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What Drives Contagion: Trade, Neighborhood, or Financial Links?

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Abstract

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

This paper presents evidence on the relative importance of alternative contagion channels during the Thai, Russian, and Brazilian crises. Results show that when crises are measured by changes in sovereign bond spreads, financial competition seems to explain almost all contagion episodes. However, when crises are measured by stock market returns, trade links and neighborhood effects appear to be relevant contagion channels during the Thai and Brazilian crises, while financial competition remains the only relevant channel in the case of the Russian crisis.

Contents   Page

I. Introduction

The effect of the crises in Mexico, Thailand, Russia, and Brazil on other developing countries has raised interest in the problem of cross-country *contagion*. Researchers and especially policy makers in developing countries, are wondering why their economies are affected when an adverse shock hits another—seemingly unrelated—economy. More specifically, why should a country like Bulgaria be affected if there are problems in Brazil, as these countries are hardly related? The answer to this question requires an examination of the channels through which disturbances are transmitted from one country to another.

A simple definition of contagion is that country A gets into trouble because country B gets into trouble.[2] Trouble, in this case, refers to a devaluation, a moratorium or other traumatic regime changes, or milder problems, such as entering into a stage in which capital inflows turn scarce (reflected in both volume and prices), there is pressure on the exchange market, and domestic asset prices decrease. We use this simple definition to identify the channels that explain cross-country *co-movement* during crisis periods.[3]

Isolating the relevant contagion channels is key from a policy perspective, for appropriate prescriptions may vary substantially depending on the nature of what drives contagion. For instance, if trade linkages were to drive contagion, countries would have few alternatives other than to diversify their trade base or to fix irrevocably their foreign exchange rate.[4] At an international level, cross-country cooperation, for instance in the form of a monetary union, would be a useful device. On the contrary, if financial links were to be blamed for contagion, countries should attempt other measures such as imposing prudential capital account regulations—more precisely, countries should impose tougher regulations than those existing in the average sample country at the time of the Thai, Russian, or Brazilian crises.[5] Furthermore, at the international level direct regulation in industrialized countries' capital markets could improve the state of affairs, although such regulation may have other adverse effects.

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[2] Note that 'simultaneous bad luck'—i.e., a negative common shock—that affects two countries should not be considered contagion.

[3] There are alternative definitions of contagion. For some, it is an *increase* in the co-movement of countries' financial indicators during crisis periods (vis-à-vis tranquil periods) unexplained by common shocks. For others, it is simply co-movement during crisis periods unexplained by a common shock. See Rigobón (1999), Forbes, and Rigobón (1999) and Kaminsky and Reinhart (1998) for details.

[4] Irrevocably fixing the exchange rate could prevent speculative attacks based on loss of competitiveness (see section II for details).

[5] This does not mean that we necessarily support this type of regulation, but rather that the policy prescription is country and crisis specific.

In this paper we try to shed some light on the question of which contagion channel is more important, based on the cross-country correlation pattern observed in two financial indicators during the recent crises in Thailand, Russia, and Brazil. We focus on three alternative contagion channels, namely, (i) direct trade competition; (ii) neighborhood effect, which could capture financial links that are due to institutional arrangements in international financial markets; and (iii) financial competition in banking centers, which is meant to capture the extent of similarity in sources of financing. Even though these three channels could be relevant simultaneously, we are interested in evaluating their relative importance. As financial indicators we use the countries' sovereign bond spreads and stock market returns. We explain the weekly behavior of these indicators in each country during the three-month period that begins with each crisis, using alternative weighted averages of the extent of the crisis in other countries in the sample—in other words, contagion occurs if the extent of the crisis in each country can be explained by what is happening elsewhere. These averages are especially constructed to isolate alternative contagion channels, therefore allowing us to evaluate which channel better explains the pattern of contagion across countries.

The paper is organized as follows. Section 2 reviews the recent theoretical and empirical literature on contagion channels. Section 3 discusses the methodology we pursue in this paper to evaluate the relevance of alternative contagion channels. Section 4 presents the empirical results using both sovereign bond spreads and stock market returns. Section 5 presents some preliminary conclusions.

II. CONTAGION CHANNELS

A. Conceptual Issues

Economic literature suggests that contagion can occur because of trade links, both direct trade among countries and competition in third markets; similar initial conditions, whereby countries co-move insofar as they have similar macroeconomic (or other) characteristics; and financial linkages.[6] These channels are reviewed briefly below.[7]

Trade links can explain contagion because of the possibility of competitive devaluations. According to this hypothesis, in the face of a devaluation in a trading partner or trade

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[6] Dornbusch, Park, and Claessens (1999) distinguish four groups of theories by dividing financial market related theories into two: (i) direct financial linkages, financial market institutional practice, and foreign investors' liquidity problems, and (ii) information asymmetries and herd behavior.

[7] It is important to note that the Initial Conditions and Financial Linkages hypotheses are all based on asymmetric or incomplete information problems, and their distinction is mainly for presentational purposes. The former hypothesis highlights macroeconomic aspects while the latter group of theories stress microeconomic structural issues.

competitor country, the government may attempt to safeguard the country's competitiveness by devaluing its currency. As investors foresee this decision as highly likely, they would cut the demand for the country's assets, therefore triggering a crisis—a devaluation—and, in the process, validating their own expectations. Thus, in the end, the crisis may be a self-fulfilling phenomenon that occurs despite the government's initial intention not to devalue. Gerlach and Smets (1995) advance this theory in explaining the 1992 EMS crisis.

The macroeconomic similarities channel explains contagion because countries with bad fundamentals are either bound to have a crisis or may enter a multiple equilibria zone. In the first case, contagion would show up as countries with bad fundamentals are subject to common negative shocks. In the second and more interesting case, because of incomplete information, investors treat all countries that look alike as equal. Therefore, once a country is hit by a crisis there is an information spillover against countries in a similar situation (the "wake up call" effect). Put less dramatically, when a country shows weaknesses—say, pays higher spreads or the stock market drops—investors may pull out from countries with similar macro conditions expecting that the same problem will arise in those countries as well (which could also lead to self-fulfilling crises).

Financial linkages explain contagion in several ways, each associated with one particular theory, namely (i) direct financial linkages, (ii) financial market institutional practices, (iii) foreign investors' liquidity problems, and (iv) information asymmetries and herd behavior.

(i) Direct financial linkages refer to direct cross-country investments which tie corporate and financial sector returns—e.g., a devaluation of the baht drives stock prices down in Malaysia because it imposes losses on Malaysian corporations investing in Thailand.

(ii) Financial market practices refer to institutional arrangements whereby countries are treated as complementary assets and fund managers use simple 'rules of thumb.' In this setting, a negative shock in a particular country generates less demand for the assets of other countries. One simple transmission mechanism arises when fund managers maintain fixed weights in different countries. Hence, after the stock market drops in a particular country, managers will pull resources out from other countries in order to rebalance their portfolios.[8] A more complex transmission mechanism arises when fund managers hedge risks using countries whose returns are correlated with those that are being hedged (Reisen and von Maltzan, 1999).

(iii) As for liquidity problems, Valdés (1997) constructs a model in which emerging market financial claims are illiquid and bad news from a particular country, measured by a lower probability of repayment, generates a higher probability of a run against other emerging

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[8] We are not discussing here the optimality of these investment rules which, in turn, can be cost-effective because of information asymmetries and other considerations.

markets, and therefore, a lower probability of repayment in these other countries.[9] Other theories include the behavior of open-end mutual funds and hedge funds, which after suffering a shock—say a crisis in a particular country—sell off securities in other countries in order to raise funds (i.e., to increase liquidity) to finance redemptions by investors who decide to withdraw from the fund.

(iv) Information asymmetries and herd behavior include a series of theories based on capital market distortions that, in turn, produce co-movement across countries. Calvo (1999) has proposed an explanation for contagion based on margin calls and asymmetric information. In particular, after a crisis fund managers need to sell securities to finance possible redemptions by investors. However, in the process of selling "good" countries, the market penalizes them because of the well-known 'lemon problem.'[10] Herd behavior, in turn, can be explained by the practice that fund managers' performance is compared to market performance and, therefore, it is very risky for them to deviate from what other managers do, even if the latter follow wrong investment strategies (Scharfstein and Stein, 1990).

B. Empirical Evidence

It is very likely that in reality, contagion occurs through different channels simultaneously. However, some channels might be more important during particular events. The empirical literature on contagion has attempted to identify the channels of transmission of shocks using alternative methodologies. Some papers have tried to identify the characteristics of those countries that show a relatively poor performance after a crisis occurs in a particular country. Sachs, Tornell, and Velasco (1996), identify the characteristics of those countries that performed worse after the 1994 Mexican crisis. They conclude that the initial real exchange rate overvaluation and the excess of bank credit creation better explain the after-crisis cross-country performance. This finding could be extended to conclude that contagion is driven by initial macroeconomic fundamentals.

Eichengreen, Rose, and Wyplosz (1997) analyze contagion in a group of 20 OECD countries. They define contagion as an increase in the likelihood of crisis in a particular country given that there is a crisis elsewhere. Crises in their sample are identified as periods of extreme high pressure in the foreign exchange market. They conclude that contagion can be explained more because of trade links than macroeconomic similarities.

Kaminsky and Reinhart (1998) follow a similar strategy, although they use a larger sample of countries, define crises with a different criterion, and consider the effect of crises in alternative clusters of countries on the likelihood of a crisis occurring in countries of that same cluster. They claim that financial links potentially are an important transmission

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[9] The model is similar in spirit to Diamond's and Dybvig's (1983).

[10] In this particular case, the lemon problem occurs as the buyer has reasons to believe that the seller is selling because he just learnt about a deterioration in the quality of the asset.

mechanism, but they argue that owing to the high correlation between trade and financial links, it is difficult to distinguish between these two channels. They provide informal evidence showing that the financial channel is important.

Using a related methodology, De Gregorio and Valdés (1999) analyze the cross-country co-movement of an indicator of foreign exchange market pressure during the debt (1982), Mexican (1994), and Asian (1997) crises. Their approach consists of explaining the behavior of the foreign exchange market pressure index (or the credit rating) in each country, with a specific weighted average of the same indicator in other countries. The weighted average is constructed to reflect a particular contagion channel and, again, contagion occurs if the average crisis indicator for other countries helps to explain the extent of the crisis in each country. They conclude that initial conditions only partially explain contagion, and that neighborhood effects—that they consider as the financial channel—are more relevant than trade links and macroeconomic similarities. It could be argued, however, that the neighborhood effect reflects institutional practices in the international financial system (i.e., institutional investors try all countries from the same region as equal, without noticing the differences in their fundamentals).[11]

An alternative definition of contagion has been used by Glick and Rose (1998), which is based on the degree of countries' closeness to the so-called "ground-zero country", the country where the crisis starts. In this approach different closeness measures reflect alternative contagion channels. Following the Sachs et al. (1996) tradition, they try to explain cross-country performance after particular crises. Glick and Rose consider five different crises and conclude that, after controlling for macroeconomic variables, trade links, rather than other factors, explain why crises tend to be regional.

Van Rijckeghem and Weder (1999) use a similar approach that incorporates a measure of fund competition in banking centers between countries and the ground-zero country. They apply this approach to a more recent set of crises and conclude that the extent of fund competition is a more robust predictor of the incidence of crises (given that the ground-zero crisis has occurred) than trade linkages and countries' macroeconomic characteristics.

In sum, there has been a slow shift in what is considered the empirically most relevant contagion channel. While initially macroeconomic fundamentals were considered an important variable, later on trade links appeared to be more important. Recent papers have shown that financial links could even be a more relevant contagion channel.

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[11] The neighborhood effect could also reflect uncovered trade links between neighbor countries.

III. METHODOLOGY

In order to evaluate the importance of the alternative contagion channels, we follow a methodology based on De Gregorio and Valdés (1999). In particular, we intend to measure whether a particular aggregation of other countries' crisis indexes affects the behavior of a typical sample country during the crisis. The key step in implementing this procedure is that the particular aggregation method is designed to reflect a specific contagion channel.

More formally, consider the financial market indicator $X_{i,t}$ for country i during time t. In our case this indicator corresponds, alternatively, to the change in sovereign bond spreads (measured by the Emerging Market Bond Indicator), or to the percentage price change in domestic stock markets. We assume that the behavior of this indicator can be explained by a properly weighted average of the extent of the crisis in other countries:

$$X_{i,t} = \beta_0 + \beta_1 \sum_j m_{i,j} X_{j,t} + \xi_{i,t} \tag{1}$$

where $m_{i,j}$ is a set of weights that add up to one, each $m_{i,j}$ reflects the importance of country j for country i *given a particular contagion channel*, and $\xi_{i,t}$ is a stochastic shock. The row vectors with entries $m_{i,j}$ can be stacked to form a matrix M of weights.

In order to test for the existence of contagion, we evaluate whether β_1 is different from zero for a given set of weights M. Furthermore, in order to evaluate the importance of each contagion channel, we compare the size of the β_1s that corresponds to the different weighting matrices. Because this parameter measures a weighted average effect of the crisis in other countries on a representative sample country, a larger estimate simply indicates that the corresponding contagion channel is more important. It is also possible to compare the importance of different contagion channels by running regressions that include two weighting matrices simultaneously:

$$X_{i,t} = \beta_0 + \beta_1 \sum_j m_{i,j} X_{j,t} + \beta_2 \sum_j m'_{i,j} X_{j,t} + \xi_{i,t} \tag{2}$$

where $m_{i,j}$ and $m'_{i,j}$ are the two sets of weights. Again, in this case we compare the size and significance of β_1 and β_2.

Because there clearly is a simultaneous equation problem in this setup, the OLS estimates of β_1 have a positive bias. However, this bias is proportional to the true β_1 and, more

important, it is zero when the true β_1 is zero. Thus, it is still valid both to test whether the estimate β_1 is zero and compare alternative estimates of β_1.[12]

We consider several important changes with respect to the estimates presented in De Gregorio and Valdés (1999). First, we use EMBIs and stock market data instead of foreign exchange market pressure indicators. This allows us to increase the frequency of the data, gaining several observations, although we lose a few countries in the process. To overcome the latter problem we also include Eastern European countries in our sample.

Second, we use weekly data and estimate models for three particular crises *separately*: the Thai, the Russian, and the Brazilian crises (in July 1997, August 1998, and January 1999, respectively). Thus, we have different contagion estimates for each crisis. This procedure also allows us to overcome potential biases arising from heteroskedasticity in country-specific shocks (Forbes and Rigobón, 2000).

The sample period we consider for each crisis corresponds to a three-month span starting in the crisis month. Thus, for each crisis we have 12 weekly observations for each country. With 17 countries (in the case of the stock market data), we have more than 200 observations to estimate β_1 using pooled OLS in each crisis.[13] In the case of EMBIs, we have less countries and data points: 96 observations in the case of the Thai crisis and 168 observations in the case of the Russian and Brazilian crises.

Third, in addition to considering M matrices to reflect trade links and neighborhood effects, we construct matrices to reflect market competition in banking centers. The size of each weighting matrix depends on which countries are considered in each particular sample. This, in turn, depends on data availability.

Trade links weights are constructed as the importance of country j in total county i's trade, measured by the sum of imports and exports. We use IMF trade data for 1996. We then re-scale weights so that they add up to one.[14] Neighborhood weights are constructed assigning dummy variables to countries that belong to the following regions: America, East Europe and

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[12] It can be shown that in this setting, $E(\hat{\beta}) = \beta + (X'X)^{-1}X'\beta$ and, therefore, not being able to reject the null hypothesis of no contagion provides a conservative result.

[13] We use pooled—instead of fixed effect—regressions to capture through the constants the "average or common shock" affecting the representative (average) emerging market economy during each crisis. Using different constants for each country, though feasible, poses a serious interpretation problem for the estimated coefficients (or for the differences among them).

[14] This is needed to make comparisons across crises valid. It also facilitates the interpretation of results in terms of effects being read as average country shocks.

Russia, and East Asia. This matrix is also re-scaled so that rows add up to one. Notice that whereas the neighborhood matrix is symmetric, the trade-links matrix is not.

To construct a measure of market competition in banking centers we follow Van Rijckeghem and Weder (1999), who study whether financial competition matters for ground-zero contagion.[15] In particular, with BIS data on origin and destination of bank financing it is possible to construct two measures of competition: absolute and relative competition. The latter measures the degree of competition scaling countries by their size (in terms of total financing), whereas the former considers that a larger country represents more competition for other countries. The interpretation of the results differs depending on the measure used. Absolute competition assumes that larger countries are more important—China is more important than say, Thailand. Thus, if the demand for funds increases in a "large" country, say because of margin calls, contagion would occur if there is a limited supply of funds.[16] Relative competition, on the other hand, implies that all countries are equally important. In this setting the results enhance the informational content of the shocks in each country—a shock in China conveys the same information to the market as a shock in Thailand. Here contagion would occur because of information spillovers or other distortions in the way the financial market works.

Denoting by b_{jc} the stock of debt of country j with countries in banking center c, absolute competition is defined as:

$$m_{i,j}^{abs} = \sum_c \frac{b_{jc} + b_{ic}}{b_j + b_i} \times \left(1 - \frac{|b_{jc} - b_{ic}|}{b_{jc} + b_{ic}} \right) \qquad (3)$$

where $b_j = \sum_c b_{jc}$. The first part of the equation measures the importance of banking center c for countries i and j together, whereas the second part measures the difference in the importance of this banking center for the two countries. Relative competition, in turn, is defined as follows:

$$m_{i,j}^{rel} = \sum_c \frac{b_{jc} + b_{ic}}{b_j + b_i} \times \left(\frac{1 - |b_{jc}/b_j - b_{ic}/b_i|}{b_{jc}/b_j + b_{ic}/b_i} \right) \qquad (4)$$

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[15] It is important to note that Van Rijckeghem and Weder consider financial competition with the ground-zero country, while in this paper we analyze financial competition with all the countries in the sample.

[16] Calvo and Reinhart (1996) present evidence that developments in larger countries have a higher impact on smaller ones than vice-versa.

In constructing financial competition weights we consider three banking centers: Europe, Japan, and North America. The stock of debt is as of June 1997.

Finally, we also consider as an explanatory variable for the indicator $X_{i,t}$, a common shock that affects all countries simultaneously. This shock generates co-movement among countries but should not be confused with contagion.[17] Formally, we estimate the following equation:

$$X_{i,t} = \beta_0 + \beta_1 \sum_j m_{i,j} X_{j,t} + \beta_3 Z_t + \xi_{i,t} \tag{5}$$

where Z_t measures the common shock. We consider two measures of Z_t: the changes in the SP500 during week t when we analyze stock market prices, and changes in the spread between on- and off-the-run 30-year Treasury Bonds during week t when we analyze EMBIs.[18] We use 26-year maturity bonds to measure off-the-run returns.

IV. EMPIRICAL RESULTS

As mentioned above, we consider two alternative indicators to measure contagion. First, we analyze contagion in sovereign bond spreads (with respect to U.S. Treasury Bonds),[19] measured by Emerging Markets Bond Index Plus (EMBI+) during the Thai crisis, and by Global EMBI during the Russian and Brazilian crises. The latter indicator is available for a larger number of countries but has been constructed only since 1998. The spreads of these bond indicators can be thought of as reflecting (or being a function of) the probability of default.

EMBI+ tracks total returns for traded external debt instruments including foreign currency denominated Brady bonds, loans and Eurobonds, and U.S. dollar denominated local market instruments. The index comprises a set of broker-traded debt instruments widely followed and quoted by several market makers. Instruments in the EMBI+ must have a minimum of $500 million outstanding. Global EMBI expands the EMBI+ database by using a different country selection process and by admitting less liquid instruments. It increases the total sample from 16 to 27 countries. Both indicators are constructed by JP Morgan.

The second indicator that we consider is the stock market return in each country, measured by the change in a domestic stock market wide index. This indicator directly measures changes in country asset prices. The data source in this case is Bloomberg.

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[17] This is the Monsoonal effect of Masson (1998).

[18] The spread between on- and off-the-run 30-year treasury bonds is a proxy for liquidity premium (off-the-run bonds are those with an effective maturity shorter than 30 years).

[19] We follow the market practice of taking 30-year Treasury Bonds as the benchmark.

Table 1 summarizes the countries that we consider in each sample. In all cases we measure weekly returns using Monday closings. Whenever a market is closed, we use the last recorded price as the relevant one.

A. Sovereign Bond Spreads

Table 2 presents the results for EMBI contagion in the three crises (panels) and four alternative weighting matrices (columns). Because in none of the regressions (as in the rest of the paper) the common shock control variable—the on- and off-the-run U.S. Treasury bond spread—turned out to be a significant variable, we excluded it from the final regressions. This negative result shows that it is not possible to explain cross-country co-movement around the three crises by a common shock.[20] In the three cases this makes a lot of sense since no important global development occurred during the sample periods (other than the crises themselves).

The results show that the four weighting matrices appear to be highly significant in explaining cross-country correlations. All estimates are significantly different from zero. However, despite all contagion coefficients being significantly different from zero, their sizes differ importantly across crises and matrices. Because the contagion coefficient measures how much a weighted unit shock in other countries affects a typical emerging market economy, it is straightforward to compare them.[21]

Overall, both absolute and relative financial competition appear to be more important than trade and neighborhood effects in explaining contagion. Indeed, the financial competition matrices have coefficients that vary between 0.81 and 0.94, whereas the trade and neighborhood matrices have coefficients that vary between 0.25 and 0.87, and between 0.40 and 0.56, respectively. The results across crises are also interesting to note. For instance, trade effects appear to be considerably more important in explaining contagion during the Thai crisis than during the Russian and Brazilian crises. Neighborhood effects appear to be equally important across crises.

The results so far allow us to rank the importance of each channel. However, because there is an important correlation between the weighting matrices—neighboring countries tend to trade among themselves and usually get financing from the same financial centers—, it is possible that some of the results are actually mirror images of the others.

In order to further evaluate the relative importance of the different contagion channels, Table 3 presents regressions with pairs of weighting matrices. Again, columns represent different matrices (pairs in this case) and panels represent crises. The entries Matrix 1 and

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[20] See footnote 2.

[21] See footnote 14.

Matrix 2 describe the two competing matrices under consideration, whereas Contagion Index 1 and 2 are the coefficients associated with matrices 1 and 2, respectively.

The results indicate that financial competition appears to be the most relevant channel of contagion. Trade competition is no longer significantly different from zero in all the six regressions in which it appears. The neighborhood effect is positive and significant only when compared to absolute financial competition during the Brazilian crisis. During the Thai crisis neighborhood effects are significantly different from zero but *negative*, further corroborating that contagion occurred because neighbor countries tended to get finance from the same banking centers.

The results also indicate that the relevance of absolute or relative competition depends on the crisis. During the Thai crisis absolute competition appears to be the relevant contagion channel, whereas relative competition appears to be more relevant during both the Russian and Brazilian crises. One potential, albeit preliminary, explanation for this result is that in the case of the Russian crisis the informational content of the shock was much larger than in the Thai crisis—the Russian crisis had a larger surprise element.[22]

B. Stock Market Returns

In principal, contagion channels could be different depending on the indicator under study. Table 4 presents results that are analogous to those in Table 2, but based on stock market returns instead of sovereign bond spreads. Again, the common shock control variable, measured in this case by the return in the SP 500, was not statistically significant in all the regressions.

Interestingly, the results do not change much between Tables 2 and 4. Financial competition effects appear to be relatively (and marginally) more important in explaining contagion than trade and neighborhood effects. All coefficients for financial competition are around 0.8 or higher, while the other two matrices have coefficients around 0.5 or lower. At the same time, it is not possible to reject the hypotheses that trade and neighborhood effects are important by themselves.

Table 5 presents the results of regressions that combine two weighting matrices. The format follows the one presented in Table 3. The results show three interesting features. First, financial competition coefficients show significant effects in all three crises. It is a contagion channel (for stock prices) that has been present during the three crises, although its intensity varied across them. During the Russian crisis it appears to be the only relevant channel. Second, in both the Thai and Brazilian crises, both trade-links and neighborhood effects

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[22] This explanation does not seem consistent with the result regarding the Brazilian crisis which was largely expected by the markets. A full understanding of this result needs additional research.

appear to be relevant contagion channels. Indeed, their point estimates are significant and sometimes even higher than the coefficients associated with financial competition. Third, using stock market returns it is not possible to know whether absolute or relative financial competition is relatively more important.

V. CONCLUDING REMARKS

We have presented evidence on the relative importance of alternative contagion channels during the Thai, Russian, and Brazilian crises. The analysis has shown that contagion channels depend on the nature of the crisis as measured by different financial variables. When measured by the cross-country correlation of sovereign bond spreads, financial competition—measured by the extent to which countries compete in banking centers—seems to explain almost all contagion. In this case, while absolute competition (funds competition) was the driving force during the Thai crisis, relative competition (in which country size does not matter) appears to be the relevant channel during the Russian and Brazilian crises.

However, when we measure contagion using cross-country stock market return correlations the picture varies in two important respects. First, trade links and neighborhood effects appear to be relevant contagion channels during both the Thai and Brazilian crises. In the case of the Russian crisis, financial competition is the only relevant channel. Second, it is not possible to conclude whether absolute or relative financial competition is more relevant.

It is possible for our results to be, at least partly, induced by the choice of variables used to measure the extent of crisis in each country, in particular, sovereign bond spreads. This would be the case if emerging market economies, as a whole, face an upward sloping supply curve of funds. The latter, however, is unknown *ex-ante*, especially given the small share that emerging market economies represent in the portfolio of investors in industrial countries. Also, the two measures of competition in financial centers used in this paper refer to bank flows only, and this type of flow is less likely to affect stock prices. Nevertheless, this issue requires additional research—perhaps through similar exercises as in this paper but using alternative crisis indexes, such as the pressure on the exchange market.

A correct design of policy measures aimed at reducing the effects of contagion should consider the different channels and types of contagion. Results in this paper suggest that policies aimed at diversifying trade will reduce contagion in stock markets but not in sovereign bond spreads—the latter is an important variable as it determines access to financial markets. In contrast, policies aimed at diversifying sources of finance across different financial centers will reduce contagion in both stock market prices and sovereign bond spreads.

Table 1. Country List and Samples

	EMBI +	Global EMBI	Stock Market
Argentina	+	+	+
Brazil	+	+	+
Chile			+
Colombia	+	+	+
Ecuador		+	+
Mexico	+	+	+
Peru	+	+	+
Venezuela	+	+	+
Indonesia			+
South Korea		+	+
Malaysia		+	+
Philippines		+	+
Singapore			+
Thailand		+	+
Bulgaria	+	+	
Poland	+	+	+
Russia		+	+
Hungary			+

Table 2. Contagion in EMBIs with Alternative Weighting Matrices

	Weighting Matrix			
	Trade	Neighborhood	Finan. Absolute	Finan. Relative
Crisis in Thailand (July–September 1997)				
Constant	-1.34	-4.36	-1.21	-1.20
	(0.68)	(2.03)	(0.66)	(0.63)
Contagion Index	0.87	0.40	0.93	0.84
	(6.52)	(3.56)	(7.69)	(7.15)
R2	0.31	0.12	0.39	0.35
Prob (F-Stat)	0.00	0.00	0.00	0.00
No. Obs.	96	96	96	96
Crisis in Russia (August–October 1998)				
Constant	49.36	43.68	16.23	15.33
	(2.44)	(2.23)	(0.84)	(0.80)
Contagion Index	0.25	0.43	0.81	0.84
	(3.30)	(4.42)	(6.53)	(6.77)
R2	0.06	0.11	0.21	0.22
Prob (F-Stat)	0.00	0.00	0.00	0.00
No. Obs.	168	168	168	168
Crisis in Brazil (January–March, 1999)				
Constant	4.83	2.27	1.95	0.59
	(0.41)	(0.20)	(0.18)	(0.05)
Contagion Index	0.37	0.56	0.84	0.86
	(4.91)	(6.25)	(7.16)	(7.59)
R2	0.13	0.19	0.24	0.26
Prob (F-Stat)	0.00	0.00	0.00	0.00
No. Obs.	168	168	168	168

Pooled OLS. T-tests in parenthesis. EMBI+ in Thai crisis and EMBI Global in the others.

Table 3. Contagion in EMBIs with Competing Weighting Matrices

	Weighting Matrices				
Matrix 1	Trade	Neighborhood	Trade	Neighborhood	Fin. Absolute
Matrix 2	Fin. Absolute	Fin. Absolute	Fin. Relative	Fin. Relative	Fin. Relative

			Crisis in Thailand (July–September 1997)		
Constant	-1.38	-1.48	-1.19	-1.00	-1.31
	(0.74)	(0.90)	(0.62)	(0.58)	(0.70)
Cont. Index 1	-0.17	-0.55	0.02	-0.74	1.10
	(0.50)	(3.60)	(0.04)	(4.24)	(2.29)
Cont. Index 2	1.07	1.49	0.83	1.62	-0.17
	(3.39)	(7.68)	(2.41)	(7.61)	(0.37)
R2	0.39	0.46	0.35	0.46	0.35
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00
No. Obs.	96	96	96	96	96
			Crisis in Russia (August–October 1998)		
Constant	17.17	15.84	17.58	15.43	15.66
	(0.88)	(0.81)	(0.91)	(0.80)	(0.81)
Cont. Index 1	-0.03	0.05	-0.11	-0.07	-0.14
	(0.38)	(0.39)	(1.15)	(-0.53)	(0.22)
Cont. Index 2	0.85	0.77	0.96	0.91	0.97
	(5.46)	(4.55)	(5.85)	(4.87)	(1.59)
R2	0.21	0.21	0.22	0.22	0.22
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00
No. Obs.	168	168	168	168	168
			Crisis in Brazil (January–March, 1999)		
Constant	2.10	1.59	0.51	0.62	-0.15
	(0.19)	(0.15)	(0.05)	(0.06)	(0.01)
Cont. Index 1	0.05	0.24	-0.02	0.15	-0.58
	(0.49)	(1.91)	(0.16)	(1.12)	(0.95)
Cont. Index 2	0.78	0.61	0.88	0.71	1.41
	(4.90)	(3.71)	(5.40)	(4.03)	(2.38)
R2	0.24	0.25	0.26	0.26	0.26
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00
No. Obs.	168	168	168	168	168

Pooled OLS. T-tests in parenthesis. EMBI+ in Thai crisis and EMBI Global in the others.

Table 4. Contagion in Stock Markets with Alternative Weighting Matrices

		Weighting Matrix		
	Trade	Neighborhood	Finan. Absolute	Finan. Relative
Crisis in Thailand (July–September 1997)				
Constant	0.07	0.01	0.03	0.00
	(0.23)	(0.05)	(0.09)	(0.01)
Contagion Index	0.75	0.75	0.87	0.92
	(9.47)	(9.60)	(8.73)	(8.70)
R2	0.31	0.31	0.27	0.27
Prob (F-Stat)	0.00	0.00	0.00	0.00
No. Obs.	204	204	204	204
Crisis in Russia (August–October 1998)				
Constant	-0.53	-0.27	0.00	0.02
	(0.70)	(0.37)	(0.00)	(0.02)
Contagion Index	0.45	0.54	0.84	0.90
	(5.83)	(6.53)	(8.22)	(8.25)
R2	0.14	0.17	0.25	0.25
Prob (F-Stat)	0.00	0.00	0.00	0.00
No. Obs.	204	204	204	204
Crisis in Brazil (January–March, 1999)				
Constant	0.23	0.31	0.19	0.16
	(0.60)	(0.86)	(0.50)	(0.44)
Contagion Index	0.43	0.56	0.76	0.78
	(4.82)	(6.04)	(5.47)	(5.34)
R2	0.10	0.15	0.13	0.12
Prob (F-Stat)	0.00	0.00	0.00	0.00
No. Obs.	168	168	168	168

Pooled OLS. T-tests in parenthesis.

Table 5. Contagion in Stock Markets with Competing Weighting Matrices

	Weighting Matrices				
Matrix 1	Trade	Neighborhood	Trade	Neighborhood	Finan. Abs.
Matrix 2	Fin. Absolute	Fin. Absolute	Fin. Relative	Fin. Relative	Fin. Relative
		Crisis in Thailand (July–September 1997)			
Constant	0.05	0.01	0.04	0.00	0.02
	(0.18)	(0.05)	(0.15)	(0.01)	(0.05)
Cont. Index 1	0.52	0.52	0.53	0.53	0.52
	(3.72)	(4.20)	(3.70)	(4.17)	(0.97)
Cont. Index 2	0.34	0.37	0.34	0.37	0.38
	(2.00)	(2.42)	(1.82)	(2.25)	(0.67)
R2	0.32	0.33	0.32	0.33	0.28
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00
No. Obs.	204	204	204	204	204
		Crisis in Russia (August–October 1998)			
Constant	-0.03	-0.01	0.00	0.00	0.02
	(0.04)	(0.01)	(0.00)	(0.00)	(0.02)
Cont. Index 1	0.06	0.16	0.03	0.11	0.35
	(0.60)	(1.37)	(0.11)	(0.93)	(0.62)
Cont. Index 2	0.78	0.69	0.87	0.78	0.53
	(5.39)	(4.76)	(5.40)	(4.68)	(0.88)
R2	0.25	0.26	0.25	0.26	0.25
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00
No. Obs.	204	204	204	204	204
		Crisis in Brazil (January–March, 1999)			
Constant	0.10	0.16	0.10	0.17	0.18
	(0.28)	(0.43)	(0.26)	(0.45)	(0.49)
Cont. Index 1	0.20	0.39	0.20	0.41	0.68
	(1.78)	(3.43)	(1.68)	(3.26)	(1.12)
Cont. Index 2	0.55	0.41	0.55	0.37	0.10
	(3.05)	(2.33)	(2.77)	(1.90)	(0.15)
R2	0.14	0.18	0.14	0.17	0.13
Prob (F-Stat)	0.00	0.00	0.00	0.00	0.00
No. Obs.	204	204	204	204	204

Pooled OLS. T-tests in parenthesis.

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