45TH CONGRESS OF THE EUROPEAN REGIONAL SCIENCE ASSOCIATION
23-27 AUGUST 2005, VRIJE UNIVERSITEIT AMSTERDAM

Financial Contagion between Economies: an Exploratory Spatial Analysis

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ABSTRACT

In this paper we study one of the consequences of the integration of markets: financial contagion in times of crisis. In recent years several authors have discussed which econometric techniques are best suited to the analysis of financial contagion. The main innovation of this paper is the implementation of Spatial Econometrics.

The crises analysed are those of Thailand, Russia and Brazil and the channels of contagion are trade links, financial links, regional effects and macroeconomic similarities.

The main conclusions are: firstly, in each crisis the markets more closely controlled by governments show similar channels of contagion; on the other hand, the markets more dependent on market forces also show a distinctive, characteristic trend. Secondly, contagion seems to have a clearly regional component. Finally, common moneylenders are among the main and most persistent channels of contagion in the three crises studied.

Key Words: Contagion channels, Financial Crises, Spatial Econometrics
JEL: C12, C21,F30,F41,G15

I.- INTRODUCTION

At present time, controversy still surrounds the importance of financial integration of markets and its possible consequences. The fact that the economy is more global implies that countries are more interdependent on each other. This brings new advantages, but also entails new dangers for countries. In this paper we study one of these dangers: financial contagion in times of crisis. In general terms, this is understood as the transmission or propagation of disturbances among financial markets of different countries. However, this debate on the benefits and risks of economic interdependence also draws attention to problems that are both very old and very new.

The problems are new because of the impact of globalization, but old because they are based on economic and political visions and ideologies that always remain the same. It is possible to see the present international economic system based on neoliberal principles in which the supervisory role of the state has been forgotten and in which the market is considered the only efficient way to allocate resources, without state intervention.

In this paper we present new ideas on the current debate on financial contagion. Specifically, we identify the economic variables that represented the crises in the Thai, Russian and Brazilian cases. We want to answer whether the cause of contagion between countries is due to the fact that their main macro economic magnitudes or economic fundamentals are at critical levels (commonly considered as the fundamentals of countries), or if, on the other hand, contagion between countries takes place because of trade and financial links and political or regional effects.

Various methodological approaches have been used to analyze the existence of contagion and the relative importance of the possible channels of transmission of crises (or channels of contagion). In recent years authors have sought to identify the econometric techniques that are better when conducting this kind of analysis. Indeed, one of the innovations of this paper is its implementation of Spatial Econometrics as a mechanism for assessing contagion. Unlike the other methodologies used, Spatial Econometrics allows an expression of international relations under explicit dynamic-spatial assumptions. Surprisingly, this technique has not been used previously for the analysis of contagion, and indeed few authors have used it in the study of financial relations in general. The study of an explicit dependency between the countries using

this econometric technique may open up a new field of research in financial interdependence relations.

This paper is structured in five parts. After the introduction, the second part reviews the main channels of contagion. The third section analyses the econometric approach that has been used. The fourth part presents the variables of the study. The fifth part presents the result and finally. the last section presents the conclusions.

II.- THE MAIN CHANNELS OF CONTAGION[1]

There are five possible channels for the transmission of crises from one country to another[2].

The first possible channel of transmission of crisis is the existence of a common shock[3]. A classic example is the increase of the interest rate by the Federal Reserve before the Debt crisis. A recent example is the appreciation of the dollar against the yen in 1995-96, which contributed to weaken the exports of the Asian Southeast and perhaps it also contributes to generate the Asian crisis (see Masson and Mussa, 1995).

The second channel arises as a result of the similarity of economic fundamentals in different countries, understood as the macroeconomic (and sometimes also microeconomic) indicators that represent the state of health of an economy. This channel can be interpreted from two perspectives. In objective terms the vulnerability of the countries is strongly related with the health of an economy. These indicators can also be understood in subjective terms; a country could be vulnerable to crisis depending on how markets perceive the news (see Baig and Goldfajn, 1999).

The third contagion link derives from trade relationships. This channel can also be interpreted from two different points of view. Firstly, in mercantilist terms, the transmission channel begins with the devaluation of a trade competitor, which forces a country to devaluate its own currency so as to protect its export sector from losing competitiveness. The second one is the devaluation of the currency of *country A* due to the devaluation of the currency of *country B*, a trade partner; if *country A* does not

[1] For a review of the methodological approaches, see Pericoli and Sbracia (2001) and Dungey et al (2004).

[2] There is no agreement on the question whether all the channels, which we will name next, are channels of Contagion. Masson (1999) explains this controversy in detail.

[3] Nevertheless, for some authors this may not be considered as a true channel of contagion since there is no transmission of a crisis from one country to another; rather the crisis occurs simultaneously in all countries.

devalue rapidly it may lose that market. A peculiarity about this link is that some authors consider that foreign direct investment is a commercial channel, but other authors such as Hernandez *et* al (2001) consider it as a financial link.

The fourth channel derives from political links between countries, caused by integration processes or discretionary performances of the states. Drazen (2000) provides an explanation for contagion that focuses on the actions of policy markers; the political costs (in terms of a loss of reputation) of the abandonment of an exchange rate commitment are lower when other countries are also devaluating their currency. In such a context, the loss of reputation associated with the devaluation will be lower for each country and the willingness to give up exchange rate parity higher. Hence, the probability of devaluation increases with other countries devaluing. Sometimes this channel is considered as a regional or neighbourhood channel.

The last channel arises from financial links between countries. In this case, the causes of contagion may be a common lender[4] or direct investments across countries. A set of effects may trigger contagion through financial links, such as risk effects, liquidity effects, spill effects, warning effects, call herding behaviour or financial panic. All these financial causes can be classified according to the rational or irrational behaviour of each investor or set of investors. Investors can also be classified as national or international. The rational changes made by investors (individuals, banks or funds) assume that the information is correct and that the problems are classic problems of portfolio: investors sell the assets of a country to maintain liquidity in their portfolio ("liquidity effect"), to cover an additional risk ("margin call"); or due to the minimum yield of the portfolio ("yield effect").

III.- METHODOLOGICAL ASPECTS

This paper performs an exploratory spatial analysis which contrasts the existence of dependency or spatial autocorrelation. Dependency or spatial autocorrelation, the main objective of Spatial Econometrics since its beginnings, appears as a result of the existence of a functional relation between what happens at a specific point in space and what happens in another place (Cliff and Ord, 1973; Paelink and Klaassen, 1979; Anselin, 1988): that is to say, when the value taken by a variable in a spatial location is

[4] This explanation can also be understood as a common shock according to certain authors.

not explained solely by internal conditioners but also by the value of the same variable observed at another neighbouring point.

$x_i = f(x_1, x_2, x_3, ..., x_N)$

So we will not assume independence between the sample observations[5]. This spatial dependence, closely (though not solely) linked with the geographic proximity, according to Tobler, can also be expressed in topological terms of contiguity. Let us suppose that a variable x is observed in N space units of a system, and also that the value of x in a spatial location *i*, a region for example, is influenced by its values in other neighbouring regions. Starting from here, we will be able to define the set of neighbours J of region *i* formed by all those regions in which:

$P[x_i/x] = P[x_i / x_J]$

That is, the probability that variable x in region i has a certain value is the result of calculating its conditional probability to the value of variable x in its J neighbouring regions. The same idea can be expressed in terms of covariance:

$Cov(x_i, x_j) = E(x_i, x_j) - E(x_i)E(x_j) \neq 0 \qquad \forall\, i \neq j, j \in J$

In consequence, the existence of spatial dependency does not allow a change in the location of the values of a variable without affecting the information contained in the sample.

Spatial autocorrelation can be positive or negative. If the presence of a particular phenomenon in a region causes the extension of this phenomenon to regions in the sorrundings, thus favouring its concentration, this will be a case of positive autocorrelation. In contrast, negative autocorrelation will exist when the presence of a phenomenon in a region prevents or impedes its appearance in the surrounding or contiguous regions, that is to say, when nearby geographic units differ ones from other more than from regions far away in the space. Lastly, when the variable analysed is randomly distributed, spatial autocorrelation will not exist.

[5] The existence of spatial autocorrelation implies that the sample contains less information than that present in another sample whose observations are independent (Anselin and Rey, 1997).

Spatial dependency is multidirectional (a region may be affected not only by another contiguous region, but by many others that surround it, just as this region can influence them). As a result the use of the lag operator L, $L^p x = x_{t-p}$, present in the time-series context, which considers only a one-directional relationship, will not be useful here. The solution in the spatial context involves the definition of what is known as the spatial weights matrix W:

$$W = \begin{bmatrix} 0 & w_{12} & . & w_{1N} \\ w_{21} & 0 & . & w_{2N} \\ . & . & . & . \\ w_{N1} & w_{N2} & . & 0 \end{bmatrix}$$

A non-stochastic square matrix whose elements w_{ij} reflect the intensity of the interdependence between each pair of regions i and *j*. There is no one way to assign values to the weights of W, as the controversy on the issue in the literature demonstrates; there is no unanimously accepted definition of W[6].

After analysing the concept of autocorrelation in the cross-section context, the following step is to study how to contrast the presence or absence of a dependency scheme in a certain variable. A set of spatial dependency statistics have been proposed, among which the Moran I (Moran, 1948) is the most important. It is computed as:

$$I = \frac{N}{S} \frac{\sum_i \sum_h w_{ih} z_i z_h}{\sum_i z_i^2}$$

where N is the number of observations, w_{ij} is the element of the spatial weight matrix W that expresses the potential interaction between two regions i and h, S is the sum of all the weights (all the elements in the weights matrix) and z_i represents the normalised value of the variable analysed in region i. Although there is no agreement on the specification of W, the contiguity criterion is usually applied.

Once standardised, a significant and positive (negative) value for this statistic indicates the existence of positive (negative) spatial autocorrelation. On the other hand, non-significance of the Moran I test implies the acceptance of the null hypothesis: the

[6] Anselin (1988) wrote that the definition of the W matrix must depend on the object of the study.

non-existence of spatial autocorrelation, that is, the prevalence of a random distribution of the variable throughout space.

IV.- VARIABLES AND SPECIFICATIONS

The present paper analyses the Asian crisis in a wide sense. Three specific crises, or three stages of the same crisis, can be distinguished: the Thai crisis (beginning in July 1997 with the devaluation of the *bath* against the US dollar), the Russian crisis (beginning in August 1998 with the devaluation of the rouble and the restructuring of the debt) and finally, the Brazilian crisis (beginning in January 1999 with the end of the gradual adjustments to the exchange rate and a large-scale devaluation of the *real*).

All the countries selected in the sample were affected by the Asian crisis in some of its forms, and have been analysed in most studies of financial contagion. The countries selected for this paper are: Argentina, Bolivia, Brazil, Bulgaria, Chile, Hong Kong, Colombia, Czech Republic, Ecuador, Hungary, Indonesia, Korea, Malaysia, Mexico, Pakistan, Paraguay, Peru, Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey, Ukraine, Uruguay, Venezuela, and Vietnam.

A vast amount of statistical information has been compiled to study the phenomenon of contagion and a many indicators or variables have been used[7]. In this paper we distinguish between objective variables which are believed to reflect or represent the crisis, and contagion channels, which consider possible ways in which crises are transmitted.

IV.1. Objective variables

We assume that the crisis will be reflected by a change in the objective variables: a fall in the international reserves and the stock-exchange quotations, or the increase in the exchange and interest rates. For this reason, we calculate the quarterly percentage variation of each variable during the period formed by the trimester prior to the beginning of the crisis and the first and second trimester of the crisis, being the only exception the interest rate which is specified as the absolute quarterly change, dividing it by one plus the interest of the initial period. Thus, the quarterly variations reflect the

[7] These indicators describe certain behaviours of contagion but these do not account for the phenomenon in its entirety.

short-term dynamics required to demonstrate contagion and to eliminate the effect of the variable in levels[8].

Table IV.1. Periods analysed according to crisis

Crises Analysed	Variation rates considered
Thailand Crisis	III trimester of 1997 versus II trimester of 1997 IV trimester of 1997 versus III trimester of 1997
Russian Crisis	III trimester of 1998 versus II trimester of 1998 IV trimester of 1998 versus III trimester of 1998
Brazilian Crisis	I trimester of 1999 versus IV trimester of 1998 II trimester of 1999 versus I trimester of 1999

The well-known database "International Financial Statistics (IFS)" was used as reference for obtaining the quantitative variables

IV.2. Channels of Contagion

We selected four possible channels of crisis transmission: trade, financial, economic fundamental similarities and regional.

i) TRADE CHANNELS

There could be two ways for contagion in trade channels: those deriving from direct trade, and those deriving from trade competition from third countries (indirect trade). The data are taken from the "Direction of Trade Statistics" of the IMF.

Direct trade: trade exchanges

The first type of trade-related contagion is caused by the mere fact of commercial exchange, that is, direct commerce, which can be induced by exports, imports or by the

[8] The variables in levels do not allow the comparison between countries because of the different economic scale of the countries compared.

sum of both of them. These variables explain the contagion caused by dependency between a country and its trade partners. So trade, though it can contributes to growth and stability in times of ”economic prosperity”, it can cause economic damage during times of crisis.

To define the weight matrices, we use information about the flow of imports and exports between the countries of the sample. Specifically the weight W_{ij} is calculated as the ratio of the exports of country *i* with country *j* divided by the total of exports of *i*. This calculation is also used for the case of the imports and for the sum of exports and imports, with the difference that the latter is the ratio of the sum and not the sum of the ratios.

Indirect trade: competition from third countries

To define the trade competition with third countries we only use exports. To value this channel accurately, we need to differentiate between commercial competition from the market comprised by the industrialized countries and competition from the market comprised by developing countries. In addition, it is worth distinguishing between competition by the total volume of exports (in absolute terms) and by the relative importance of the exports (in relative terms). The relative specification eliminates the possible effect of the size of the economy.

The above distinctions provide us with the following specifications of the weights for W matrices:

Table IV.2 Weights of trade competition

ABSOLUTE COMPETITION	$W_{ij} = \frac{X_{ides} + X_{jdes}}{X_{i.} + X_{j.}} * \left[1 - \frac{\lvert X_{ides} - X_{jdes} \rvert}{X_{ides} + X_{jdes}} \right]$
RELATIVE COMPETITION	$W_{ij} = \frac{X_{ides} + X_{jdes}}{X_{i.} + X_{j.}} * \left[1 - \frac{\lvert \frac{X_{ides}}{X_{i.}} - \frac{X_{jdes}}{X_{j.}} \rvert}{\frac{X_{ides}}{X_{i.}} + \frac{X_{jdes}}{X_{j.}}} \right]$

The specification implemented for this channel has been used previously in the literature. The first authors to use this specification in the context of contagion were Glick and Rose (1999). They used a specification that does not allow the relation between countries, and only with the country that was first affected by the crisis (called "zero country" in the literature). However, in our specification we allow the relation between countries, which is implicit in contagion.

ii) FINANCIAL CHANNELS

This transmission channel is understood in this paper as the effect caused by a common banking moneylender, or the "common bank lender effect".

We used data from "the BIS consolidated international banking statistics" of the International Settlements Bank. These data include the loans given to banks outside the seventeen industrialized countries[9].

The weight matrices were generated under the same specification as in the case of trade competition, since trade competition and competition in financial funds correspond entirely. In this case, besides differentiating between competition of loans in absolute and relative terms, we assess the importance of the fact that the four or eight maximum moneylenders of all the countries chosen that provide more than ninety percent of all the loans to these countries[10].

iii) SIMILARITIES IN THE FUNDAMENTALS ACROSS COUNTRIES

We specified six different weight matrices associated with six macro magnitudes: rate of unemployment, inflation, public deficit, domestic credit, expansion of credit and deficit by current account. In all cases, the weights of the matrices were obtained as the reverse of the absolute distance of each variable between pair of economies. In this way, two countries with similar values for the variables will have high W_{ij} weight, and two economies very different from each other (elevated economic distance) will have near zero W_{ij} weight. All these matrices will be symmetrical by construction.

The information required to generate these matrices was extracted from the International Financial Statistics database of the International Monetary Fund, although

[9] The countries are Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Holland, Norway, Spain, Sweden, United Kingdom and the U.S.A..

[10] The four first are: United Kingdom, Germany, the U.S.A., Japan and the following ones are: Italy, France, Holland and Switzerland.

in some cases we have used the national statistics of the countries analysed to complete the existing information.

iv) REGIONAL CHANNEL

In addition to the above specifications, we also generate a final weight matrix: the regional matrix. We consider those countries in the same continent as neighbours, and allocated to them a score of 1 (0 in opposite case) [11].

In this case, this matrix may reflect either a generic similarity in the macroeconomic fundamentals of countries i and j[12] or a greater link of a commercial, financial or political nature between nearby countries.

After reviewing the different specifications of the weight matrices defined, two aspects stand out. Firstly, contagion may be simultaneous, which means that both the country affected and the country infected enter crisis in the same time period (in our case, in a trimester) or, on the other hand, non- simultaneous, which means that the country affected and the country infected could receive the effects of the crisis in different periods (in our case the difference is a trimester, thus extending the period of possible contagion to a semester). This is why two structures of contagion are considered for the construction of the weight matrices. First, the matrix of simultaneous contagion, in which the weight matrix will be diagonal by blocks, and second, the non-simultaneous contagion matrix, which will be triangular inferior by blocks (allowing contact in the same trimester and with a delay or lag).

Secondly, the weights of the W matrices of commerce, finances and fundamental are calculated as the average of the value obtained by the variables in the two years before each crisis[13]. The only exception in the calculation of the weights of the first W is the expansion of credit, since, being an increase, we only use the data for the last year. Note that the matrices of finances are calculated from six-monthly rather than annual data.

[11] South Africa is considered a country in the Asian region; placing it in another region does not affect the results.
[12] The market could consider them as equal and punish them in a similar way, causing the crisis to spread among them.
[13] This has also been proved with the matrices of the year previous to the crisis, but the variations in the results are relatively insignificant.

Finally we should note that other authors have used some of these specifications[14], although none of them considered this matrix from the perspective of Spatial Econometrics, with its consequences for the estimation of statistical inference.

V. RESULTS

The results displayed below are from the exploratory spatial analysis. A set of spatial dependency statistics have been proposed, among which the Moran I is the most used. To carry out this study the Moran I global contrast was calculated.

The analysis aims to answer the following questions:

- In periods of crisis, do countries linked in some way (finance, trade, geographical proximity and/or economic policy) behave in similar ways? Is there a clear scheme of spatial autocorrelation in periods of crisis?
- Which channels of contagion were the most important in each crisis? And which objective variables were the best indicators of the crisis?

The results are displayed for each objective variable. The type of variable is shown in the upper left part of each table (see tables V.1 to V.4). The results for each crisis (Thai, Russian and Brazilian) are shown in columns, and for each crisis the results are presented according to whether the matrix of contacts allows non-contemporary dependency or only contemporary dependency. An asterisk represents that the contact is positive and significant at 1%, two asterisks at 5% and three asterisks at 10%. The negative and significant values at 10% are displayed in red; the values at 5% are in bold.

[14] De Gregorio and Valdés (2001), Glick and Rose (1999) among others.

Table V.1 Moran I test of the percentage increase of the exchange rate. Period 1997-1999.

EXCHANGE RATE	THAILAND		RUSSIA		BRAZIL	
Moran I empiric distribution	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**
compet funds 4 main	**2.70***	**4.02***	0.10	-0.31	0.81	0.12
compet funds 8 main	**2.47****	**3.78***	0.09	-0.38	0.85	0.10
compet (relative country) funds 4 main	**2.50****	**4.68***	0.95	1.52	1.46	1.58
compet (relative country) funds 8 main	1.87***	3.53*	0.77	1.25	1.45	1.46
exports	**2.40****	**2.50****	**4.79***	**5.19***	0.40	0.76
imports	**2.93***	**2.90***	**5.77***	**6.07***	0.51	0.72
sum of exports and imports	**2.75***	**2.80***	**5.47***	**5.85***	0.45	0.76
compet trade industrialized	1.13	1.73***	-0.49	-1.27	1.32	0.36
compet trade developing	0.66	0.84	-1.74	**-2.72**	0.78	-0.26
compet (relative country) trade developing	0.08	-0.11	-1.07	**-2.35**	1.24	0.77
compet (relative country) trade industrialized	-0.46	-1.39	-0.03	-0.44	1.36	0.76
deficit by currency account	0.67	0.92	0.20	0.27	**2.11****	**1.66*****
deficit by currency account respect ppp	1.68***	2.31**	-0.16	-0.21	0.51	0.71
expansion of domestic credit respect M2	-1.49	-1.84	-0.11	-0.07	0.26	0.25
domestic credit respect M2	0.53	0.69	0.06	-0.01	0.19	0.08
public deficit respect GDP	0.94	1.25	0.41	0.51	-0.89	-1.25
inflation	-0.69	-0.95	0.58	0.61	0.49	0.38
unemployment	-1.25	-1.21	-0.18	-0.24	1.13	1.52
regional	**4.64***	**5.34***	1.81***	1.65	**2.69***	**3.43***

Table V.2 Moran I test of the percentage increase of the international reserves. Period 1997-1999.

INTERNATIONAL RESERVES	THAILAND		RUSSIA		BRAZIL	
Moran I empiric distribution	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**
compet funds 4 main	**2.83***	**2.18****	**4.43***	**2.53****	-0.33	-0.23
compet funds 8 main	**2.85***	**2.13****	**4.73***	**2.94***	-0.18	-0.01
compet (relative country) funds 4 main	**3.19***	1.86***	**6.90***	**6.04***	0.58	0.81
compet (relative country) funds 8 main	**3.55***	**2.30****	**6.94***	**6.37***	0.81	1.27
exports	1.14	0.11	**3.06***	**3.18***	**2.98***	1.69***
imports	0.58	-1.67	**3.79***	**3.87***	**4.20***	**2.58***
sum of exports and imports	0.91	-0.82	**3.50***	**3.63***	**3.70***	**2.20****
compet trade industrialized	**3.72***	**2.95***	**3.72***	**2.15****	-0.39	-0.23
compet trade developing	**3.74***	**3.20***	**4.33***	**2.07****	0.40	0.49
compet (relative country) trade developing	**4.18***	**3.03***	**5.66***	**4.04***	0.95	0.86
compet (relative country) trade industrialized	***4.28****	**3.25***	**6.30***	**5.79***	0.15	0.33
deficit by currency account	1.04	1.42	0.30	-0.41	-0.42	-0.04
deficit by currency account respect ppp	**1.99****	1.71***	0.45	0.18	0.54	0.46
expansion of domestic credit respect M2	-0.14	-0.73	0.37	-0.28	-0.23	-0.60
domestic credit respect M2	1.29	0.80	1.26	1.13	0.20	0.25
public deficit respect GDP	1.23	1.13	**2.07****	1.38	1.16	1.02
inflation	0.75	0.39	1.38	1.36	0.50	0.30
unemployment	1.55	1.10	1.65***	1.52	0.07	-0.14
regional	**2.05****	1.30	**4.34***	**3.38***	**4.08***	**4.45***

Table V.3 Moran I test of the increase of the interest rate. Period 1997-1999.

INTEREST RATE	THAILAND		RUSSIA		BRAZIL	
Moran I empiric distribution	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**
compet funds 4 main	**2.07****	**2.17****	0.99	1.02	-0.58	-1.06
compet funds 8 main	**2.03****	**2.26****	1.06	1.11	-0.59	-1.07
compet (relative country) funds 4 main	**2.20****	**2.05****	1.91***	**2.36****	-0.08	-0.28
compet (relative country) funds 8 main	1.93***	1.91***	**2.14****	**2.71***	-0.09	-0.33
exports	1.56***	0.49	**3.11***	1.73***	1.27	1.19
imports	**2.03****	0.36	**4.92***	**2.40****	1.89***	1.63
sum of exports and imports	1.81***	0.43	**4.18***	**2.16****	1.65***	1.48
compet trade industrialized	0.90	1.56	0.87	0.73	-0.52	-0.70
compet trade developing	1.55	1.93***	1.67***	1.07	-0.34	-0.63
compet (relative country) trade en industrialized	1.06	0.85	1.91***	**2.13****	-0.87	**-2.31**
compet (relative country) trade industrialized	0.21	0.16	1.53	**1.98****	-0.43	-1.01
deficit by currency account	0.48	0.25	0.51	0.31	-0.45	-0.15
deficit by currency account respect ppp	1.41	0.97	0.35	0.33	-0.50	-0.66
expansion of domestic credit respect M2	-0.02	-0.18	0.65	0.41	0.39	0.60
domestic credit respect M2	0.00	-0.01	-0.19	-0.26	-0.24	-0.31
public deficit respect GDP	-0.05	-0.02	-0.64	-0.21	0.28	0.41
inflation	-0.20	-0.04	-0.16	0.38	0.30	0.22
unemployment	**-2.43**	-1.89	0.13	-0.46	-0.42	-0.51
regional	**2.59***	**1.60**	1.09	1.20	-0.19	-0.40

Table V.4 Moran I test of the percentage increase of the stock quotations. Period 1997-1999.

STOCK-EXCHANGE QUOTATIONS	THAILAND		RUSSIA		BRAZIL	
Moran I empiric distribution	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**	**SIMULT**	**NO SIMULT**
compet funds 4 main	**3.54***	**2.04****	**11.53***	**8.69***	**9.54***	**7.48***
compet funds 8 main	**3.62***	**2.16****	**11.78***	**9.03***	**9.75***	**7.73***
compet (relative country) funds 4 main	**5.12***	**4.40***	**12.87***	**11.53***	**10.49***	**9.41***
compet (relative country) funds 8 main	**5.10***	**4.38***	**13.27***	**12.21***	**10.73***	**9.80***
exports	1.75***	0.91	**7.65***	**4.15***	**3.93***	**1.99****
imports	1.71***	0.55	**7.68***	**4.07***	**4.27***	1.61
sum of exports and imports	1.74***	0.74	**7.71***	**4.16***	**4.11***	1.82***
compet trade industrialized	**4.76***	**3.47***	**12.50***	**9.42***	**10.31***	**8.56***
compet trade developing	**2.78***	**1.95****	**12.16***	**9.08***	**9.93***	**7.72***
compet (relative country) trade developing	**3.46***	**2.95***	**13.43***	**12.20***	**10.23***	**9.29***
compet (relative country) trade industrialized	**5.57***	**5.10***	**12.98***	**11.95***	**10.27***	**9.39***
deficit by currency account	-1.04	-1.10	1.56	1.01	0.24	-0.10
deficit by currency account respect ppp	1.41	0.58	0.89	0.49	1.45	0.65
expansion of domestic credit respect M2	0.92	0.12	**2.29****	1.05	**3.85***	1.81***
domestic credit respect M2	-0.63	-1.91	1.37	0.70	1.02	0.34
public deficit respect GDP	0.40	0.20	1.32	0.55	**1.97**	0.66
inflation	0.18	-0.06	1.61	1.01	**2.55***	1.49
unemployment	**3.63***	**2.60***	**3.40***	1.77***	1.09	0.79
regional	**2.26****	0.95	**9.31***	**5.75***	**5.95***	**3.34***

The main conclusions are described the next. Firstly, in periods of crisis there is a significant positive scheme of spatial autocorrelation in the objective variables analysed (the significant negative values at 5% do not persist in the two columns), or, describing it in another way, in periods of crisis the similarity in the evolution of countries depends on previous economic patterns.

Secondly, there is a noticeably regional behaviour for all the crises, mainly in the contemporary analysis. However, the similarity in fundamentals does not seem to act as a significant channel of contagion.

Thirdly, In the Thai crisis, the best channels were geographic proximity and the competition of funds or common moneylender. In the Russian crisis, direct commerce and to a lesser extent geographical proximity. In the Brazilian crisis, the only channel of contagion was geographic proximity (we think that the channels have a smaller explanatory capacity due to the proximity in time to other crises, which distorts the transmission channels; in addition, the crisis had been anticipated for some time, thus allowing the implementation of specific policies for each country).

Fourthly, the variables more controlled by the authorities of the countries (exchange and interest rates) behave similarly in periods of crisis, stressing the importance of economic policy; the reserves and the quotations also have similar channels (these variables are more controlled by market forces). The memory of markets differs if the variable is controlled by market forces (in which case the memory is shorter and the rapidity greater) or by the authorities (more persistence).

Finally, thus, it seems that in the variables that are more controlled by market forces (unlike those controlled by governments), trade and financial competition is the best channel; this competition is based on relative terms, and in relation to developed countries the result is in line with the findings of Van Rijckeghem (2001).

VI.- CONCLUSIONS

Controversy still surrounds the importance of the financial integration of markets and its possible consequences. The fact that the economy is more global means that countries are more interdependent on each other. This offers advantages, but also entails new dangers for countries. In this paper we have studied one of these dangers: financial contagion in times of crisis. The crises analysed have been the Thailand, Russia and Brazil crisis.

Our main contributions are that, firstly, we have used four objective variables, which characterize four markets, to represent the correct form of financial crises. Secondly, we have also regarded a wide number of contagion channels (trade links, financial links, regional effects and macroeconomic similarities).Various definitions have been used trying to reflect different channels of crisis transmission from one country to another.

Thirdly, the crises we have studied have a similar macroeconomic context where the results, a priori, are more consistent than those that appear in other papers that their result have different macroeconomic context because of their sample are longer.

Fourthly, we have used an extensive sample with twenty eight countries, where each one were affected by the Asian crisis in some of its forms.

Finally, in recent years several authors have discussed which econometric techniques are best suited to the analysis of financial contagion. The main innovation of this paper is the implementation of Spatial Econometrics in this area. Unlike other methodologies used to date, Spatial Econometrics allows us to express the international relations under explicit dynamic-spatial multidirectional assumptions. We implement a valuable methodology based on an exploratory analysis. So this analysis performed represents an important step on the way towards a deeper analysis of financial contagion using spatial econometric techniques.

We sum up the main conclusions of this paper. First of all, in each crisis the markets more closely controlled by governments show similar channels of contagion; on the other hand, the markets more dependent on market forces also show a distinctive, characteristic trend. In addition, we detect that contagion seems to have a clearly regional component. In the end, common moneylenders are among the main and most persistent channels of contagion in the three crises studied.

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