises with Self-Fulfilling Features. *European Economic Review* 40: 1037-47.

Radelet, Steven, and Jeffrey Sachs. 1999. The East Asian Financial Crisis: Diagnosis, Remedies, Prospects. *Brookings Papers on Economic Activity*. Washington: The Brookings Institution.

Rodrik, Dani. 1998. Who Needs Capital-Account Convertibility? In: Should the IMF Pursue Capital-Account Convertibility. Essay in International Finance 207. Princeton, NJ: Princeton University.

Sachs, Jeffrey, Aaron Tornell, and Andres Velasco. 1996. Financial Crises in Emerging Markets: The Lessons from 1995. *Brookings Papers on Economic Activity* 1: 147-215. Washington: The Brookings Institution.

Van Rijckeghem, Caroline, and Beatrice Weder. 1999. Sources of Contagion: Finance or Trade? International Monetary Fund Working Paper 146. Washington: IMF.

Wolf, Holger. 1998. Comovements Among Emerging Equity Markets. In *Managing Capital Flows and Exchange Rates: Perspectives from the Pacific Basin,* ed. Reuven Glick. Cambridge University Press.

APPENDIX: DATA DEFINITIONS AND SOURCES

Country Sample

The 24 countries of the sample are: Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, Czech Republic, Hungary, Jordan, Poland, Russia, South Africa, and Turkey.

Fundamentals

The set of fundamentals covers a fairly wide range of variables, many of which have been mentioned in the academic literature as potential culprits for some currency crisis or another. Kaminsky, Lizondo, and Reinhart (1997) provide a comprehensive review of empirical work on currency crises and emphasize the lack of empirical consensus on what may cause crises. The empirical analysis starts from a broad approach by including a wide range of variable definitions in order to avoid ignoring potentially powerful factors in the analysis.

- Foreign debt: total foreign debt/GDP, total short-term debt/GDP, and short-term debt/total foreign debt. Source: *IMF/WB/OECD/BIS* joint publication.
- Capital inflows: total capital inflows/GDP, short-capital inflows/GDP and short-term to total capital inflows. Source: *IMF*.
- Trade balance: (exports+imports)/GDP and current account. Source: *IMF*.
- Overvaluation of exchange rate: real effective exchange rate (REER) relative to 1990, and the change in REER during the prior one or two years. Source: *JP Morgan*.
- Foreign exchange reserves: ratio of total foreign exchange reserves to either M2 or to imports. Source: *IMF*.
- Lending boom: rate of credit expansion to the private sector relative to GDP. Source: *IMF*.
- Government deficit/GDP and government debt/GDP. Source: *IMF*.
- Changes in interest rates and growth rates in industrial countries. Source: *IMF*.
- US$ exchange rate changes to Japanese yen and German mark. Source: *IMF*.

Exogenous Variable

- Exchange Market Pressure (EMP): definition in text. Source: *IMF* and national central banks.

Contagion Variables

- Real Integration Contagion: definition in text. Source: *World Trade Analyzer* (1989-97); commodities measured at the 3-digit SITC level, excluding agriculture and natural resources.
- Common Bank Lender: definition in text. Source: *BIS/OECD/WB/IMF Joint Database*.
- Financial Market Integration: definition in text. Source: *Datastream/Reuters* and *IMF*.

Table 5: Correlations of Contagion Variables

	REAL	BANKCOMP	FINCORR1	FINCORR2
REAL	1			
BANKCOMP	0.045	1		
FINCORR1	0.012	0.103	1	
FINCORR2	-0.030	0.086	0.641	1

Note: See equations (10), (11), (13) and (14) for definitions of the contagion variables.

Table 6: Results of Markov-Switching Models

	MEXICO				ARGENTINA				THAILAND				KOREA			
	(1)	**(2)**	(3)	**(4)**	(1)	**(2)**	(3)	**(4)**	(1)	**(2)**	**(3)**	(4)	(1)	**(2)**	**(3)**	(4)
Const.(Regime 1)	* -66.05	* -52.00	-66.91	* -64.38	* -9.497	* -18.28	-2.298	* -7.041	4.346	* 3.695	14.30	* 14.70	2.573	4.992	15.237	15.16
Const.(Regime 2)		* -51.98		* -33.15		* -16.72		-5.739		-0.26		* 14.76		5.087		15.20
Const.(Regime 3)		* -26.87				* -13.61		-2.654		* 17.37		* 14.98		5.235		15.36
Capital Flows	0.136	0.095	0.058	0.049	-0.015	-0.091	-0.110	-0.080	-0.214	0.708	-0.641	-0.686	-0.035	-0.052	-0.092	-0.092
Lending Boom	-12.49	-8.959	-37.17	5.221	* 10.11	* 14.04	63.41	* 9.358	0.108	* -17.32	-3.578	-3.579	* 69.64	* 59.39	* 90.63	* 90.62
Foreign Debt	* 24.98	* 19.21	* 26.86	* 22.39	-12.38	-13.70	-7.167	-8.323	* 6.725	* 6.081	* 9.962	* 9.964	* 30.55	* 19.17	* 48.69	* 48.69
Overvaluation	* 0.716	0.482	* 0.819	* 0.549	* 12.61	* 12.46	* 13.99	* 17.25	* 48.66	* 40.95	* 54.99	* 54.99	* 18.81	* 23.91	* 25.92	* 25.32
Reserves	-3.248	2.544	-18.33	15.94	-11.24	-9.721	-12.58	-14.87	0.208	* 5.871	-2.663	-2.663	-8.618	-11.33	-23.24	-23.24
Trade Balance	131.6	57.95	116.9	122.1	* -25.51	* -21.10	* -25.61	* -29.31	75.36	22.20	92.16	92.16	-255.7	-184.8	-245.2	-245.2
Real Contagion			* 4.514	* 6.558			1.228	* 1.689			1.178	1.178			* 10.04	* 10.04
Financial Cont.			0.465	0.450			* 10.11	* 9.109			* 12.79	* 12.83			* 10.21	* 10.52
Log-likelihood	-132.4	-114.2	-101.2	-82.44	-50.84	-40.57	-46.89	-36.62	-104.7	-77.40	-72.95	-72.95	-121.2	-101.7	-90.44	-90.44
Variance	43.95	10.84	49.73	9.597	2.926	0.317	2.719	0.261	11.00	1.141	7.582	7.581	25.16	22.19	24.32	24.32
p_{11}		0.673		0.964		0.531		0.571		0.686		0.686		0.686		0.688
p_{22}		0.716		0.382		0.442		0.584		0.912		0.912		0.786		0.669
p_{33}		0.299				0.150		0.333		0.499		0.499		0.001		0.615

	PHILIPPINES				INDONESIA				CHILE				INDIA			
	(1)	**(2)**	**(3)**	(4)	(1)	**(2)**	**(3)**	(4)	(1)	**(2)**	(3)	**(4)**	(1)	**(2)**	(3)	**(4)**
Const.(Regime 1)	3.512	2.079	0.656	0.603	* -47.62	* -71.57	* -43.39	* -43.53	3.513	-1.722	* -23.26	* -32.27	-14.12	-55.14	-13.19	* 74.84
Const.(Regime 2)		* 13.30		0.695		* -66.38		* -43.44		* 4.469		* -25.80		-49.65		* 80.29
Const.(Regime 3)						-60.32		* -43.26		2.449		* -22.62		-42.78		* 85.48
Capital Flows	0.043	0.077	-0.084	-0.084	0.276	-0.612	0.030	0.030	-0.509	-0.776	-0.417	-1.126	* 0.316	* 0.496	* 0.324	* 0.309
Lending Boom	12.06	16.68	-52.60	-52.61	* 49.97	* 89.69	* 61.99	* 61.99	-13.04	-17.52	-62.12	-52.87	-98.71	-21.62	-38.48	* -4.854
Foreign Debt	* 4.412	* 8.796	* 14.67	* 14.67	* 25.02	* 19.31	* 15.37	* 15.37	* 9.549	* 10.06	* 6.502	* 4.358	* 24.63	* 3.591	* 19.94	* 17.00
Overvaluation	* 14.42	2.800	* 13.79	* 13.79	* -19.45	* -8.342	* -22.78	* -22.77	-2.160	0.743	* 37.02	* 31.78	0.382	0.678	0.200	* 0.351
Reserves	7.023	* 14.67	* 14.46	* 14.46	59.89	* 90.00	54.86	54.85	-1.632	-1.212	7.158	8.187	1.247	0.770	1.156	-0.275
Trade Balance	88.99	155.5	81.71	81.71	52.14	* -88.64	52.99	53.08	-16.38	-16.98	-112.6	-93.23	* 30.68	* 27.48	220.3	186.2
Real Contagion			* 8.889	* 8.889			* 1.336	* 1.333			5.367	2.774			0.939	* 0.764
Financial Cont.			* 14.29	* 14.29			* 12.32	* 12.31			2.679	* 4.705			* 7.942	* 16.79
Log-likelihood	-111.9	-105.7	-69.49	-69.49	-77.72	-66.81	-65.91	-65.90	-108.6	-101.4	-72.32	-52.71	-64.35	-50.37	-62.86	-52.95
Variance	24.83	6.869	7.063	7.063	12.46	1.383	5.518	5.518	7.321	1.832	7.264	0.388	10.08	0.906	8.947	0.954
p_{11}		0.849		0.623		0.198		0.537		0.623		0.568		0.701		0.701
p_{22}		0.588		0.744		0.784		0.629		0.407		0.703		0.916		0.916
p_{33}						0.690		0.590		0.075		0.109		0.573		0.573

Note: Columns in bold indicate the appropriate number of regimes for each model. p_{kl} denotes the probability of regime persistence.

* indicates statistical significance at the 10% level.

WORKING PAPERS

No. 94-1.	Jeffrey A. Frankel with Shang-Jin Wei and Ernesto Stein, "APEC and Regional Trading Arrangements in the Pacific"
No. 94-2.	Edward M. Graham, "Towards an Asia Pacific Investment Code"
No. 94-3.	Paul Wonnacott, "Merchandise Trade in the APEC Region: Is There Scope for Liberalization on an MFN Basis?"
No. 94-4.	Paul Wonnacott, "The Automotive Industry in Southeast Asia: Can Protection Be Made Less Costly?"
No. 94-5.	Marcus Noland, "Implications of Asian Economic Growth"
No. 95-1.	C. Fred Bergsten, "APEC: The Bogor Declaration and the Path Ahead"
No. 95-2.	Jeffrey J. Schott, "From Bogor to Miami . . . and Beyond: Regionalism in the Asia Pacific and the Western Hemisphere"
No. 95-3.	Marcus Noland, "Has Asian Export Performance Been Unique?"
No. 95-4.	Gautam Jaggi, "Association of Southeast Asian Nations (ASEAN) and ASEAN Free Trade Area (AFTA): Chronology and Statistics"
No. 95-5.	Marcus Noland, "The North Korean Economy"
No. 95-6.	Marcus Noland, "China and the International Economic System"
No. 96-1.	C. Fred Bergsten, "APEC after Osaka: Toward Free Trade by 2010/2020"
No. 96-2.	Marcus Noland, "Public Policy, Private Preferences, and the Japanese Trade Pattern"
No. 96-3.	Marcus Noland, "German Lessons for Korea: The Economics of Unification"
No. 96-4.	Marcus Noland, "Research and Development Activities and Trade Specialization in Japan"
No. 96-5.	Gautam Jaggi, Mary Rundle, Daniel Rosen, and Yuichi Takahashi, "China's Economic Reforms: Chronology and Statistics"
No. 96-6.	Marcus Noland, "US-China Economic Relations"
No. 96-7.	Raymond Atje and Gary Hufbauer, "The Market Structure Benefits of Trade and Investment Liberalization"
No. 96-8.	Marcus Noland, "The Future of US-Korea Economic Relations"
No. 96-9.	Edward M. Graham, "Competition Policies in the Dynamic Industrializing Economies: The Case of China, Korea, and Chinese Taipei"
No. 96-10.	Marcus Noland, Sherman Robinson, and Monica Scatasta, "Modeling Economic Reform in North Korea"
No. 96-11.	Marcus Noland, "Trade, Investment, and Economic Conflict between the US and Asia"
No. 96-12.	C. Fred Bergsten, "APEC in 1996 and Beyond: The Subic Summit"
No. 96-13.	Marcus Noland, "Some Unpleasant Arithmetic Concerning Unification"
No. 96-14.	Marcus Noland, "Restructuring Korea's Financial Sector for Greater Competitiveness"
No. 96-15.	C. Fred Bergsten, "Competitive Liberalization and Global Free Trade: A Vision for the 21st Century"
No. 97-1.	Marcus Noland, "Chasing Phantoms: The Political Economy of USTR"
No. 97-2.	Jacqueline McFadyen, "U.S.-Japan Civil Aviation: Prospects for Progress"
No. 97-3.	C. Fred Bergsten, "Open Regionalism"
No. 97-4.	Adam S. Posen, "Lessons from the Bundesbank on the Occasion of Its 40th (and Second to Last?) Birthday"
No. 97-5.	Marcus Noland, Sherman Robinson, and Li-Gang Liu, "The Economics of Korean Unification"
No. 98-1.	Marcus Noland, Sherman Robinson, and Li-Gang Liu, "The Costs and Benefits of Korean Unification"
No. 98-2.	Li-Gang Liu, Marcus Noland, Sherman Robinson, and Zhi Wang, "Asian Competitive Devaluations"
No. 98-3.	C. Fred Bergsten, "Fifty Years of the GATT/WTO: Lessons from the Past for Strategies for the Future"
No. 98-4.	Jacqueline McFadyen, "NAFTA Supplemental Agreements: Four Year Review"

No. 98-5. Hiroko Ishii and Erika Wada, "Local Government Spending: Solving the Mystery of Japanese Fiscal Packages"
No. 98-6. Marcus Noland, Sherman Robinson, and Zhi Wang, "The Global Economic Effects of the Japanese Crisis"
No. 99-1. Marcus Noland, Sherman Robinson, and Tao Wang, "Rigorous Speculation: The Collapse and Revival of the North Korean Economy"
No. 99-2. Marcus Noland, Sherman Robinson, and Tao Wang, "Famine in North Korea: Causes and Cures"
No. 99-3. Marcus Noland, "Competition Policy and FDI: A Solution in Search of a Problem?"
No. 99-4. Marcus Noland, Sherman Robinson, and Zhi Wang, "The Continuing Asian Financial Crisis: Global Adjustment and Trade"
No. 99-5. Adam S. Posen, "Why EMU Is Irrelevant for the German Economy"
No. 99-6. C. Fred Bergsten, "The Global Trading System and the Developing Countries in 2000"
No. 99-7. Marcus Noland, Sherman Robinson, and Tao Wang, "Modeling Korean Unification"
No. 99-8. Marcus Miller and Lei Zhang, "Sovereign Liquidity Crisis: The Strategic Case for a Payments Standstill"
No. 99-9. C. Fred Bergsten, Olivier Davanne, and Pierre Jacquet, "The Case for Joint Management of Exchange Rate Flexibility"
No. 99-10. Kenneth N. Kuttner and Adam S. Posen, "Does Talk Matter After All? Inflation Targeting and Central Bank Behavior"
No. 99-11. Gary Clyde Hufbauer and Erika Wada, "Hazards and Precautions: Tales of International Finance"
No. 99-12. Gary Clyde Hufbauer and Tony Warren, "The Globalization of Services: What Has Happened? What Are the Implications?"
No. 00-1. Keith Maskus, "Regulatory Standards in the WTO: Comparing Intellectual Property Rights with Competition Policy, Environmental Protection, and Core Labor Standards"
No. 00-2. Richard M. Goodman and John M. Frost, "International Economic Agreements and the Constitution"
No. 00-3. Catherine L. Mann, "Electronic Commerce in Developing Countries: Issues for Domestic Policy and WTO Negotiations"
No. 00-4. C. Fred Bergsten, "The New Asian Challenge"
No. 00-5. Marcus Noland, "How the Sick Man Avoided Pneumonia: The Philippines in the Asian Financial Crisis"
No. 00-6. Kenneth N. Kuttner and Adam S. Posen, "Inflation, Monetary Transparency, and G3 Exchange Rate Volatility"
No. 00-7. Catherine L. Mann, "Transatlantic Issues in Electronic Commerce"
No. 00-8. Morris Goldstein, "Strengthening the International Financial Architecture: Where Do We Stand?"
No. 00-9. Marcel Fratzscher, "On Currency Crises and Contagion"

Working Papers are only available directly from the Institute (not from our international distributor or bookstores). Most appear in full form on our Web site at http://www.iie.com/catalog/wp/apecwp.htm. If you require a paper that is not available on the Web site, please contact us.

Working Papers
Tel: (202) 328-9000
Fax: (202) 328-5432
http://www.iie.com

Institute for International Economics
11 Dupont Circle, NW, Suite 620
Washington, DC 20036-1207