A SPATIAL APPROACH TO MODELLING CONTAGION AMONG EMERGING ECONOMIES

Harry H. Kelejian
University of Maryland, College Park

George S. Tavlas
Bank of Greece

George Hondroyiannis
Bank of Greece

November, 2005
(Very Preliminary)

Abstract

This paper takes a spatial modeling approach in specifying and testing for contagion among emerging market economies. Our approach enables us to estimate asymmetries such as the magnitude of contagion of one country upon others, as well as how that country in turn is affected, on average, by the events of others. The approach also enables us to test for contagion in a formal, straightforward way and to take account for trade and distance among countries. The results suggest that contagion is a significant factor in foreign exchange markets and, furthermore, its effects are not uniform across the countries considered.

Keywords: Contagion; Currency crises; Spatial modeling;
JEL classification: F30; F32; C10

Corresponding author: George S. Tavlas, Director-Advisor, Economic Research Department, Bank of Greece, Room 569**,** 21, E. Venizelos Avenue, Athens 102 50, Greece, Tel. 30 210 3237224, Fax: 30 210 3202432, Email: gtavlas@bankofgreece.gr

1. Introduction

A prominent feature of crises in foreign exchange markets during the past ten years or so has been the extent to which instability in these markets was quickly transmitted from one economy to others in the same region, and in some cases, beyond. This process has come to be known as contagion and it has given rise to an expanding empirical literature that tests for its existence. In order to test for the presence of contagion, research has mainly focused on two types of channels through which a crisis in one country is transmitted to other countries. These channels involve trade and financial spillovers among countries.[1] This approach, however, does not, or should not, rule out the possibility that changes in fundamentals can, at least partially, explain the transmission of foreign-exchange instability. As an example, according to the trade-spillovers approach, when a particular country experiences a devaluation of its currency, trading partners may experience a deterioration in their competitiveness. The change in competitiveness, which provokes a currency attack, is nonetheless, due to a change in a fundamental variable and so the resulting crisis should be attributed to interdependence, and not to *pure* contagion, if, as often assumed, pure contagion represents a force that is exerted beyond the fundamentals (Edwards, 2000).[2]

In an attempt to isolate the effects of pure contagion, some empirical studies have sought to control for the role of the fundamentals. In this connection, Claessens, Dornbusch and Park (2001) identify several empirical approaches that have been applied.[3] One approach has been to estimate changes in correlation coefficients of asset prices (e.g., Baig and Goldfaijn, 1998; Forbes and Rigobon, 2001; Hernandez and Valdes, 2001; Fratzscher, 2003); a significant increase in correlations among different countries' markets, after controlling for the fundamentals, is considered evidence of contagion.[4] A second approach is to study conditional correlations or conditional probabilities; a commonly-used methodology is to examine whether the

---

[1] Surveys of the empirical literature are contained in Claessens, Dornbusch and Park (2001), Forbes and Rigobon (2001), Pericoli and Sbracia (2001), Ito and Hashimoto (2002), and Kaminsky, Reinhart and Vegh (2003).

[2] Edwards, (2000, p. 880) defines contagion as "a situation where the extent and magnitude of the international transmission of shocks exceeds what was expected [based on the fundamentals] by market participants".

[3] For a somewhat different classification, see Pericoli and Sbracia (2001).

[4] Kaminsky and Reinhart (2002) analyze the degree of co-movement in asset prices across a large number of countries for four different asset classes. Although the study is not strictly concerned with

likelihood of a crisis in a given country is higher when there is a crises a "ground zero" country, or in several countries (e.g., Glick and Rose, 1999; Kaminsky and Reinhart, 2000; Rigobon, 2002). A third approach, (Dellas and Stockman, 1993; Ahluwalia, 2000) attempts to separate similarities in economic weaknesses from shifts in investors' expectations (i.e., signals) as investors consider these signals to be sorting devices; the aim is to examine whether macroeconomic similarities can play a proximate role in causing contagion by coordinating shifts in investors' sentiments. Yet another approach estimates spillovers in volatility, i.e., cross-market movements in the second moments of asset prices, often using ARCH or GARCH techniques (e.g., Edwards, 2000; Edwards and Susmel, 2001). In general, the empirical work appears to have provided some support for the view that there is both interdependence among the asset prices of different countries due to common factors and contagion.[5]

This paper takes a different approach in specifying and then testing for contagion. First, we feel it is evident that if, for whatever reason, the fundamentals of a given country, say country A, change, the exchange markets in that country may be affected. If there are spillovers (contagion) relating to a neighboring regional country, say country B, exchange markets in that country may also be affected. Continuing in this fashion, if there are spillovers from country B to still another neighboring regional country, say country C, exchange markets in that country may also be affected. The extension of this argument to its obvious limit suggests that, if there are spillovers, exchange markets in each and every country in a region will be affected by all relevant fundamentals in all neighboring regional countries, and perhaps in countries which are not even in the region being considered. Second, and in a similar light, it follows that exchange markets in each and every country in a given region will be affected by a random macro shock in any country in that region, and perhaps beyond that region. All of this suggests that a model of an exchange-market variable must account for all relevant fundamentals and macro shocks in all of the neighboring regional countries, and perhaps in countries beyond that region. Notice, in the absence of spillovers (contagion), one would expect exchange markets in each and every country to only relate to the fundamentals of that country.

---

contagion, the results indicate that there are important differences in the degree of responsiveness of different asset markets to external shocks.

[5] Studies that do not find some evidence of contagion include Boyer, Gibson and Loretan (1999), Corsetti, Pericoli and Sbracia (2002), and Forbes and Rigobon (2002).

In modeling an exchange market variable the challenge is to account for all of these factors in a reasonably parsimonious fashion, and, if spillovers relate to geographical distance or to trade, to take account of that distance, or trade . Our spatial modeling approach of contagion does just that. In addition, it suggests a straightforward test for the absence of contagion. Our formulation also enables us to estimate asymmetries such as the magnitude of contagion of one country upon others, as well as how that country in turn is affected by the events in others. To the best of our knowledge the results of a spatial modeling approach applied to exchange markets have not been reported in the literature.

Our empirical results are based on a sample of 25 emerging market economies (EMEs) - - (Argentina, Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Israel, Jordan, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Russia, North Korea, Singapore, South Africa, Sri Lanka, Thailand, Turkey, and Venezuela) during six crises - - namely, the Mexican peso crisis of 1994-95, the Asian crisis of 1997, the Russian crisis of 1998, the Brazilian crisis of 1999, the Turkish crisis of 2001 and the Argentinean crisis of 2002. The particular sample of EMEs and the crises episodes are representative of the focus of much of the literature on contagion in foreign-exchange markets.[6] As a preview, our results suggest that contagion is indeed a statistically significant factor in determining foreign-exchange-market instability. They also suggest that the magnitude of contagion, while small, was not the same during the Mexican and Asian crises, as it was for the Russian, Brazilian, Turkish, and Argentine crises. Furthermore, for certain countries contagion was effected primarily via trade linkages, while for countries geographic distances was of primary importance. As an illustration of the magnitudes involved, during the Mexican and Asian crises, the elasticity of an exchange market crisis index in a country other than Malaysia with respect to a change in the real GDP in Malaysia was, on average, roughly -.32 , with a (rather large) standard deviation of roughly 1.82. These figures indicate quite a bit of variability in contagion response! Results with respect to a change in other fundamentals in Malaysia, or in other countries are somewhat similar.

---

[6] These are the same 25 countries as those identified by Goldstein (2002) in his study of exchange-rate regimes for EMEs. The crises are the same as those identified by Kaminsky, Reinhart and Vegh (2003). To our knowledge, the two most recent crises - - i.e., those of Turkey and Russia - - have not yet been

The remainder of this paper is divided into four sections. Section 2 describes the model and variables, and our expectations concerning the effects of the variables on foreign-exchange markets. In Section 3 we give a matrix formulation of the model. This formulation is convenient for describing the ramifications of contagion as it relates to spillovers in foreign-exchange markets from one country to another. Empirical results are reported in Section 4. Conclusions and suggestions for further work are given Section 5.

2. The model and data

The model we consider is essentially an expended version of the model considered by Glick and Rose (1999)[7]. Specifically, we consider the model

$$IND^{q}{}_{it} = \beta_1 + \beta_2(RGDP^{q}{}_{it-}) + \beta_3(RER^{q}{}_{it-}) + \beta_4(SDRES^{q}{}_{it-}) + \beta_5(CRED^{q}{}_{it-})$$
$$+ \beta_6(EXP^{q}{}_{it-}) + \beta_7(CT^{q}{}_{it-}) + \beta_8(CD_{it-}{}^{q}) + \varepsilon^{q}{}_{it};$$
$$t = 1994, 1997, 1998, 1999, 2001, 2002; \; q = M, A, R, B, T, AR \qquad (1)$$

where $IND^{q}{}_{it}$ is a crisis index for country i at time t during crisis q=M (Mexican), q=A (Asian), q=R (Asian and Russian), q=B (Brazilian), q=T (Turkish) and q=AR (Argentinean). The use of a crisis index to measure contagion was developed by Eichengreen, Rose and Wyplosz (1996). The particular crisis index used (and updated) in this paper was developed by Kaminsky and Reinhart (1999). The index is a weighted average of reserve losses and exchange rate depreciation (local currency against the U.S. dollar), with weights such that the two components have equal sample volatility. This weighting scheme prevents the much-greater volatility in exchange rates (owing to several very large devaluations during periods of foreign exchange crises) from dominating the crisis measure (Kaminsky and Reinhart, 2000, p. 150). Because changes in the exchange rate enter the index with a positive weight and reserves enter with a negative weight, large positive readings of this index

incorporated into the literature dealing with contagion. Zhu and Yang (2004) incorporated the Brazilian crisis in their data sample.

[7] The model used by Glick and Rose, in turn, is a generalisation of the models used by Sachs, Tornell and Velasco (1996), Tornell (1998), and Bussière and Mulder (1999). As discussed below, the specifications relating to the fundamental variables are similar to those used by previous authors. In addition, we note that some authors (e.g., Ahluwalia, 2000) considered contagion but modelled it essentially as a dummy variable which shifts the intercept.

indicate a speculative attack. The higher the value of the index the more severe the crisis in a particular country.

In dating the beginning of each of the crises, we follow Kaminsky, Reinhart, and Vegh (2003, pp. 53-54) as follows: December 1994 for the Mexican crisis, July 1997 for the Asian crisis, August 1998 for the Russian crisis, January 1999 for the Brazilian crisis, February 2001 for the Turkish crisis and December 2001/January 2002 for the Argentinean crisis. The crisis index is constructed employing the intervals 1994M11-1995M4, 1997M5-1997M10, 1998M7-1998M10, 1998M12-1999M2, 2001M1-2001M10 and 2001M7-2002M6 for the six crisis years respectively. That is, the length of the Mexican crisis, for example, is assumed to last six months (November 1994 through April 1995); the starting date for the crisis index is the month prior to the onset of the crisis and the ending date is the month in which the crisis index peaked.[8,9]

The fundamental macroeconomic variables considered, are $RGDP^{q}{}_{it-}$, $RER^{q}{}_{it-}$, $SDRES^{q}{}_{it-}$ $CRED^{q}{}_{it-}$, and $EXP^{q}{}_{it-}$; they are described below. Our generalization relates to the two contagion variables $CT^{q}{}_{it}$ and $CD^{q}{}_{it}$, which are also described below. The introduction of these variables requires an estimation procedure that accounts for an endogenous variable; such a procedure in terms of panel estimation has not, to our knowledge, been considered in the literature. The subscript relating to time, for all the independent variables except the two contagion measures is meant to indicate that the corresponding variable is defined at an earlier point in time than the dependent variable, $IND^{q}{}_{it}$. Most data are from the IFS. The data and the data sources are described in the Annex. Finally, $\varepsilon^{q}{}_{it}$ is the error term that we assume is i.i.d. over both i and t as N(0, σ^2).

[8] The intervals for the first four crises correspond to those used by Ahluwalia (2000) and Zhu and Yang (2004), who, in turn, follow Sachs, Tornell and Velasco (1996) in determining the interval for the Mexican crisis. In constructing their crises indices, these authors begin with the month prior to the onset of the crisis. In determining the end of the crises, these authors used the month in which the crisis index peaked. For the Turkish crisis we followed a similar methodology. For the Argentinean crisis we used July 2001 as the beginning of the interval because, after the announcement of the "zero deficit" on July 11, 2001, the country's emerging market bond index (EMBI) spread widened more than 300 basis points. As a result a large amount of bank deposits was withdrawn exercising large pressure on domestic interest rates and on tax revenues. See IMF (2001).

[9] In constructing this index, we used the end-of-period monthly exchange rate against the U.S. dollar (IFS line ae) and total reserves minus gold (IFS, line IL. D). The sample variances of the monthly percentage changes in the exchange rate and reserves are estimated of the period 1990-2002. Because of the unavailability of data, the period is different for the Czech Republic (1993M2-2002M12) and Russia (1994M12-2002M12).

In constructing the fundamental macroeconomic variables, we follow the methodology used in much of the literature (e.g., Ahluwalia, 2000; Zhu and Yang, (2004). $RGDP^{q}_{it-}$ is, for the i-th country during crisis q, real GDP growth the year before the onset of the crisis. Low (or negative) real GDP growth is used as a measure of macroeconomic imbalance in the country that may have made the economy vulnerable to financial market contagion. Therefore we expect $\beta_2 < 0$. RER^{q}_{it-} is the change in the real effective exchange rate between December of the year preceding the year in which a crisis started and December three years earlier. A decrease in RER signifies an appreciation of the real exchange rate. Ceteris paribus, the more appreciated the real effective exchange rate (the less is RER) the greater the impending need for adjustment in the nominal exchange rate. Therefore, we expect $\beta_3 < 0$. $SDRES^{q}_{it-}$ is the ratio of short-term debt to reserves minus gold in the six-month period immediately prior to the crisis episode.[10] It is a measure of the amount of domestic money that can easily be converted into foreign exchange. We, therefore, expect $\beta_4 > 0$. $CRED^{q}_{it-}$ is the corresponding percentage change in the domestic credit over the previous period ending in December of the year preceding the crisis year. A large positive value could indicate a lending boom. Accordingly, we expect $\beta_5 > 0$. EXP^{q}_{it-} is the percentage growth of the domestic currency value of exports over the previous year. We expect $\beta_6 < 0$.[11]

As indicated, our contagion variables are CT^{q}_{it} and CD^{q}_{it}. The first contagion variable, CT^{q}_{it}, is a measure of the effects of trade linkages that involve common third markets. For example, at the time of the Asian crisis, both Thailand and Singapore exported many of the same goods to the same third-countries, such as the United Sates. To capture trade links through a third party, the variable CT^{q}_{it} is constructed as a product of the IND variable and a weighting matrix W, which is not row normalized. Following Glick and Rose (1999) each element, of the W, w_{ij}, is a weighted average of the importance of exports to country A for countries i and j adjusted to vary according to the size of countries. The United States, Japan and the

[10] Data on short-term debt were obtained from the Bank for International Settlements.

[11] In addition, some other variables such as the inflation, the rates of broad money to international reserves and changes in major stock market indexes were used in a basic specification. These variables, however, were not significant in explaining the crisis indicator. As discussed below, the three variables are used as instruments in the estimation of equation 1.

European Union countries are used as the relevant trade partners. [12] Hence each element w_{ij} of W matrix is given as follows.

$$w_{ij} = \frac{X_{iA} + X_{jA}}{X_i + X_j} * \left[1 - \frac{\left| \frac{X_{iA}}{X_i} - \frac{X_{jA}}{X_j} \right|}{\frac{X_{iA}}{X_i} + \frac{X_{jA}}{X_j}} \right]$$

where X_{iA} and X_{jA} are the exports of countries i and j to the United States, Japan, and the European Union countries and X_i and X_j are the total exports of countries i and j. The importance of United States, Japan and European Union countries is greatest when it is an export market of equal importance to both i and j. The index is higher the more equal are the exports as percentage of the total exports of countries i and j to United States, Japan and European Union countries. As noted in the first section, however, this variable may not be a measure of pure contagion.

Given this definition of w_{ij}, the contagion variable $CT^q{}_{it}$ can be expressed as

$$CT^q{}_{it} = \sum_{j=1}^{25} w_{ij} IND^q{}_{jt} \text{ ,for all i=1,…,25,} \qquad (2)$$

where $IND^q{}_{jt}$ is defined in reference to equation (1) as the crisis index corresponding to country j at time t during crisis q = M, A, R, B, T, AR. The specification in (2) implies that, for each of the crises, the weight given to $IND^q{}_{jt}$ is zero for the same country and increases as countries i and j are exports competitors in USA, Japan and European Union. Therefore, our specifications in equations (1) and (2) imply that a crisis in one country, perhaps due to a change in a fundamental of that country, can potentially, via $CT^q{}_{it}$, affect exchange markets in all countries. As an example, a crisis in country j could affect exchange markets in country i if they are export competitors in United States, Japan and EU countries. The crisis in country i, in turn, could then affect exchange markets in country j if they are competitors, etc. Thus, the crisis in

[12] All data for the trade weighting matrix are from the International Monetary Fund, "Direction of Trade Statistics".

country j could, in this manner, affect exchange markets in all related countries, which could then feedback to country j. Therefore it is expected that $\beta_7 > 0$.

Next, consider $CD^q{}_{it}$ as another crisis index which depends on the geographical distance among the twenty-five countries. The second contagion variable $CD^q{}_{it}$ is a product of IND variable and a weighting matrix D. The D matrix is not row standardized. Each element of the D matrix is the inverse arc distance d_{ij} between two countries i and j. It is natural that $d_{ii}=0$ for all i=1,…,25.[13]

Given this definition of d_{ij}, the contagion variable $CD^q{}_{it}$ can be expressed as

$$CD^q{}_{it} = \sum_{j=1}^{25} d_{ij} IND^q{}_{jt} \text{ ,for all i=1,…,25,} \qquad (3)$$

where $IND^q{}_{jt}$ is defined in reference to equation (1) as the crisis index corresponding to country j at time t during crisis q = M, A, R, B, T, AR. Again, and less abstractly, the specification in (3) implies that, for each of the crises, the weight given to $IND^q{}_{jt}$ is zero for the same country and increases as the distance between country i and j decreases. Therefore, it should be clear, at least intuitively, that our specifications in equations (1) and (3) imply that a crisis in one country, perhaps due to a change in a fundamental of that country, can potentially, via $CD^q{}_{it}$, affect exchange markets in all countries. As an illustration, a crisis in country j could affect exchange markets in country i if they are close to each other, that is, there is small geographical distance between the two countries. The crisis in country i, in turn, could then affect exchange markets in country k if they are close to each other, etc. Thus, the crisis in country j could, in this manner, affect exchange markets in all related countries, which could then feedback to country j. The details involved will become clear from our theoretical development in Section 3. At this point, it should be evident that since d_{ij} is the inverse distance between countries i and j our expectation is that $\beta_8 > 0$.

As a review, our parameter expectations are that

[13] In constructing the no row standardized matrix D the following procedure is used. First, the co-ordinates for the capital of each country are collected. Next, the two co-ordinates (latitude X and longitude Y) are transformed into decimal employing the following formula: decimal = degrees + minutes times 0.01666667 + seconds times 0.00027778. The arc distance d_{ij} between two countries i and j is then calculated. Data for the two co-ordinates were obtained at the following website: www.mapsofworld.com/utilities/world-latitude-longitude.htm.

$$\beta_2 < 0, \beta_3 < 0, \beta_4 > 0, \beta_5 > 0, \beta_6 < 0, \beta_7 > 0, \beta_8 > 0 \quad (4)$$

As suggested above, our specifications imply that, if exchange markets in a given country are affected by crises via contagion in neighboring countries with respect to trade and distance, then the crisis in that given country will be affected by the fundamentals of neighboring countries. We now express our model in matrix terms in order to show these relationships more exactly.

3. A matrix formulation of the model and corresponding implications [14]

There are 150 observations relating to (1). These observations result from the six crises and the 25 EMEs. Let IND^q be the 25x1 vector of observations on the dependent variable corresponding to the qth crisis, where, again, $q = M$ (Mexican), A (Asian), $q = R$ (Asian and Russian), q = B (Brazilian), q = T (Turkish) and q = AR (Argentinean). Similarly, let are $RGDP^q{}_{it-}$, $RER^q{}_{it-}$, $SDRES^q{}_{it-}$ $CRED^q{}_{it-}$, and $EXP^q{}_{it-}$ be the corresponding 25x1 vectors of observations on the explanatory variables in (1) except for the contagion variable. Note that the corresponding vector of observations on the two contagion variables, CT_{it}^q and CD_{it}^q can be expressed as

$$CT^q = W \times IND^q, q = M, A, R, B, T, AR \quad (5)$$

$$CD^q = D \times IND^q, q = M, A, R, B, T, AR \quad (6)$$

where W and D are a 25x25 not row standardized weighting matrices whose diagonal elements are all zero. Finally, for the qth crisis, let X^q be the 25 x 6 regressor matrix relating to all the regressors in (1), including the intercept, but not including the two contagion variables. More precisely, we specify X^q as $X^q = [e_{25}, RGDP_-^q, RER_-^q, SDRES_-^q, CRED_-^q, EXP_-^q]$, $q = M, A, R$,B,T,AR

where e_{25} is an 25x1 vector of unit elements.

Given this notation, the model in (1) can be expressed as

[14] Standard references on spatial models include Anselin (1988), Cliff and Ord (1973, 1981), and Cressie (1993). Some recent applied and theoretical studies include, Kelejian and Prucha (1998, 1999, 2001), Pinkse and Slade (1998), Pinkse (1999), and Lee (1999a, b, c).

$$\begin{bmatrix} IND^M \\ IND^A \\ IND^R \\ IND^B \\ IND^T \\ IND^{AR} \end{bmatrix} = \beta_7 \begin{bmatrix} W & 0 & 0 & 0 & 0 & 0 \\ 0 & W & 0 & 0 & 0 & 0 \\ 0 & 0 & W & 0 & 0 & 0 \\ 0 & 0 & 0 & W & 0 & 0 \\ 0 & 0 & 0 & 0 & W & 0 \\ 0 & 0 & 0 & 0 & 0 & W \end{bmatrix} \begin{bmatrix} IND^M \\ IND^A \\ IND^R \\ IND^B \\ IND^T \\ IND^{AR} \end{bmatrix}$$

$$+ \beta_8 \begin{bmatrix} D & 0 & 0 & 0 & 0 & 0 \\ 0 & D & 0 & 0 & 0 & 0 \\ 0 & 0 & D & 0 & 0 & 0 \\ 0 & 0 & 0 & D & 0 & 0 \\ 0 & 0 & 0 & 0 & D & 0 \\ 0 & 0 & 0 & 0 & 0 & D \end{bmatrix} \begin{bmatrix} IND^M \\ IND^A \\ IND^R \\ IND^B \\ IND^T \\ IND^{AR} \end{bmatrix} + \begin{bmatrix} X^M \\ X^A \\ X^R \\ X^B \\ X^T \\ X^{AR} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ . \\ \beta_6 \end{bmatrix} + \begin{bmatrix} \varepsilon^M \\ \varepsilon^A \\ \varepsilon^R \\ \varepsilon^B \\ \varepsilon^T \\ \varepsilon^{AR} \end{bmatrix} \qquad (7)$$

where $\varepsilon^q, q = M, A, R$,B,T,AR are the corresponding disturbance vectors. In somewhat more "macro" terms, this model can be expressed as

$$IND = \beta_7 (I_6 \otimes W) IND + \beta_8 (I_6 \otimes D) IND + X\beta + \varepsilon \qquad (8)$$

where

$$\text{IND} = \begin{bmatrix} IND^M \\ IND^A \\ IND^R \\ IND^B \\ IND^T \\ IND^{AR} \end{bmatrix}, \text{X} = \begin{bmatrix} X^M \\ X^A \\ X^R \\ X^B \\ X^T \\ X^{AR} \end{bmatrix}$$

$$\beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ . \\ \beta_6 \end{bmatrix}, \quad \varepsilon = \begin{bmatrix} \varepsilon^M \\ \varepsilon^A \\ \varepsilon^R \\ \varepsilon^B \\ \varepsilon^B \\ \varepsilon^T \\ \varepsilon^{AR} \end{bmatrix}$$

and where our specifications concerning the error term imply that

$$\mathrm{E}\left(\varepsilon\varepsilon'\right) = \sigma_{\varepsilon}^{2} I_{150} \quad (9)$$

We now describe spillover effects relating to both the explanatory variables, which are the fundamentals, and the error terms which result from contagion by solving the model in (8) for the crisis vector IND. Specifically, the solution of (8) for IND is[15]

$$\mathrm{IND} = [I - \beta_7 (I \otimes W) - \beta_8 (I \otimes D)]^{-1} X\beta + \psi \quad (10)$$

$$\psi = [I - \beta_7 (I \otimes W) - \beta_8 (I \otimes D)]^{-1} \varepsilon$$

where our assumptions relating to ε_{it}^{q} in (1) imply

$$\mathrm{E}(\psi\psi') = \sigma_{\varepsilon}^{2} [I - \beta_7 (I \otimes W) - \beta_8 (I \otimes D)]^{-1} [I - \beta_7 (I \otimes W') - \beta_8 (I \otimes D')]^{-1} \quad (11)$$

Given the expression in (9), the solution for the dependent vector for each of the crises can be expressed as

$$IND^{q} = (I - \beta_7 W - \beta_8 D)^{-1} X^{q} \beta + \psi^{q} \quad (12)$$

$$\psi^{q} = (I - \beta_7 W - \beta_8 D)^{-1} \varepsilon^{q}, \;\; q = M, A, R, \text{B, T, AR}$$

It should be clear from (12) that the elements of IND^{q}, namely the crisis index for the 25 countries during the crises $q = M, A, R$, B, T, AR depend not only upon the "within country" values of the regressors and the disturbance term (e.g., the corresponding elements of X^{q} and ε^{q}), but also upon the values of the regressors and disturbance terms of all neighboring countries. As an example, the expected value of the dependent vector during the Mexican crisis IND^{M} is, via (12)

$$\mathrm{E}(IND^{\mathrm{M}}) = (I - \beta_7 W - \beta_8 D)^{-1} X^{\mathrm{M}} \beta \quad (13)$$

Let g_{ij} be the $i, j-th$ element of $(I - \beta_7 W - \beta_8 D)^{-1}$. Then, the change in the expected value of the crisis index in the $i-th$ country during the Mexican crisis, namely $E(IND_{it}^{\mathrm{M}})$, with respect to a change in the real GDP growth in the $j-th$ country, namely, $RGDP_{jt-}^{\mathrm{M}}$ is, via (13)

[15] In this case the X^{q} is a 25 x 6 matrix since there are five regressors and the constant.

$$\frac{\partial \mathrm{E}(IND_{it}^{\mathrm{M}})}{RGDP_{jt-}^{\mathrm{M}}} = g_{ij}\beta_2, \; j = 1,....,25 \qquad (14)$$

In general, g_{ij} will not be zero unless $\beta_7 = 0 and \beta_8 = 0$.[16] Therefore, a glance at (14) suggests that unless $\beta_7 = 0 and \beta_8 = 0$ or $\beta_2 = 0$, or $\beta_7 = \beta_8 = \beta_2 = 0$ the derivative in (14) will not be zero. Clearly, the magnitude of the cross derivative in (14) depends upon the direct effect of $RGDP_{jt-}^{\mathrm{M}}$ in equation (1), which is β_2, and an indirect spillover effect due to contagion, which is g_{ij}. Generalizing, it should now be clear that the crisis variable in a given country will be affected by the values of all of the significant variables in (1) in all related neighboring countries with respect to trade and distance. In the absence of contagion, e.g., $\beta_7 = 0 and \beta_8 = 0$ there will be no such "spillover" effects.

3.1 Two measures of contagion: own and emanating

At least two measures of the extent of contagion are suggested by (14). The first is a measure of how the existence of contagion, in a given country i, changes the effect of a variable from what it would be in the absence of contagion in that given country i. The second relates to how a change in a variable in a given country i influences all the other countries.

Consider the first measure and note from equation (1) that the direct effect of $RGDP_{it-}^{\mathrm{M}}$ on IND_{it}^{M} is β_2. That is, ignoring the effects of contagion, the effect on the crisis variable in the i-th country of a one unit change in real GDP growth variable $RGDP_{it-}^{\mathrm{M}}$ in the i-th country is β_2. However, if country i has an effect (via contagion) on other countries and they, in turn, feedback to country i, β_2 will not be the final effect of a change in $RGDP_{it-}^{\mathrm{M}}$ on IND_{it}^{M}. The final effect is given as a special case of (14), namely $g_{ii}\beta_2$. Therefore, one measure of the extent of *own* contagion of the i-th country is based on the ratio of the final effect to the direct effect, which is just g_{ii}. In particular, our first measure, in terms of elasticity is

---

[16] This should be clear from (7) since, if $\beta_9 = 0$, IND^q will only depend upon X^q, q = M,A,R,B,T, AR.

$$OWN_i = (g_{ii} - 1)\beta_2(\overline{RGDP_i} / \overline{IND_i}) \qquad (15)$$

where $\overline{RGDP_i} and \overline{IND_i}$ are the average of RGDP and IND variables of country i. Clearly, if exchange markets in country i have no effect on exchange markets in other countries, the final effect will be equal to the direct effect and so $g_{ii} = 1$ and, hence, $OWN_i = 0$. Alternatively, the greater is OWN_i the greater is the own contagion of the i-th country.

In passing we note that the development of the measure in (15) was in terms of the variable $RGDP_{it-}^{M}$. However, since the corresponding coefficient, namely β_2, cancels it should be clear that the measure in (15) is not variable specific, e.g., the development in terms of any other variable would lead to the same expression for the i-th country.

Now consider the contagion *emanating* effect of country j as to how a change in the real GDP growth variable effects all the other i countries. Again, in light of (14), the emanating effect in terms of elasticity of country j to country i is given by

$$EM_{ij} = g_{ij}\beta_2(\overline{RGDP_j} / \overline{IND_i}) \qquad (16)$$

where $\overline{RGDP_j} and \overline{IND_i}$ are the average of RGDP and IND variables of countries j and i. The measure in (16) is the average of the final response of IND_{it}^{M} to a percentage point change in the real GDP growth in the jth country.

3.2 An interpretation of the econometric specification of contagion

It may be useful to give an interpretation of the econometrics behind the contagion specification. Note that (8) is essentially a structural equation. The endogenous variable is of the two contagion variables, which is represented by $\beta_7(I_6 \otimes W)IND + \beta_8(I_6 \otimes D)IND$. The solution form of (8), namely (10), is a reduced form equation. As in many cases, the reduced form of the model describes the relationship between the endogenous variable, in this case $IND_{it}{}^{q}$, and all the predetermined variables appearing in the system, in this case the values of the predetermined corresponding to all of the cross sectional units. This is the reason why the derivative in (14) is not zero. Note, also, that the reduced form is nonlinear in the parameters, and the disturbance vector corresponding to the reduced form model has a complex variance-covariance matrix, which is given in (11). In contrast, and again in most cases, the structural form of the model, namely (8) and correspondingly (9), yields interpretations and is relatively simple in its specification. For example, (8) is linear in the parameters and relates the dependent variable in each country to a linear combination of the values of the independent variables in that country, and to the contagion variable. The variance-covariance matrix of the disturbance vector, in (9), is the "standard" one.

Because the structural form in (8) and (9) and the reduced form in (10) and (11) imply each other they are equivalent. The value of the structural (contagion) specification is that, without it, one would be left with the task of specifying and explaining, in our case, why and how the crisis variable in a given country is related to the fundamentals of all related countries and, correspondingly, why the disturbance vector has a specification that is so complex.

3.3 Final comments on the modeling approach

Before leaving this section we review some of the benefits of our spatial modeling approach. First, contagion is represented in our model (1) by the two variables CT_{it}^{q} and CD_{it}^{q} and so the tests for their absence is simply $H_0 : \beta_7 = 0$ against $H_1 : \beta_7 \neq 0$, $H_0 : \beta_8 = 0$ against $H_1 : \beta_8 \neq 0$ and $H_0 : \beta_7 = \beta_8 = 0$ against $H_1 : \beta_7 \neq \beta_8 \neq 0$. We note that both CT_{it}^{q} and CD_{it}^{q} are continuous variables and so our model accounts for degrees of contagion. A dummy variable approach, at best, could only account for whether or not contagion exists. Our model is also parsimonious in terms of the number of parameters but yet, via contagion, accounts for the reaction of exchange markets in each and every country with respect to the fundamentals, as well as macro shocks, in all related countries – see, e.g., equations (10) – (14). Indeed, our approach even allows user-friendly estimates of contagion effects which emanate from a given country to others, as well as those which impact each country considered. As we have seen, these two contagion effects are not symmetrical. Finally, trade contagion is often thought to relate, to both trade and, at least partially, to geographic distance. Our modeling approach, via the weighting matrix, allows us to capture the effects of trade and distance.

The stylized facts indicate that contagion during the estimation period is not the same among the crises and among the emerging countries of the sample. Therefore, in what follows, we take account of the following. First, contagion appears to have been more prevalent during the Mexican and Asian crises than in the remaining four crises (Kaminsky, Reinhart, and Vegh, 2003 p. 61).[17] To account for this factor a dummy variable (NEW) is included in the final equation with the contagion variables. The dummy variable, NEW, takes the value one for the first two crises (Mexican and Asian) and zero otherwise. Thus, in the final regression we allow for the coefficients on the contagion variables to differ for the Mexican and Asian crises as compared with the other four crises.

Second, contagion appears to have had a strong regional element. For example, the countries hardest hit by the Asian crisis were Indonesia, Korea, Malaysia, the Philippines and Singapore (Goldstein, 1998). To deal with the regional phenomenon, three regional dummies are included in our specification, with the constant term forming a fourth regional effect. ASIA includes all Asian countries plus Turkey. LATIN includes all Latin American countries. MIDDIE countries of Israel and Jordan. The constant term is the base group, consisting of the European countries plus South Africa.

Third, some of the EMEs in our sample apparently were little affected by contagion during each of six crises considered. In particularly, five countries - - China, India, Israel, Jordan, and South Africa - - experienced relative little exchange-market pressures due to the existence of capital controls and/or large (geographic) distances from the crisis epicenter. To deal with this factor, from the original trade matrix, W, two others matrices W1 and W2 were constructed. The first, W1, has all rows and columns corresponding to Israel, Jordan, China, India, and South Africa equal to zero. The second matrix, W2, is the opposite of W1: namely all rows and columns corresponding to Israel, Jordan, China, India, and South Africa are as they are in the original T matrix, but all the other rows and columns are zeroes. Similarly, we constructed two distance matrices D1 and D2 from the original. Hence the two

[17] Kaminsky, Reinhart, and Vegh, (2003 pp. 60-61) note that spillovers effects were associated with the Russian crisis of August 1998. These authors also point out, however, that it is not clear whether the spillovers emanated from the Russian loan default or the crisis sparked by the collapse of Long Term Capital Management (LTCM) which occurred in the fall of 1998.

coefficients β_7 and β_8 vary between Israel, Jordan, China, India, and South Africa as to the other twenty countries.

Hence, eight contagion variables are included in the basic specification. CT1*NEW is defined as the trade contagion variable for the first two crises (Mexican and Asian) and is related to all countries except Israel, Jordan, China, India, and South Africa. CT1*(1-NEW) is defined as the trade contagion variable for the last four crises (Russian, Brazilian, Turkish, Argentinean) and is related to all countries except Israel, Jordan, China, India, and South Africa. CT2*NEW is defined as the trade contagion variable for the first two crises (Mexican and Asian) and is related to Israel, Jordan, China, India, and South Africa. CT2*(1-NEW) is defined as the trade contagion variable for the last four crises (Russian, Brazilian, Turkish, Argentinean) and is related to Israel, Jordan, China, India, and South Africa equal to zero. Similarly the other four contagion variables, CD1*NEW, CD1*(1-NEW) CD2*(1-NEW) CD2*NEW, related to distance, are defined.

4. Empirical results

The empirical results relating to equation (1) are reported in Table 1.[18] To take into account endogeneity, two stage least squares is employed with all independent variables included as instruments. The first column of the table contains the estimates of the basic model without contagion variables; this specification is called Model 1. All variables are significant and the coefficients are of the correct sign.

The second column adds all the contagion variables to the basic specification.[19] The following results are worth-noting. First, all the regional dummies are statistically significant. Second, all the trade contagion variables except

[18] Generalized least squares method with cross section weights is used in the panel estimation. Cross section standard errors, adjusted for heteroskedacity and covariances corrected for the degrees of freedom are estimated.

[19] Models 2 and 3 are estimated employing as instruments all the independent variables except the contagion variables plus all the independent variables times the distance and trade matrices, respectively. Since, the trade matrix is estimated using 1998 data, a dummy variable is employed; the dummy takes the value zero for the first three crises and unity for the last three crises. Hence, all the instruments which are estimated as the product of the independent variables and the trade matrix take the value equal to zero for the first three crises. To account for the possible endogeneity of the independent variables for the first three crises three variables, which originally were included in the basic specification, but were not significant in explaining the crisis indicator (inflation, the rates of broad money to international reserves and changes in major stock market indexes), are included as instruments multiplied by 1minus the dummy.

CT1*NEW (i.e., the trade contagion variable for the Mexican and Asian crises applied to twenty countries) are correctly signed (a higher importance of exports to United Sates, Japan and European Union countries results in a higher crisis index), but are not significant for CT1*NEW and CT1*(1-NEW) (i.e., the trade contagion variable for the last four crises applied to twenty countries). Third, all the distance contagion variables except CD2*(1-NEW) (i.e. the distance contagion variable for the last four crises applied to five countries) are correctly signed (a greater distance reduces contagion), but are not significant for CD2*NEW (i.e. the distance contagion variable for the first two crises applied to five countries) and CD2*(1-NEW). The addition of the contagion variables do not change significantly the values of the fundamental variables (i.e.,RGDP, RER, SDRES and CRED).

Three joint tests of significance are performed for the contagion variables. The F-statistic for the hypothesis that CT1*NEW and CT1*(1-NEW) are equal to zero is not rejected (F=0.087). In addition, the F-statistic testing the hypothesis that CD2*NEW and CD2*(1-NEW) are equal to zero is not rejected (F=0.335). Finally, the F-statistic testing the hypothesis that CT1*NEW, CT1*(1-NEW), CD2*NEW and CD2*(1-NEW) are equal to zero is not rejected (F=0.550).

Next, from Model 2 all the contagion variables which are not statistically significant are excluded. Model 3 presents the empirical estimates. All variables included in the model are significant and correctly signed. The F-statistic testing the hypothesis that CT2*NEW (i.e. the trade contagion variable for the first two crises applied to five countries) and CT2*(1-NEW) are equal to zero is rejected (F=6.001). In addition, the F-statistic testing the hypothesis that CD1*NEW (i.e. the distance contagion variable for the first two crises applied to twenty countries) and CD1*(1-NEW) are equal to zero is not rejected (F=240.38).

Our results suggest that contagion may be a factor in exchange markets even after the effects of relevant fundamentals and trade linkages are accounted for. The empirical results from Model 3 suggest that trade linkages are statistically significant during all of the crises but only for the five countries, Israel, Jordan, India, China, and South Africa. For the other twenty countries, contagion via geographic distance is statistically significant during all of the crises.

Table 1			
Model Estimates			
Variables	**Model 1 (1)**	**Model 2 (2)**	**Model 3 (3)**
Constant	-0.158 (-0.07)	-3.585 (-2.53)	-3.201** (-2.30)
ASIA	2.11 (0.98)	3.68** (1.91)	2.887* (1.86)
LATIN	5.293** (2.23)	5.751*** (2.71)	4.809** (2.00)
MIDDLE	0.701 (0.32)	6.541** (2.41)	3.782** (2.09)
RGDP	-0.520*** (-4.62)	-0.674*** (-13.61)	-0.758*** (-6.01)
RER	-0.123*** (-4.62)	-0.132*** (-4.98)	-0.131*** (-7.35)
SDRES	0.019*** (7.08)	0.023** (2.38)	0.024*** (2.83)
CRED	0.058** (2.23)	0.057* (1.77)	0.065*** (2.00)
EXP	-0.032** (-1.91)	-0.031 (-1.51)	-0.036* (-1.76)
CT1*NEW		-0.012 (-0.27)	
CT1*(1-NEW)		0.001 (0.06)	
CT2*NEW		0.025* (1.77)	0.029 (0.98)
CT2*(1-NEW)		0.042** (2.20)	0.060*** (2.61)
CD1*NEW		105.025*** (17.00)	96.772*** (18.54)
CD1*(1-NEW)		86.068*** (6.99)	91.453*** (4.67)
CD2*NEW		11.282 (0.76)	
CD2*(1-NEW)		-8.183 (-0.51)	
R-squared adjusted	0.13	0.18	0.18
S.E. regression	16.82	16.28	16.51
Notes: t-statistics are given in parenthesis. ***,**,* indicate 1%, 5% and 10% level of significance respectively.			

The results in Tables 2 and 3 contain estimates of the emanating elasticities during the different crises with respect to a change in real GDP growth. The first column in Tables 2 and 3 relates to contagion which emanates from each listed country – i.e..first column presents the impact of South Africa to the other listed country – i.e., EM_{ij} in (16). As shown in the first column, contagion does not emanate each country in a uniform fashion. For example, the figures in the first column range from to -0.28 to 0.13 with an average of -0.008 and a standard deviation of 0.08. To take the case of Malaysia for the Mexican and Asian crises the emanating elasticity with respect to real GDP ranges from -8.46 to 1.85 with an average of -0.31 and a standard deviation of 1.84. The reason for this variation is that Malaysia is an immediate neighbor to Singapore (-8.45) so that a change in growth of real GDP in Malaysia effects the exchange rate pressure in Singapore whereas it is far away form other countries such as Brazil. Therefore, a change in a fundamental in Malaysia impacts exchange markets in other countries, which in turn, impact still other countries, etc.

Similarly, Tables 4 and 5 contain the estimates of own contagion elasticities during the different crises with respect to a change in real GDP growth. The estimated elasticities for the Mexican and Asian crises range from -6.22 for Singapore to 0.40 for Korea. The elasticities measure how the existence of contagion in a given country changes the effect of real GDP growth in that same country due to contagion. Therefore, the results indicate for example, that changes in real growth in Singapore and Korea, respectively, will affect exchange markets more in Singapore than in Korea.

5. Summary and suggestions for further work

Among other things, our modeling approach enables us to test for contagion in a formal, straightforward way. It also enabled us to obtain measures of contagion which emanate from one country to others, as well as contagion which impacts a given country from others. Our contagion variables are continuous variables and so we are able to account for degrees of contagion, which clearly cannot be done in a dummy variable formulation. We have also given interpretations of our contagion specification in terms of a structural simultaneous equation, and described its solution as a reduced form equation. Our results suggest that trade linkages are statistically significant during the Mexican and Asian crises, as well as for the other crises, but only for the five countries Israel, Jordan, India, China, and S. Africa. On the other hand, contagion via geographic distances are statistically also during all of the crises, but only for the other twenty countries. Two types of contagion elasticities are estimated. The emanating elasticities relate to how a change in a fundamental in one country effects the other countries and the own contagion elasticites relate to how the existence of contagion effects the same country. These elasticities are small, on average, but have a large standard deviation which indicates that the results are not uniform over the countries.

One suggestion for further work would be to estimate a spatial model such as ours in terms of an extended data set which includes non-crisis as well as crisis periods. If such a model were properly specified, contagion could turn out to be a "continuum" that may be more intense during crisis periods, but exists never-the-less during non-crisis periods. Another suggestion would be to develop a nonlinear spatial model which is able to account for possible nonlinearities in the relationship between foreign-exchange-market activity in one country and that of its neighbors.

References

Ahluwalia, P., 2000, "Discriminating Contagion: An Alternative Explanation of Contagious Currency Crises in Emerging Markets", *IMF Working Paper*, 00/14.

Anselin, L., 1988, *Spatial Econometrics: Methods and Models* (Kluwer Academic Publishers, Boston).

Audretsch, D. and M. Feldmann, 1996, "R&D Spillovers and the Geography of Innovation and Production", *American Economic Review,* 86, 630-640.

Baig, T. and I. Goldfaijn, 1998, "Financial Market Contagion and the Asian Crisis", *IMF Working Paper,* 98/115.

Boyer, B., M. Gibson and M. Loretan, 1999, "Pitfalls in Tests for Changes in Correlations", *Working Paper* 597R, Federal Reserve Board, International Finance Division.

Bussière, M. and C. Mulder, 1999, "External Vulnerability in Emerging Market Economies: How High Liquidity Can Offset Weak Fundamentals and the Effects of Contagion", *IMF Working Paper*, 99/88.

Calvo, G. A., 1999, "Contagion in Emerging Markets: When the Wall Street is a Carrier", University of Maryland, mimeo.

Case, A., 1991, "Spatial Patterns in Household Demand", *Econometrica,* 59, 953-966.

Case, A., J. Hines Jr. and H. Rosen, 1993, "Budget Spillovers and Fiscal Policy Independence: Evidence from the States", *Journal of Public Economics,* 52, 285-307.

Claessens, S., R. Dornbusch and Y. Park, 2001, "International Financial Contagion: How it Spreads and How It can be Stopped", in: Claessens, S. Forbes, K. J. (eds), *International Financial Contagion*, Kluwer Academic Publishers, Boston, 3-18.

Cliff, A. and J. Ord., 1973, *Spatial Autocorrelation* (Pion, london).

Cliff, A. and J. Ord., 1981, *Spatial Processes, Models and Applications* (Pion, London).

Corsetti, G., M. Pericoli and M. Sbracia, 2002, "Some Contagion, Some Interdependence: More Pitfalls in tests of Financial Contagion", mimeo.

Cressie, N., 1993, *Statistics of Spatial Data* (Wiley, New York).

Dellas, H. and A. Stockman, 1993, "Self-Fulfilling Expectations, Speculative Attack, and Capital Controls", *Journal of Money, Credit and Banking*, 25, 721-730.

Dubin, R., 1988, "Estimation of Regression Coefficients in the Presence of Spatially Autocorrelated Error Terms", *Review of Economics and Statistics,* 70, 466-474.

Edwards, S., 2000, "Contagion", *The World Economy*, 23, 873-900.

Edwards, S. and R. Susmel, 2001, "Volatility Dependence and Contagion in Emerging Markets", *Journal of Development Economics*, 66, 505-32.

Eichengreen, B., A. K. Rose and C. Wyplosz, 1996, "Contagious Currency Crises", *Scandinavian Journal of Economics,* 98, 463-484.

Forbes, K. J. and R. Rigobon, 2001, "Measuring Contagion: Conceptual and Empirical Issues", in: Claessens, S. Forbes, K. J. (eds), *International Financial Contagion,* Kluwer Academic Publishers, Boston, 43-66.

Forbes, K. J. and R. Rigobon, 2002, “No Contagion, Only Interdependence: Measuring Stock Market Co-Movements”, *Journal of Finance*, 57, 2223-2261.

Fratzscher, M., 2003, “On Currency Crises and Contagion”, *International Journal of Finance and Economics*, 8, 109-30.

Glick, R. and A. K. Rose, 1999, “Contagion and Trade Why are Currency Crises Regional?” *Journal of International Money and Finance*, 18, 603-617.

Hernandez, L. F. and R. O. Valdes, 2001, “What Drives Contagion Trade, Neighbourhood, or Financial Links?” *International Review of Financial Analysis*, 10, 203-218.

Holtz-Eakin, D., 1994, “Public Sector Capital and the Productivity Puzzle”, *Review of Economics and Statistics*, 76, 12-21.

International Monetary Fund, 2001, "The Global Economy After September 11", *World Economic Outlook,* December, Washington D. C..

Ito, T. and Y. Hashimoto, 2002, “High-Frequency Contagion of Currency Crises in Asia”, *NBER Working Paper*, 9376.

Kaminsky, G. L. and C. M. Reinhart, 1999, “The Twin Crises: The Causes of Banking and Balance of Payments Problems”, *American Economic Review*, 89, 473-500.

Kaminsky, G. L. and C. M. Reinhart, 2000, “On Crises, Contagion and Confusion”, *Journal of International Economics*, 51, 145-168.

Kaminsky, G.L. and C.M. Reinhart, 2002, “Financial Markets in Time of Stress”, *Journal of Development Economics*, 69, 451-70.

Kaminsky, G.L., Reinhart, C. M. and C. A. Végh, 2003, “The Unholy Trinity of Fiancial Contagion”, *Journal of Economic Perspectives*, 17, 51-74.

Kelejian, H. H. and I. R. Prucha, 1998, “A Generalized Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances”, *Journal of Real Estate Finance and Economics*, 17, 99-121.

Kelejian, H. H. and I. R. Prucha, 1999, “A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model”, *International Economic Review*, 40, 509-533.

Kelejian, H. H. and I. R. Prucha, 2001, “On the Asymptotic Distribution of the Moran I Test Statistic with Applications”, *Journal of Econometrics*, 104, 219-257.

Lee, L., 1999a, “Best Spatial Two-Stage Least Squares Estimators for a Spatial Autoregressive Model with Autoregressive Disturbances”, mimeo, *Department of Economics, Hong Kong University of Science and Technology.*

Lee, L., 1999b, “Consistency and Efficiency of Least Squares Estimation for Mixed Regressive, Spatial Autoregressive Models”, mimeo, *Department of Economics, Hong Kong University of Science and Technology*.

Lee, L., 1999c, “Asymptotic Distributions of Maximum Likelihood Estimators for Spatial Autoregressive Models”, mimeo, *Department of Economics, Hong Kong University of Science and Technology*.

Masson, P., 1999, “Contagion: Monsoonal Effects, Spillovers and Jumps Between Multiple Equilibria, in Agenor”, P. R., M. Miller, D. Vines and A. Weber (eds), *The Asian Financial Crisis: Causes, Contagion and Consequences*, Cambridge University Press.

Pericoli, M., and M. Sbracia, 2001, “A Primer on Financial Contagion”, *Temi di discussione*, Bank of Italy, 407.

Pinkse, J., and M. Slade, 1998, “Contracting in Space: An Application of Spatial Statistics to Discrete-Choice Models”, *Journal of Econometrics*, 85, 125-154.

Pinkse, J., 1999, “Asymptotic Properties of Moran and Related Tests and Testing for Spatial Correlation in Probit Models”, *Department of Economics, University of British Columbia and University College London*.

Rigobon, R., 2002, “The Curse of Non-investment Grade Countries”, *Journal of Development Economics*, 69, 423-49.

Sachs, J., D., A. Tornell and A. Velasco, 1996, “Financial Crises in Emerging Markets: The Lessons from 1995”, *Brookings Papers on Economic Activity*, No.1, 147-215.

Shroder, M., 1995, “Games the States don’t Play: Welfare Benefits and the Theory of Fiscal Federalism”, *Review of Economics and Statistics*, 77, 183-191.

Topa, G., 1996, *Social Interactions, Local Spillovers, and Unemployment*, Ph.D. Thesis (University of Chicago, Chicago).

Tornell, A., 1998, “Common Fundamentals in the Tequila and Asian Crises”, mimeo, Harvard University.

Zhu, L. and J. Yang, 2004, " The Role of Psychic Distance in Contagion: A Gravity Model for Contagious Financial Crises", The George Washington University.

Table 2

Estimates of each Country's Emanating Elasticities During the Mexican and Asian Crises

with Respect to a Change in RGDP in the Initiating Country

Effected Countries	**Initiating Countries**								
	South Africa	Argentina	Brazil	China	Chile	Colombia	Czech Republic	Hungary	India
South Africa		-0.0333	-0.0272	-0.0619	-0.0423	-0.0288	-0.0608	-0.0400	-0.0415
Argentina	-0.0113		-0.0410	-0.0399	-0.1199	-0.0338	-0.0425	-0.0280	-0.0267
Brazil	-0.0072	-0.0321		-0.0257	-0.0353	-0.0214	-0.0263	-0.0173	-0.0178
China	0.0103	0.0196	0.0161		0.0256	0.0172	0.0343	0.0226	0.0247
Chile	0.0158	0.1314	0.0494	0.0573		0.0458	0.0546	0.0359	0.0394
Colombia	-0.0142	-0.0489	-0.0395	-0.0510	-0.0605		-0.0536	-0.0352	-0.0359
Czech Republic	0.0495	0.1018	0.0806	0.1676	0.1194	0.0886		0.2891	0.1222
Hungary	-0.0404	-0.0830	-0.0657	-0.1371	-0.0973	-0.0721	-0.3581		-0.0997
India	-0.1821	-0.3438	-0.2934	-0.6497	-0.4640	-0.3196	-0.6575	-0.4333	
Indonesia	-0.0254	-0.0469	-0.0344	-0.0878	-0.0549	-0.0364	-0.0949	-0.0628	-0.0602
Israel	0.0452	0.0866	0.0729	0.1560	0.1176	0.0872	0.1835	0.1209	0.1124
Jordan	0.0108	0.0211	0.0161	0.0359	0.0255	0.0175	0.0368	0.0243	0.0246
Korea	0.1303	0.2326	0.1766	0.4351	0.2758	0.1988	0.5172	0.3419	0.2957
Malaysia	-0.0180	-0.0330	-0.0244	-0.0617	-0.0386	-0.0260	-0.0684	-0.0453	-0.0423
Mexico	-0.0032	-0.0080	-0.0060	-0.0104	-0.0098	-0.0093	-0.0107	-0.0071	-0.0078
Pakistan	-0.0298	-0.0575	-0.0443	-0.1066	-0.0673	-0.0479	-0.1422	-0.0945	-0.0747
Peru	0.0291	0.1250	0.0885	0.1067	0.1647	0.1286	0.1060	0.0697	0.0745
Philippines	-0.0072	-0.0130	-0.0096	-0.0247	-0.0153	-0.0106	-0.0272	-0.0180	-0.0175
Poland	0.0264	0.0538	0.0426	0.0894	0.0631	0.0468	0.2275	0.1481	0.0650
Russia	-0.0252	-0.0500	-0.0393	-0.0865	-0.0586	-0.0433	-0.1689	-0.1122	-0.0617
Singapore	-0.2833	-0.5203	-0.3845	-0.9654	-0.6089	-0.4091	-1.0770	-0.7134	-0.6597
Sri Lanka	0.0174	0.0342	0.0257	0.0620	0.0399	0.0272	0.0737	0.0489	0.0434
Thailand	-0.0161	-0.0294	-0.0219	-0.0561	-0.0344	-0.0235	-0.0627	-0.0415	-0.0389
Turkey	0.0878	0.1780	0.1402	0.3032	0.2082	0.1523	0.5782	0.3962	0.2169
Venezuela	0.0366	0.1176	0.0999	0.1301	0.1428	0.2134	0.1396	0.0917	0.0900
sum	**-0.2044**	**-0.1976**	**-0.2227**	**-0.8214**	**-0.5248**	**-0.0583**	**-0.8996**	**-0.0594**	**-0.0755**
average	**-0.0085**	**-0.0082**	**-0.0093**	**-0.0342**	**-0.0219**	**-0.0024**	**-0.0375**	**-0.0025**	**-0.0031**
st. deviation	**0.0806**	**0.1566**	**0.1201**	**0.2771**	**0.1889**	**0.1367**	**0.3292**	**0.2228**	**0.1681**
absolute sum	**1.1226**	**2.4008**	**1.8398**	**3.9078**	**2.8897**	**2.1052**	**4.8023**	**3.2381**	**2.2933**
absolute average	**0.0468**	**0.1000**	**0.0767**	**0.1628**	**0.1204**	**0.0877**	**0.2001**	**0.1349**	**0.0956**
absolute st. deviation	**0.0655**	**0.1190**	**0.0916**	**0.2244**	**0.1452**	**0.1033**	**0.2608**	**0.1751**	**0.1369**

Table 2 (continues)									
Estimates of each Country's Emanating Elasticities During the Mexican and Asian Crises									
with Respect to a Change in RGDP in the Initiating Country									
	Initiating Countries								
Effected Countries	Indonesia	Israel	Jordan	Korea	Malaysia	Mexico	Pakistan	Peru	Philippines
South Africa	-0.0903	-0.0355	-0.0068	-0.0577	-0.1751	-0.0307	-0.0382	-0.0479	-0.0464
Argentina	-0.0567	-0.0232	-0.0045	-0.0351	-0.1093	-0.0260	-0.0251	-0.0702	-0.0286
Brazil	-0.0326	-0.0153	-0.0027	-0.0208	-0.0633	-0.0153	-0.0151	-0.0389	-0.0165
China	0.0520	0.0205	0.0038	0.0321	0.1002	0.0166	0.0228	0.0294	0.0266
Chile	0.0727	0.0345	0.0060	0.0456	0.1401	0.0351	0.0322	0.1013	0.0368
Colombia	-0.0639	-0.0338	-0.0054	-0.0434	-0.1247	-0.0441	-0.0303	-0.1047	-0.0336
Czech Republic	0.2749	0.1177	0.0189	0.1868	0.5433	0.0838	0.1487	0.1426	0.1431
Hungary	-0.2255	-0.0961	-0.0154	-0.1530	-0.4457	-0.0681	-0.1224	-0.1161	-0.1173
India	-0.9390	-0.3881	-0.0679	-0.5749	-1.8075	-0.3268	-0.4205	-0.5396	-0.4946
Indonesia		-0.0519	-0.0094	-0.1160	-0.5694	-0.0361	-0.0750	-0.0616	-0.1153
Israel	0.2343		0.0172	0.1431	0.4512	0.0899	0.1108	0.1450	0.1328
Jordan	0.0534	0.0216		0.0342	0.1035	0.0175	0.0229	0.0288	0.0277
Korea	0.9302	0.2541	0.0484		1.8501	0.2010	0.3925	0.3259	0.5902
Malaysia	-0.2078	-0.0365	-0.0067	-0.0842		-0.0257	-0.0551	-0.0434	-0.0835
Mexico	-0.0134	-0.0074	-0.0011	-0.0093	-0.0261		-0.0062	-0.0139	-0.0071
Pakistan	-0.2077	-0.0679	-0.0112	-0.1355	-0.4183	-0.0464		-0.0785	-0.1071
Peru	0.1326	0.0692	0.0110	0.0875	0.2563	0.0805	0.0610		0.0686
Philippines	-0.0636	-0.0162	-0.0027	-0.0406	-0.1262	-0.0106	-0.0213	-0.0176	
Poland	0.1468	0.0625	0.0100	0.1000	0.2903	0.0444	0.0799	0.0754	0.0765
Russia	-0.1416	-0.0562	-0.0094	-0.0974	-0.2803	-0.0414	-0.0789	-0.0698	-0.0740
Singapore	-3.3991	-0.5684	-0.1052	-1.3303	-8.4595	-0.4049	-0.8650	-0.6850	-1.3301
Sri Lanka	0.1513	0.0416	0.0066	0.0794	0.3100	0.0262	0.0626	0.0452	0.0704
Thailand	-0.1548	-0.0337	-0.0060	-0.0787	-0.3434	-0.0232	-0.0519	-0.0389	-0.0759
Turkey	0.5012	0.2025	0.0332	0.3352	0.9918	0.1439	0.2795	0.2466	0.2592
Venezuela	0.1634	0.0796	0.0137	0.1111	0.3195	0.1047	0.0783	0.2190	0.0857
Sum	**-2.8832**	**-0.5264**	**-0.0858**	**-1.6218**	**-7.5925**	**-0.2557**	**-0.5139**	**-0.5670**	**-1.0125**
Average	**-0.1201**	**-0.0219**	**-0.0036**	**-0.0676**	**-0.3164**	**-0.0107**	**-0.0214**	**-0.0236**	**-0.0422**
st. deviation	**0.7700**	**0.1650**	**0.0300**	**0.3152**	**1.8497**	**0.1287**	**0.2321**	**0.2162**	**0.3305**
absolute sum	**8.3089**	**2.3339**	**0.4232**	**3.9319**	**18.3047**	**1.9426**	**3.0965**	**3.2854**	**4.0476**
absolute average	**0.3462**	**0.0972**	**0.0176**	**0.1638**	**0.7627**	**0.0809**	**0.1290**	**0.1369**	**0.1686**
absolute st. deviation	**0.6949**	**0.1336**	**0.0243**	**0.2759**	**1.7085**	**0.0992**	**0.1923**	**0.1666**	**0.2853**

Table 2 (continues)							
Estimates of each Country's Emanating Elasticities During the Mexican and Asian Crises							
with Respect to a Change in RGDP in the Initiating Country							
Effected Countries	**Initiating Countries**						
	Poland	Russia	Singapore	Sri Lanka	Thailand	Turkey	Venezuela
South Africa	-0.1038	0.1009	-0.1781	-0.0411	-0.0878	-0.0090	0.0088
Argentina	-0.0721	0.0682	-0.1113	-0.0275	-0.0544	-0.0062	0.0096
Brazil	-0.0446	0.0420	-0.0644	-0.0161	-0.0317	-0.0038	0.0064
China	0.0587	-0.0578	0.1011	0.0244	0.0509	0.0052	-0.0052
Chile	0.0926	-0.0875	0.1427	0.0351	0.0697	0.0080	-0.0128
Colombia	-0.0909	0.0856	-0.1268	-0.0317	-0.0631	-0.0077	0.0253
Czech Republic	0.7303	-0.5520	0.5519	0.1419	0.2780	0.0483	-0.0274
Hungary	-0.5890	0.4539	-0.4528	-0.1166	-0.2281	-0.0410	0.0223
India	-1.1230	1.0846	-1.8195	-0.4497	-0.9278	-0.0975	0.0950
Indonesia	-0.1627	0.1597	-0.6011	-0.1005	-0.2369	-0.0144	0.0111
Israel	0.3126	-0.2863	0.4540	0.1249	0.2329	0.0264	-0.0243
Jordan	0.0628	-0.0602	0.1053	0.0249	0.0520	0.0054	-0.0053
Korea	0.8887	-0.8808	1.8873	0.4233	0.9657	0.0775	-0.0603
Malaysia	-0.1174	0.1154	-0.5461	-0.0752	-0.1918	-0.0104	0.0079
Mexico	-0.0183	0.0173	-0.0266	-0.0065	-0.0132	-0.0015	0.0026
Pakistan	-0.2451	0.2465	-0.4237	-0.1152	-0.2199	-0.0223	0.0147
Peru	0.1798	-0.1696	0.2609	0.0647	0.1283	0.0153	-0.0319
Philippines	-0.0468	0.0460	-0.1298	-0.0258	-0.0641	-0.0041	0.0032
Poland		-0.3098	0.2950	0.0758	0.1487	0.0260	-0.0145
Russia	-0.3043		-0.2848	-0.0732	-0.1439	-0.0239	0.0133
Singapore	-1.8477	1.8161		-1.1707	-2.9703	-0.1642	0.1244
Sri Lanka	0.1265	-0.1242	0.3116		0.1567	0.0114	-0.0083
Thailand	-0.1076	0.1060	-0.3433	-0.0680		-0.0096	0.0072
Turkey	0.9977	-0.9333	1.0073	0.2623	0.5080		-0.0469
Venezuela	0.2366	-0.2223	0.3250	0.0814	0.1618	0.0200	
Sum	**-1.1870**	**0.6585**	**0.3341**	**-1.0592**	**-2.4805**	**-0.1723**	**0.1148**
Average	**-0.0495**	**0.0274**	**0.0139**	**-0.0441**	**-0.1034**	**-0.0072**	**0.0048**
st. deviation	**0.5798**	**0.5531**	**0.6632**	**0.2863**	**0.6942**	**0.0462**	**0.0388**
absolute sum	**8.5595**	**8.0260**	**10.5505**	**3.5763**	**7.9859**	**0.6591**	**0.5886**
absolute average	**0.3566**	**0.3344**	**0.4396**	**0.1490**	**0.3327**	**0.0275**	**0.0245**
absolute st. deviation	**0.4539**	**0.4360**	**0.4883**	**0.2467**	**0.6144**	**0.0375**	**0.0300**

Table 3									
Estimates of each Country's Emanating Elasticities During the Russian, Brazilian, Turkish and Argentinean Crises with Respect to a Change in RGDP in the Initiating Country									
	Initiating Countries								
Effected Countries	South Africa	Argentina	Brazil	China	Chile	Colombia	Czech Republic	Hungary	India
South Africa		-0.0101	-0.0152	-0.0721	-0.0301	-0.0150	-0.0201	-0.0824	-0.0454
Argentina	-0.0045		-0.0062	-0.0181	-0.0218	-0.0049	-0.0044	-0.0179	-0.0111
Brazil	-0.0103	-0.0094		-0.0412	-0.0243	-0.0110	-0.0097	-0.0398	-0.0263
China	0.0363	0.0203	0.0306		0.0617	0.0305	0.0390	0.1598	0.0910
Chile	-0.0253	-0.0408	-0.0301	-0.1031		-0.0266	-0.0231	-0.0944	-0.0654
Colombia	-0.0437	-0.0319	-0.0472	-0.1768	-0.0920		-0.0427	-0.1744	-0.1142
Czech Republic	0.0730	0.0354	0.0519	0.2805	0.0994	0.0531		0.6212	0.1866
Hungary	0.2606	0.1263	0.1855	1.0041	0.3550	0.1892	0.5421		0.6669
India	-0.2419	-0.1323	-0.2062	-0.9632	-0.4140	-0.2086	-0.2742	-1.1229	
Indonesia	0.0700	0.0312	0.0434	0.2742	0.0877	0.0431	0.0670	0.2757	0.1732
Israel	-0.0352	-0.0191	-0.0294	-0.1376	-0.0601	-0.0322	-0.0432	-0.1770	-0.0901
Jordan	0.0468	0.0269	0.0382	0.1798	0.0765	0.0385	0.0516	0.2113	0.1146
Korea	0.0347	0.0150	0.0214	0.1319	0.0425	0.0222	0.0348	0.1429	0.0826
Malaysia	0.0943	0.0417	0.0584	0.3670	0.1173	0.0582	0.0916	0.3768	0.2316
Mexico	-0.0438	-0.0244	-0.0344	-0.1628	-0.0707	-0.0461	-0.0390	-0.1594	-0.1105
Pakistan	0.2990	0.1383	0.1992	1.2075	0.3893	0.2014	0.3504	1.4463	0.7762
Peru	0.2096	0.1847	0.2437	0.8632	0.5607	0.3160	0.1997	0.8163	0.5537
Philippines	0.1597	0.0702	0.0983	0.6223	0.1989	0.1007	0.1552	0.6379	0.4038
Poland	-0.7490	-0.3609	-0.5297	-2.8850	-1.0147	-0.5414	-1.5161	-6.1356	-1.9150
Russia	-0.0106	-0.0050	-0.0073	-0.0413	-0.0140	-0.0074	-0.0167	-0.0691	-0.0269
Singapore	0.4573	0.2024	0.2827	1.7676	0.5689	0.2819	0.4435	1.8242	1.1122
Sri Lanka	0.0311	0.0146	0.0207	0.1251	0.0411	0.0206	0.0331	0.1366	0.0804
Thailand	0.0658	0.0290	0.0408	0.2590	0.0816	0.0410	0.0651	0.2677	0.1650
Turkey	-0.0092	-0.0044	-0.0065	-0.0361	-0.0124	-0.0065	-0.0143	-0.0609	-0.0236
Venezuela	-0.0089	-0.0061	-0.0094	-0.0355	-0.0173	-0.0172	-0.0087	-0.0354	-0.0226
sum	**0.6560**	**0.2916**	**0.3933**	**2.4096**	**0.9091**	**0.4794**	**0.0608**	**-1.2524**	**2.1869**
average	**0.0273**	**0.0121**	**0.0164**	**0.1004**	**0.0379**	**0.0200**	**0.0025**	**-0.0522**	**0.0911**
st. deviation	**0.2160**	**0.1083**	**0.1558**	**0.8406**	**0.3088**	**0.1629**	**0.3660**	**1.4178**	**0.5293**
absolute sum	**3.0207**	**1.5803**	**2.2363**	**11.7549**	**4.4519**	**2.3136**	**4.0853**	**15.0860**	**7.0890**
absolute average	**0.1259**	**0.0658**	**0.0932**	**0.4898**	**0.1855**	**0.0964**	**0.1702**	**0.6286**	**0.2954**
absolute st. deviation	**0.1758**	**0.0857**	**0.1245**	**0.6832**	**0.2468**	**0.1314**	**0.3221**	**1.2652**	**0.4448**

Table 3 (continues)									
Estimates of each Country's Emanating Elasticities During the Russian, Brazilian, Turkish									
and Argentinean Crises with Respect to a Change in RGDP in the Initiating Country									
	Initiating Countries								
Effected Countries	Indonesia	Israel	Jordan	Korea	Malaysia	Mexico	Pakistan	Peru	Philippines
South Africa	0.0002	-0.0320	-0.0116	-0.0190	-0.0375	-0.0314	-0.0198	-0.0154	-0.0273
Argentina	0.0000	-0.0078	-0.0030	-0.0037	-0.0074	-0.0079	-0.0041	-0.0061	-0.0054
Brazil	0.0001	-0.0182	-0.0064	-0.0079	-0.0158	-0.0167	-0.0089	-0.0121	-0.0114
China	-0.0004	0.0631	0.0223	0.0364	0.0735	0.0588	0.0402	0.0319	0.0535
Chile	0.0002	-0.0460	-0.0159	-0.0196	-0.0393	-0.0427	-0.0216	-0.0346	-0.0286
Colombia	0.0004	-0.0856	-0.0277	-0.0355	-0.0675	-0.0965	-0.0388	-0.0676	-0.0501
Czech Republic	-0.0007	0.1427	0.0461	0.0691	0.1321	0.1015	0.0839	0.0531	0.0961
Hungary	-0.0025	0.5101	0.1649	0.2476	0.4743	0.3617	0.3023	0.1895	0.3446
India	0.0026	-0.4372	-0.1506	-0.2408	-0.4909	-0.4222	-0.2731	-0.2165	-0.3672
Indonesia		0.1203	0.0433	0.0775	0.2382	0.0854	0.0791	0.0448	0.1338
Israel	0.0004		-0.0222	-0.0344	-0.0703	-0.0657	-0.0410	-0.0330	-0.0561
Jordan	-0.0005	0.0818		0.0477	0.0941	0.0764	0.0501	0.0391	0.0691
Korea	-0.0004	0.0572	0.0215		0.0776	0.0447	0.0400	0.0226	0.0665
Malaysia	-0.0017	0.1609	0.0583	0.1068		0.1152	0.1102	0.0600	0.1840
Mexico	0.0003	-0.0834	-0.0263	-0.0341	-0.0639		-0.0361	-0.0431	-0.0479
Pakistan	-0.0034	0.5647	0.1872	0.3312	0.6638	0.3921		0.2044	0.4688
Peru	-0.0018	0.4099	0.1315	0.1683	0.3254	0.4211	0.1840		0.2401
Philippines	-0.0023	0.2993	0.0998	0.2132	0.4289	0.2013	0.1814	0.1032	
Poland	0.0072	-1.4614	-0.4726	-0.7127	-1.3610	-1.0377	-0.8686	-0.5424	-0.9897
Russia	0.0001	-0.0195	-0.0066	-0.0102	-0.0194	-0.0144	-0.0126	-0.0075	-0.0141
Singapore	-0.0087	0.7720	0.2830	0.5193	2.0921	0.5582	0.5324	0.2909	0.9027
Sri Lanka	-0.0004	0.0614	0.0196	0.0344	0.0849	0.0401	0.0419	0.0211	0.0537
Thailand	-0.0010	0.1152	0.0407	0.0772	0.2130	0.0811	0.0802	0.0420	0.1300
Turkey	0.0001	-0.0175	-0.0058	-0.0088	-0.0171	-0.0125	-0.0112	-0.0066	-0.0123
Venezuela	0.0001	-0.0160	-0.0055	-0.0071	-0.0135	-0.0183	-0.0078	-0.0114	-0.0100
sum	**-0.0121**	**1.1338**	**0.3644**	**0.7948**	**2.6943**	**0.7718**	**0.3820**	**0.1063**	**1.1226**
average	**-0.0005**	**0.0472**	**0.0152**	**0.0331**	**0.1123**	**0.0322**	**0.0159**	**0.0044**	**0.0468**
st. deviation	**0.0026**	**0.4073**	**0.1356**	**0.2179**	**0.5629**	**0.3030**	**0.2386**	**0.1527**	**0.3214**
absolute sum	**0.0355**	**5.5833**	**1.8724**	**3.0625**	**7.1017**	**4.3033**	**3.0693**	**2.0989**	**4.3628**
absolute average	**0.0015**	**0.2326**	**0.0780**	**0.1276**	**0.2959**	**0.1793**	**0.1279**	**0.0875**	**0.1818**
absolute st. deviation	**0.0022**	**0.3343**	**0.1108**	**0.1778**	**0.4885**	**0.2436**	**0.2004**	**0.1240**	**0.2666**

Table 3 (continues)							
Estimates of each Country's Emanating Elasticities During the Russian, Brazilian, Turkish and Argentinean Crises with Respect to a Change in RGDP in the Initiating Country							
Effected Countries	**Initiating Countries**						
	Poland	Russia	Singapore	Sri Lanka	Thailand	Turkey	Venezuela
South Africa	-0.1251	-0.0336	-0.0627	-0.0340	0.0156	-0.0297	-0.0226
Argentina	-0.0270	-0.0071	-0.0125	-0.0072	0.0031	-0.0064	-0.0070
Brazil	-0.0600	-0.0157	-0.0263	-0.0153	0.0066	-0.0141	-0.0163
China	0.2427	0.0660	0.1221	0.0688	-0.0310	0.0586	0.0456
Chile	-0.1426	-0.0374	-0.0657	-0.0377	0.0163	-0.0336	-0.0373
Colombia	-0.2637	-0.0689	-0.1128	-0.0656	0.0284	-0.0615	-0.1284
Czech Republic	0.9184	0.1926	0.2206	0.1313	-0.0561	0.1673	0.0803
Hungary	3.2434	0.6937	0.7918	0.4723	-0.2013	0.6212	0.2862
India	-1.7045	-0.4549	-0.8129	-0.4682	0.2089	-0.4052	-0.3071
Indonesia	0.4181	0.1129	0.4142	0.1645	-0.0828	0.1012	0.0642
Israel	-0.2681	-0.0681	-0.1163	-0.0737	0.0301	-0.0621	-0.0450
Jordan	0.3202	0.0848	0.1574	0.0870	-0.0392	0.0756	0.0571
Korea	0.2175	0.0593	0.1301	0.0687	-0.0335	0.0519	0.0332
Malaysia	0.5716	0.1547	0.7215	0.2334	-0.1272	0.1385	0.0869
Mexico	-0.2417	-0.0635	-0.1068	-0.0610	0.0269	-0.0562	-0.0651
Pakistan	2.1971	0.6075	1.1058	0.6929	-0.2887	0.5446	0.3022
Peru	1.2347	0.3229	0.5437	0.3146	-0.1359	0.2890	0.3982
Philippines	0.9687	0.2622	0.7255	0.3436	-0.1809	0.2329	0.1496
Poland		-2.0841	-2.2721	-1.3533	0.5779	-1.7344	-0.8189
Russia	-0.1097		-0.0324	-0.0192	0.0082	-0.0237	-0.0112
Singapore	2.7672	0.7488		1.1195	-0.6068	0.6704	0.4211
Sri Lanka	0.2069	0.0559	0.1405		-0.0356	0.0507	0.0308
Thailand	0.4063	0.1102	0.3503	0.1639		0.0985	0.0613
Turkey	-0.0899	-0.0233	-0.0285	-0.0172	0.0073		-0.0099
Venezuela	-0.0535	-0.0140	-0.0226	-0.0132	0.0057	-0.0125	
Sum	**10.6267**	**0.6010**	**1.7520**	**1.6949**	**-0.8840**	**0.6610**	**0.5481**
Average	**0.4428**	**0.0250**	**0.0730**	**0.0706**	**-0.0368**	**0.0275**	**0.0228**
st. deviation	**1.0569**	**0.5209**	**0.6378**	**0.4306**	**0.2003**	**0.4433**	**0.2412**
absolute sum	**16.7990**	**6.3421**	**9.0950**	**6.0262**	**2.7542**	**5.5393**	**3.4857**
absolute average	**0.7000**	**0.2643**	**0.3790**	**0.2511**	**0.1148**	**0.2308**	**0.1452**
absolute st. deviation	**0.9002**	**0.4462**	**0.5123**	**0.3533**	**0.1667**	**0.3764**	**0.1916**

Table 4	
Estimates of Own Contagion Elasticities During the Mexican and Asian crises with Respect to a Change in RGDP	
Country	**Own contagion elasticities**
South Africa	-0.0105
Argentina	-0.0332
Brazil	-0.0101
China	0.0209
Chile	0.0510
Colombia	-0.0316
Czech Republic	0.3378
Hungary	-0.1807
India	-0.2727
Indonesia	-0.2026
Israel	0.0659
Jordan	0.0024
Korea	0.4039
Malaysia	-0.3850
Mexico	-0.0038
Pakistan	-0.0693
Peru	0.0914
Philippines	-0.0221
Poland	0.2989
Russia	0.2041
Singapore	-6.2297
Sri Lanka	0.0499
Thailand	-0.1154
Turkey	0.0619
Venezuela	-0.0227

Table 5	
Estimates of Own Contagion Elasticities During the Russian, Brazilian, Turkish and Argentinean crises with respect to a change in RGDP	
Country	**Own contagion elasticities**
South Africa	-0.0143
Argentina	-0.0029
Brazil	-0.0065
China	0.1102
Chile	-0.0420
Colombia	-0.0368
Czech Republic	0.1163
Hungary	1.6939
India	-0.4861
Indonesia	-0.0009
Israel	-0.0534
Jordan	0.0228
Korea	0.0276
Malaysia	0.3052
Mexico	-0.0473
Pakistan	0.2773
Peru	0.1607
Philippines	0.2166
Poland	-7.2330
Russia	-0.0207
Singapore	2.5034
Sri Lanka	0.0553
Thailand	-0.0605
Turkey	-0.0156
Venezuela	-0.0104