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Crisis Transmission: Evidence from the Debt, Tequila, and Asian Flu Crises

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This article analyzes how external crises spread across countries. The authors analyze the behavior of four alternative crisis indicators in a sample of 20 countries during three well-known crises: the 1982 debt crisis, the 1994 Mexican crisis, and the 1997 Asian crisis. The objective is twofold: to revisit the transmission channels of crises, and to analyze whether capital controls, exchange rate flexibility, and debt maturity structure affect the extent of contagion. The results indicate that there is a strong neighborhood effect. Trade links and similarity in precrisis growth also explain (to a lesser extent) which countries suffer more contagion. Both debt composition and exchange rate flexibility to some extent limit contagion, whereas capital controls do not appear to curb it.

The increasing globalization of the economy has put the issue of transmission of crises across countries in the front line. Although the word contagion is a rather new concept in international finance, it has been the focus of a large number of policy-oriented seminars and debates. Both regional and time clustering of currency crises are at the heart of the discussion. There are several important questions that need to be answered. In this article, we focus on two of them. First, what are the propagation channels of international crises across countries (other than common shocks)? Second, are there useful policy instruments for shielding countries from contagion? In particular, do capital controls, exchange rate flexibility and the external debt maturity structure affect contagion? We seek to answer these questions using evidence from three key events: the 1982 debt crisis, the 1994 Mexican devaluation, and the 1997 Asian crisis.

There is an ongoing discussion about the proper definition of contagion (see, for example, Kaminsky and Reinhart 1998; Forbes and Rigobón 1999). Here we simply refer to it as the co-movement suffered by countries during crisis periods and that is unexplained by initial conditions or common shocks. It is a characteristic of crises because it is precisely during these periods in which the

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issue is important from a policy perspective. Nevertheless, as Rigobón (1999) emphasizes, contagion could be confused with the presence of a large common shock. In our empirical investigation, we attempt to separate the effects of contagion from other large common shocks. However, because we select crisis periods, we cannot strictly compare whether they are essentially of a different nature than tranquil times. This issue has led many to question the view that contagion is a particular phenomenon during crisis and is different from simple interdependence. We do not solve this problem, although we compare different transmission mechanisms through which interdependence across countries occurs.[1]

This article is closely related to other studies of contagion, particularly those that analyze the existence of contagion and the likelihood of alternative propagation channels by examining a number of currency crises. According to Eichengreen, Rose, and Wyplosz (1997) and Glick and Rose (1998), trade links are the key transmission channel of crises across countries. While the first study focuses on Organisation for Economic Co-operation and Development (OECD) countries, the second studies five international crises using a narrower form of contagion than the one we use, namely, contagion originating from "ground zero." Kaminsky and Reinhart (1998) claim that financial links are potentially an important transmission mechanism. However, they argue that because of the high correlation between trade and financial links, it is difficult to distinguish between both channels. We revisit the existence of contagion as well as the most likely transmission channels.

Instead of focusing on transmission from ground-zero countries to the rest of the world, we look at the impact of crises elsewhere on the likelihood that a country will suffer a crisis. This allows us to study the fact that many times contagion happens from country A to country B, but what may cause problems in country C is not a crisis in A, but the problems in B. A typical case we have in mind is that a crisis in Mexico may affect Chile more through its impact on Argentina and Brazil than through the crisis in Mexico itself. For this reason, focusing on ground-zero countries could give an incomplete picture of the evidence.

Section I discusses our basic empirical approach. Section II provides evidence of the existence of contagion and investigates the transmission channels behind this phenomenon. Section III investigates the extent to which capital controls, exchange rate flexibility, and debt structure shield countries against contagion effects. Section IV presents concluding remarks.

I. Empirical Approach

This section describes our empirical methodology. To measure contagion or transmission of crises across countries, we follow an approach that combines previous work by Sachs, Tornell, and Velasco (1996); Eichengreen, Rose, and Wyplosz

1. We use indistinctly the expressions contagion, interdependence, and co-movements.

(1997); and Glick and Rose (1998). In particular, we try to explain the cross-sectional variation in alternative crisis indicators during particular events using (i) a set of initial macroeconomic conditions, and (ii) a weighted average of the evolution of the crisis indicator in other countries. With (i), we seek to control for country-specific characteristics that may directly explain the extent of crises as well as common factors that affect countries differently depending on macroeconomic characteristics (for example, an international interest rate shock). With (ii), we seek to measure and characterize contagion. Because alternative weighting schemes can be associated a priori with different transmission channels, we are able to study what may drive contagion.

We focus the analysis on three important events of the past 25 years from the perspective of developing countries: crisis 1, the 1982 debt crisis; crisis 2, the 1994 Mexican devaluation; and crisis 3, the 1997 Asian crisis. In the spirit of Glick and Rose (1998), we identify a ground-zero country for each crisis and date the episode accordingly. This is used just to date the beginning of the crisis, not to define how it spreads to other countries. We assume that when the crisis begins, all countries are subject to contagion. We use a dummy to control only for the ground-zero country, which captures the fact that this country by definition cannot suffer from contagion.

In the case of the debt crisis, we use Mexico as the ground-zero country and date the initial period of the crisis in August 1982, when Mexico announced a moratorium on its external debt. In the case of the tequila crisis, the ground-zero country is naturally Mexico and the initial date is December 1994. Finally, we consider that the Asian crisis started in Thailand in July 1997.

We analyze the performance of four alternative crisis indicators in 20 countries, 8 from Latin America, 6 from Asia, and 6 controls (small, open OECD countries). Appendix table A-1 lists the countries as well as their neighborhood codes.

Measuring Contagion

To measure contagion, we explain the performance of crisis indicators in the countries, using particular averages of what happens in other countries. More formally, indexing countries by i ($i = 1, 2, \dots, 20$) and crises by j ($j = 1, 2, 3$), we estimate cross-section models of the following form:

$$(1) \qquad \Delta CI_{i,t,j} = \beta_0 + \beta_1 X_{i,j} + \beta_2 \sum_{k \neq i} M_{i,k,j} \Delta CI_{k,t,j} + \beta_3 \sum_{k \neq i} M_{1,1} \Delta CI_{k,t,j} + \in_{i,t,j},$$

where $\Delta CI_{i,t,j}$ denotes the change in crisis indicator CI in country i, during crisis j, between one month before that crisis and month t; $X_{i,j}$ is a vector of initial macroeconomic conditions in country i prior to crisis j; $M_{i,k,j}$ is a fixed number that weights ex ante the importance of country k in explaining the performance of country i; $M_{1,1}$ is a fixed number that weights equally all countries different from i; and $\varepsilon_{i,t,j}$ is a random shock.

We construct a series of matrixes with weights $M_{i,k,j}$ to calculate particular linear combinations of other countries' returns. Each linear combination represents a particular theory of contagion.

The $M_{1,1}$ allows us to control for the effect of the size of each crisis. In other words, it controls for the effect of the common shock that occurs elsewhere. After normalizing the weights, this is equivalent to adding for each country the average crisis in all other countries. If we had a very large sample, this could be approximated by the average across countries, and solved by including a dummy variable for each crisis. However, in our sample, this could lead to biases as long as countries subject to large shocks—that is, large changes in the crisis indicator—also have a large weight in the average change in the crisis indicator. There would be an obvious and strong upward bias because the country with a large weight would be included in both the left- and right-side variables. For this reason, we exclude the country when computing the average external shock for each observation.

When the true β_2 is positive (that is, there is contagion) and the $M_{i,k,j}$ weights are nonnegative, the ordinary least squares (OLS) estimation of equation 1 has a positive bias.[2] A shock in $\in_{i,t,j}$ that triggers a crisis in a country will affect, through contagion, the performance of other countries; the other countries, in turn, will affect country i's performance, introducing a positive correlation between the error term ($\in_{i,t,j}$) and one of the regressors ($\Sigma_{k\neq i} M_{i,k,j}\ \Delta CI_{k,t,j}$). However, because this bias is monotonic in β_2 and hence there is no bias when β_2 is zero (and there is negative bias when $\beta_2 < 0$), the issue is not a serious problem for our particular purposes. As long as we focus on comparing alternative models, it is valid to compare different OLS estimates of β_2. The same is true when we compare alternative measures for curbing contagion. In a very large sample, this effect would not exist because the feedback from a single country to others would be small. Here we presume this is also small; as long as there are about 20 countries per episode, the effect of a particular $\varepsilon_{i,t,j}$ should be small.

We consider the following four crisis indicators:

- A foreign exchange market pressure index at a three-month horizon after the crisis, denoted by *PI-3*.
- A foreign exchange market pressure index at a 12-month horizon after the crisis, denoted by *PI-12*.
- The level of the real exchange rate 12 months after the crisis, denoted by *RER*.
- A credit rating indicator, denoted by *CR*.

When using indicators with the same time horizon in different crises, we are implicitly assuming that the three crises have similar contagion patterns in the time dimension. This does not need to be the case. The credit rating measure partially takes into account this issue.

In constructing *PI-3* and *PI-12*, we follow the standard procedure of calculating a weighted average of changes in the real exchange rate and the stock of international reserves in each country/observation. In the case of crises 2 and 3, we also include (minus) the change in the real interest rate with respect to the 12-

2. We consider only nonnegative $M_{i,k,j}$ weights.

month average level observed prior to the crisis. As in Kaminsky and Reinhart (1999), we weight each component of the index such that each one has equal (crisis-specific) volatility. A negative change in *PI* shows an increase in market pressure that may arise from any of the three components.[3] We use data from International Monetary Fund (IMF; various years) for international reserves, interest rates (short-run deposits), and inflation. We use the JP Morgan database for real exchange rates, in which a downward movement in *RER* means depreciation.[4]

For credit rating, we use the credit risk indicator compiled by *Institutional Investor*. Because it is published only in March and September of each year, we are not able to have a perfect dating for each crisis. However, this allows us to select the horizon we consider more appropriate in each crisis. For crisis 1, we use the 1-year change in the index published in March 1983; for crisis 2, we use the 6-month change published in September 1995 (which seems to better capture the Mexican downgrade); and for crisis 3, we use the 12-month change published in March 1998.

The 60 × 60 matrix with weights $M_{i,t,j}$ can take several forms. However, because cross-crisis contagion makes little economic sense, we restrict it to a block diagonal with three 20 × 20 submatrixes. Moreover, because we are not interested in explaining contagion suffered by ground-zero countries, the matrixes have zeros in the respective row. Furthermore, to avoid running regressions in which an independent variable is a function of that same dependent variable, we restrict the main diagonal to be zero. We follow the same procedure when constructing the $M_{1,1}$ matrix of equal weights. In any case, the concept of own contagion does not make sense.

Depending on the exact definition of contagion, there are two alternative classes of weighting matrixes. If contagion is defined as occurring exclusively from the ground-zero country to other countries, then the matrix has to have nonzero elements only in the columns corresponding to the ground-zero country. This is the approach taken by Glick and Rose (1998). Alternatively, if contagion is defined more broadly as transmission of crises from a particular set of countries to others, then the nonzero elements could appear anywhere in the 20 × 20 matrixes, except in the row of the ground-zero country. This is the approach followed by Eichengreen, Rose, and Wyplosz (1997) in trying to explain the probability of crisis (a binary variable) in a group of OECD countries. They consider that there is contagion as long as a weighted "crises elsewhere" variable affects the probability of crisis in an individual country.[5] We focus our analysis on the second type of contagion, although we also analyze the first type.

3. None of the results change in any important way if we exclude from *PI* interest rates for crises 2 and 3.

4. Because of dramatic jumps unrelated to the crises, we excluded international reserves from the indicators for South Africa in crises 2 and 3 and the real interest rate for Brazil in crisis 2.

5. The approach taken by Kaminsky and Reinhart (1998) is conceptually similar although formally different. They estimate the incidence of crises as a function of fundamentals and the number of crises in alternative clusters of countries. This is equivalent to having matrixes with ones in particular entries.

To test for the presence of contagion, we check whether β_2 in equation 1 is significantly different from zero. To compare the strength of contagion across different weighting matrixes (of the second type), we rescale them such that each row adds up to one. Thus, β_2 shows the impact of a particular weighted average of crisis indicators elsewhere in the crisis indicators of the average (not ground-zero) country. Then different weighting matrixes allow us to identify the most important transmission channels.

Macroeconomic Fundamentals

The vector $X_{i,j}$ of initial macroeconomic conditions includes country-specific characteristics that may explain the extent of the crises in each country. Specifically, we consider a set of variables that are typically related to currency attacks and balance of payments crises according to standard models (first, second, and later generations) and the existing empirical evidence.[6] The list of variables is the following:

1. *Credit boom 1*. Total credit to the private sector (as a percentage of gross domestic product, GDP) in excess of the long-run trend of the ratio credit/GDP calculated using a Hodrik-Prescott filter (see Gourinchas, Landerretche, and Valdés 2001). We consider 1981, 1994, and 1996 as the initial conditions for crises 1, 2, and 3, respectively.
2. *Credit boom 2*. Total credit (as a percentage of GDP) in excess of the long-run trend of the ratio credit/ GDP, for the same years as for credit boom 1.
3. RER *overvaluation*. Twelve-month average of *RER* misalignment prior to each crisis calculated using as equilibrium *RER* an HP filter with information up to the month before each crisis (therefore the filter is one-sided).
4. *Fiscal balance/GDP*. Fiscal balance as a percentage of GDP, for the same years as for credit booms.
5. *Current account/GDP*. Current account balance as a percentage of GDP, for the same years as for credit booms.
6. *GDP growth*. GDP annual growth rate, for the same years as for credit booms.
7. *Debt/GDP*. Debt to GDP ratio. For OECD countries, we estimate the stock of debt by adding up current account deficits since 1950. This is for the same years as for credit booms.
8. *Inflation*. Consumer price index 12-month inflation measured in the month before each crisis (measured as p/(1 + p), where p is the rate of inflation).

Before analyzing the presence of contagion, it is interesting to evaluate whether these macroeconomic fundamentals matter in explaining which countries suffer stronger crises (or a crisis at all) during an international crisis. Sachs, Tornell, and Velasco (1996) address this issue, although they focus only on the Tequila crisis. Their main result is that excess credit creation and *RER* misalignment are

6. See Eichengreen, Rose, and Wyplosz (1997); Kaminsky, Lizondo, and Reinhart (1998); and the comprehensive study by Berg and Pattillo (1998) for details.

the most important variables in explaining the extent of crises across countries. They do not find any relevant role for the current account deficit. Berg and Pattillo (1998) find similar results using several alternative methodologies. They find that the most important indicators of vulnerabilities are the rate of growth of domestic credit, a measure of real exchange rate overvaluation, and the ratio of reserves to the M2 money supply. They find that the current account deficit, the budget deficit, and the composition of external liabilities are good predictors of external fragilities only in some cases (estimations).

Table 1 presents the results of estimating equation 1 without contagion effects. In the equation, we include ground-zero countries, so we estimate a standard crisis-prediction equation. In our estimations, the current account balance appears as a highly significant explanatory variable in *PI-3*, *PI-12*, and *RER* (the "objective" indicators). Credit boom (private credit), *RER* overvaluation, fiscal balance, and GDP growth are significant in some of the crisis indicators. In the case of the *RER* depreciation indicator, it is interesting to note that the signs of the current account balance and the fiscal balance are opposite. This indicates that an increase in the current account increases the real depreciation 12 months later, but the converse occurs with the fiscal balance. The interpretation is not straightforward. By accounting, we can decompose the current account deficit into private and public components, the latter being the budget balance. An in-

TABLE 1. Crisis Indicators and Initial Conditions

	Crisis indicator			
Variable	Change in *PI-3*[a]	Change in *PI-12*[b]	Change in credit rating	Change in *RER*[c]
Constant	–0.08	–4.62	–1.92	–1.25
	(–0.04)	(–2.94)	(–2.41)	(–0.68)
Credit boom	–30.82	—	–15.92	–44.35
	(–1.64)		(–1.75)	(–2.27)
RER overvaluation	–0.24	–0.45	—	—
	(–1.43)	(–2.63)		
Fiscal budget/GDP	—	—	—	–0.77
				(–2.14)
Current account/GDP	0.44	0.67	—	1.04
	(1.70)	(2.54)		(3.49)
GDP growth	—	1.50	—	—
		(3.22)		
R^2	0.17	0.31	0.05	0.29
F-statistic p-value	0.02	0.00	0.09	0.00
Observations	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants (not reported). White's robust t-tests are in parentheses. We report variables with at least 80 percent significance.

[a]Foreign exchange market pressure index three months after the crisis.

[b]Foreign exchange market pressure index 12 months after the crisis.

[c]Level of the real exchange rate 12 months after the crisis.

Source: Authors' calculations.

crease in the budget deficit would raise the current account deficit, deteriorating the *RER* indicator, but there is a direct effect partially offsetting the current account effect.

An interesting result is that, other than credit boom, macro-variables do not explain changes in credit rating. Credit rating is a "subjective" crisis indicator because it is based on the assessment of vulnerabilities assigned by the market.

Neither the debt/GDP ratio nor inflation has significant effects in explaining any of the crisis indicators. As shown by the R^2 statistics, the macroeconomic fundamentals we consider have a limited capability for explaining the cross-country experience during crisis periods, a result consistent with the already large literature on crisis forecasting.

II. Contagion and Transmission Channels

This section investigates the presence of contagion in the three crises we study and analyzes the likelihood of alternative transmission channels. It discusses the construction of alternative weighting matrixes and presents some empirical results.

Weighting Matrixes

There are several potential channels for the propagation of contagion. The most important are direct trade links, trade competition in third markets, macroeconomic similarities, and financial links. Eichengreen, Rose, and Wyplosz (1997) and Glick and Rose (1998) find evidence that trade links are the most important channel of propagation. Kaminsky and Reinhart (1998) also find strong evidence of regional contagion. They conclude that this pattern could be associated with trade links as well as with financial links. A key problem is that the two are correlated. An additional problem is that measures to control for financial links are limited.

Controlling for the average shock elsewhere is a form of controlling for the international environment. In addition, we may capture the channels through which interdependence or contagion occurs by weighting the shocks elsewhere by some characteristics of the relationship among countries. Thus, different weighting matrixes $M_{i,k,j}$ allow us to investigate the importance of alternative transmission channels of contagion (from country i to country k). We consider the following matrixes:

1. Equal weights for all countries k, allowing us to control for differences across crises.
2. Direct trade links measured by the ratio of bilateral trade between countries i and k to total trade of country i. This set of weights is motivated by trade-based contagion theories, such as competitive devaluation.
3. Trade competition in third markets measured through a similarity index of the trade pattern based on the relative importance in total exports of

six sectors (agriculture, food, fuel, ores, high-tech manufacturing, and low-tech manufacturing). This matrix has the same motivation as in point 2.

4. Neighborhood (regional) dummies for Latin American, Asian, and industrial countries (see appendix table A-1 for details). This matrix is motivated by the presumption that contagion is regional (explained primarily by financial links after controlling for trade links).
5. An overall macroeconomic similarity index that combines RER misalignment, current account balance, credit boom, fiscal balance, and GDP growth. Macroeconomic similarities may explain contagion if, for instance, investors learn and update their priors during a crisis (that is, there is a "wake-up call" during crisis).
6. Specific macroeconomic similarity indexes, including external similarity (encompassing RER and current account), credit boom, and GDP growth.
7. All of the above measures, but with respect to only neighboring countries. This allows us to evaluate the alternative contagion channels at the regional level.

Both trade-pattern similarity, because of data availability, and neighbor dummy matrixes, by definition, are constant across crises. The rest of the matrixes are crisis-specific. All the matrixes are symmetric, except the one with direct trade links. The reason for the lack of symmetry of the trade-link matrix is that trade is measured with respect to total trade of the country; thus, bilateral trade is symmetric, not its importance with respect to each country.

To construct a similarity index between countries i and k when considering a single variable (for example, GDP growth or credit boom), we calculate:[7]

$$\theta_{i,k,j} = \exp(-|x_{i,j} - x_{k,j}|), \tag{2}$$

where x_i is the standardized variable under analysis in country i. The standardization is based on cross-country, crisis-specific observations.[8]

When constructing similarity indexes that combine multiple variables (for example, trade pattern, external conditions, and overall macroeconomic similarity), we calculate:

$$\theta_{i,k,j} = \exp(-\sum_{s}|x_{s,i,j} - x_{s,k,j}|), \tag{3}$$

where s indexes the different variables entering the index and $x_{s,i,j}$ is the standardized variable s in country i and crisis j.

To facilitate comparability across different matrixes, we rescale the $\theta_{i,k,j}$'s so that maximum similarity takes the value 1 and minimum similarity takes the value 0. Thus, we calculate the weight $M_{i,k,j}$ as follows:

7. The procedure for constructing similarity indexes is somewhat ad hoc because it introduces some nonlinear transformations in the data; however, it allows us to reduce the effect of outliers.

8. By standardized variable, we refer to a variable in a given crisis minus its mean divided by its standard deviation.

(4)
$$M_{i,k,j} = \frac{\theta_{i,k,j} - \min(\theta_{i',k',j})}{\max(\theta_{i',k',j}) - \min(\theta_{i',k',j})}$$

where i', k', and j represent all possible country combinations in crisis j. Furthermore, for a straightforward interpretation of the results, we rescale $M_{i,k,j}$ again so that $\Sigma_i M_{i,k,j} = 1$. Thus, β_2 reflects the impact of a weighted average of what is happening elsewhere on the average country.

Empirical Results

Tables 2 to 5 present the estimation of equation 1 using *PI-3*, *PI-12*, *RER*, and *CR*, respectively, and with alternative weighting matrixes for each crisis indicator. The variable "contagion index" corresponds to β_2, while "equal weight" corresponds to β_3. All regressions include a constant and dummies for the ground-zero countries (not reported).

The results for the *PI-3* indicator show that contagion is strongly and almost exclusively driven by neighborhood and direct trade effects. None of the "wider" matrixes (those considering not only neighbors) yields a significant coefficient that could indicate the presence contagion. Indeed, when constraining weighting matrixes to neighboring countries, most of the results are significant. The point estimate of direct trade links is smaller than that of the neighbor dummies, and, because we are constraining weights to be one, we can conclude that the neighbor effect is quantitatively stronger than that of direct trade. This probably reflects the close trade links that exist between neighbors rather than a proper propagation channel. In fact, when we consider direct trade with neighboring countries only, the estimate is highly significant, but the point estimate is still smaller than what the neighbor dummy matrix yields. Interestingly, neither macroeconomic similarities nor the common shock proxy plays any role in explaining the cross-country propagation of contagion at this three-month horizon.

None of the parameters corresponding to the variables measuring macroeconomic initial conditions, except for credit boom, changes in any important way when we incorporate the contagion index. In fact, credit boom ceases to be significant in all specifications. Consequently, once the effects of interdependence across crises are included, the R^2 increases from 0.17 in table 1 to values around 0.5. This reveals the importance that contagion and transmission of crisis across countries have on the vulnerability to external crisis.[9]

The results for *PI-12* show a different picture (table 3). For this indicator, we observe that a real exchange rate overvaluation, a current account deficit, and low growth increase the (absolute) value of the crisis indicator, that is, increase the incidence of crisis. After controlling for the equal-weight matrix, the R^2s increase with respect to the value reported in table 1, but the marginal explanatory power of this variable is not as large as that of the three-month exchange

9. It is also worth mentioning that, aside from the *PI-12* indicator, results do not change if we exclude the $M_{1,1}\Delta CI_{k,t,j}$ term in the regressions.

TABLE 2. Three-Month Change in Foreign Exchange Market Pressure Index and Total Contagion

	Weighting matrix								
Variable	Direct trade	Trade pattern	Neighbor dummy	Macro similarity	External similarity	Credit similarity	Growth similarity	Trade with neighbors	Trade pattern with neighbors
Credit boom	–5.32	–13.22	0.68	–13.07	–15.45	–21.92	–12.55	–2.09	–3.34
	(–0.33)	(–0.78)	(0.05)	(–0.68)	(–0.91)	(–0.96)	(–0.74)	(–0.14)	(–0.21)
RER overvaluation[a]	–0.24	–0.26	–0.21	–0.25	–0.25	–0.26	–0.25	–0.21	–0.21
	(–1.73)	(–1.78)	(–1.75)	(–1.71)	(–1.74)	(–1.79)	(–1.72)	(–1.63)	(–1.61)
Current account/GDP	0.45	0.24	0.41	0.28	0.27	0.26	0.27	0.49	0.40
	(1.98)	(1.00)	(2.05)	(1.18)	(1.18)	(1.15)	(1.20)	(2.30)	(1.87)
Contagion index	0.63	–0.54	0.71	–0.18	–3.40	–1.24	–0.73	0.61	0.47
	(2.37)	(–0.52)	(4.29)	(–0.12)	(–1.14)	(–0.65)	(–0.38)	(3.50)	(2.91)
Equal weight	–0.06	1.05	–0.08	0.71	3.80	1.91	1.21	–0.02	0.10
	(–0.14)	(1.01)	(–0.26)	(0.45)	(1.31)	(0.89)	(0.67)	(–0.07)	(0.31)
R^2	0.51	0.46	0.60	0.46	0.47	0.46	0.46	0.56	0.53
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

[a]See text for definition.

Source: Authors' calculations.

TABLE 3. Twelve-Month Change in Foreign Exchange Market Pressure Index and Total Contagion

	Weighting matrix								
Variable	Direct trade	Trade pattern	Neighbor dummy	Macro similarity	External similarity	Credit similarity	Growth similarity	External similarity of neighbors	Growth of neighbors
RER overvaluation[a]	–0.46	–0.42	–0.45	–0.51	–0.44	–0.46	–0.46	–0.52	–0.43
	(–2.66)	(–2.60)	(–2.98)	(–2.96)	(–2.32)	(–2.68)	(–2.64)	(–3.17)	(–2.79)
Current account/GDP	0.45	0.48	0.39	0.53	0.47	0.48	0.47	0.39	0.41
	(1.56)	(1.87)	(1.59)	(1.94)	(1.73)	(1.75)	(1.68)	(1.50)	(1.63)
GDP growth	1.31	1.18	1.53	1.49	1.26	1.26	1.12	1.36	1.84
	(2.62)	(2.59)	(3.51)	(2.97)	(2.63)	(2.64)	(1.46)	(2.98)	(3.94)
Contagion index	–0.13	–2.80	–1.72	–3.03	0.15	–0.49	0.42	–1.08	–1.41
	(–0.34)	(–2.46)	(–3.50)	(–1.33)	(0.06)	(–0.33)	(0.22)	(–2.42)	(–3.37)
Equal weight	0.72	3.31	2.28	3.51	0.45	1.10	0.18	1.60	2.00
	(1.63)	(2.93)	(4.26)	(1.59)	(0.18)	(0.72)	(0.10)	(3.31)	(4.18)
R^2	0.40	0.46	0.52	0.42	0.40	0.40	0.40	0.46	0.50
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

[a]See text for definition.

Source: Authors' calculations.

market pressures indicator. We find that for this indicator, co-movement is almost exclusively driven by the common shock (proxied by the equal-weight matrix, that is, crisis elsewhere). Transmission through trade, neighbor effects, and similarities do not appear to play an important additional role. In fact, none of the weighting matrixes yields significantly positive parameters. If we do not control for the equal-weight matrix, the results change dramatically, with several weighting matrixes having significantly positive results. However, this follows from the fact that the equal weight and other matrixes are collinear across crises. In what follows, we no longer consider *PI-12* in the analysis and conclude that there is no particular form of contagion in this indicator beyond the existence of common shocks (although there is a high degree of co-movement across countries).[10]

In the case of the indicator based on 12-month *RER* depreciation (table 4), we find that contagion indexes are significantly positive when we consider direct trade links, neighbors, and growth similarity. The strong negative sign for trade pattern similarity indicates that there is evidence against third-market competition being an important transmission mechanism of crises.

Conventional wisdom indicates that when a country has a currency crisis, a real depreciation will hurt competitors in those markets, leading to competitive devaluations. However, because a crisis in a country is usually coupled with an output collapse, it may create opportunities for the country's main competitors. This may be what is happening with the reverse sign we find, at least at the one-year horizon. It might also be that trade pattern similarity is not appropriately measuring third-market competition, and perhaps third-market competition could be better proxied by some regional effect. We still find that initial conditions measured by the current account deficit and budget deficit help to explain 12-month *RER* depreciation. Credit boom is the only initial macroeconomic variable that looses significance in the *RER* equation when we include contagion.

Finally, in the case of change in credit rating (table 5), we find that the direct trade links, neighbors, overall macro similarity, and growth similarity matrixes yield significant contagion coefficients. When considering only similarities with neighboring countries, we find that both trade and external macroeconomic similarity appear to be very important channels of contagion. As in the previous case, initial conditions measured by credit boom looses significance when we include contagion. With the *CR* index, we find no initial condition to be significant when we include contagion.

The evidence presented so far is not able to discriminate completely among (statistically significant) competing weighting matrixes. Following Eichengreen, Rose, and Wyplosz (1997), table 6 presents the results of estimating equation 1

10. We look again at *PI-12* only when examining contagion from ground-zero countries because the specification and the implication of the results are different. In addition, in the remaining results, we exclude the equal-weight matrix from the analysis because it is not significant for indicators other than *PI-12*.

TABLE 4. Real Exchange Rate Depreciation and Total Contagion

Variable	Weighting matrix: Direct trade	Trade pattern	Neighbor dummy	Macro similarity	External similarity	Credit similarity	Growth similarity	External similarity of neighbors	Growth of neighbors
Credit boom	–14.77	–23.81	–9.55	–10.78	–20.24	–13.95	–11.33	–7.25	–9.34
	(–0.77)	(–1.23)	(–0.49)	(–0.51)	(–1.02)	(–0.60)	(–0.61)	(–0.37)	(–0.48)
Fiscal budget/GDP	–0.65	–0.96	–0.68	–0.77	–0.90	–0.86	–0.52	–0.63	–0.68
	(–1.95)	(–2.90)	(–2.06)	(–2.26)	(–2.60)	(–2.54)	(–1.57)	(–1.92)	(–2.05)
Current account/GDP	1.08	0.94	1.09	1.07	1.03	1.02	1.14	1.08	1.09
	(4.02)	(3.47)	(4.12)	(3.84)	(3.72)	(3.69)	(4.34)	(4.11)	(4.07)
Contagion index	0.65	–2.39	0.60	1.52	–1.57	0.67	4.14	0.64	0.56
	(2.17)	(–1.99)	(2.36)	(1.14)	(–0.68)	(0.48)	(2.81)	(2.53)	(2.13)
Equal weight	0.10	3.09	0.26	–0.76	2.37	0.06	–3.08	0.21	0.33
	(0.26)	(2.58)	(0.72)	(–0.55)	(1.01)	(0.04)	(–2.21)	(0.60)	(0.95)
R^2	0.49	0.48	0.49	0.45	0.44	0.44	0.51	0.50	0.48
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

Source: Authors' calculations.

TABLE 5. Change in Credit Rating and Total Contagion

	Weighting matrix								
Variable	Direct trade	Trade pattern	Neighbor dummy	Macro similarity	External similarity	Credit similarity	Growth similarity	Trade with neighbors	External similarity of neighbors
Credit boom	–0.95	–8.21	1.28	0.41	–7.10	–24.71	–3.80	1.58	3.63
	(–0.12)	(–1.06)	(0.19)	(0.05)	(–0.86)	(–2.41)	(–0.49)	(0.24)	(0.58)
Contagion index	0.75	–2.09	0.74	2.15	–0.38	–6.63	2.33	0.82	0.83
	(2.70)	(–2.01)	(5.34)	(1.82)	(–0.20)	(–2.59)	(2.16)	(5.11)	(6.10)
Equal weight	0.10	2.59	0.04	–1.23	0.99	7.46	–1.51	0.09	0.02
	(0.33)	(2.59)	(0.16)	(–1.16)	(0.58)	(2.82)	(–1.47)	(0.39)	(0.10)
R^2	0.48	0.45	0.62	0.45	0.41	0.48	0.46	0.61	0.65
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

Source: Authors' calculations.

TABLE 6. Contagion and Competing Weighting Matrixes

	Pressure indicator								
	Change in PI-3[a]		Change in RER[b]			Change in credit rating			
Variable	(1)	(2)	(1)	(2)	(3)	(1)	(2)	(3)	(4)
Credit boom	0.00	0.01	–0.13	–0.10	–0.08	0.01	0.02	0.07	0.04
	(0.02)	(0.05)	(–0.69)	(–0.54)	(–0.44)	(0.12)	(0.26)	(1.2)	(0.59)
RER overvaluation[b]	–0.21	–0.22	—	—	—	—	—	—	—
	(–1.74)	(–1.78)							
Fiscal budget/GDP	—	—	–0.68	–0.62	–0.68	—	—	—	—
			(–2.07)	(–1.92)	(–2.10)				
Current account/GDP	0.37	0.38	1.08	1.10	1.10	—	—	—	—
	(1.95)	(1.92)	(4.06)	(4.19)	(4.17)				
Direct trade matrix	–0.22	—	0.50	0.37	—	–0.12	—	—	—
	(–0.74)		(1.47)	(1.12)		(–0.42)			
Neighbor dummy matrix	0.82	0.76	—	0.41	0.50	0.81	0.71	–2.00	—
	(3.48)	(2.22)		(1.26)	(1.91)	(4.36)	(5.09)	(–2.62)	
Macro similarity matrix	—	—	—	—	—	—	0.13	—	—
							(0.48)		
Growth similarity matrix	—	—	0.40	—	0.47	—	—	—	—
			(0.89)		(1.22)				
Trade with neighbors	—	–0.08	—	—	—	—	—	—	1.04
		(–0.24)							(2.83)
External similarity with neighbors matrix	—	—	—	—	—	—	—	2.90	–0.25
								(3.64)	(–0.61)
R^2	0.60	0.60	0.49	0.50	0.50	0.58	0.62	0.69	0.66
F-statistic *p*-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust *t*-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

[a]Foreign exchange market pressure index three months after the crisis.

[b]Level of the real exchange rate 12 months after the crisis.

Source: Authors' calculations.

simultaneously including competing relevant contagion indexes. We consider some of the matrixes that appeared as more relevant in tables 2–5 in pairs, using the same initial macroeconomic conditions as before.

The results show that in the cases of indicators based on *PI-3* and country *CR*, the identification is straightforward. In both cases, the neighborhood effect appears as the most relevant propagation mechanism for contagion. In the second case, we also observe that external similarities with respect to neighbors appears to be a strong mechanism (which is a particular form of a neighborhood effect). Trade links no longer appear important in these two cases when we control for the effect of neighbors. Although trade links and neighbor effects are highly correlated, our results suggest that the prime candidate for contagion is not trade, as documented in other papers, but geographical proximity.[11] The results are less clear-cut in the case of the indicators based on RER. Because of strong collinearity, some times we observe that a pair of matrixes is highly significant when considered individually, but is no longer significant (individually) when considered together. Despite this issue, it is possible to exclude some explanations and rank others informally according to point estimates. Direct trade links and neighbors appear as the two most relevant matrixes.[12]

Contagion from Ground-Zero Countries

An alternative way of defining contagion is to limit it to propagating from ground-zero countries only. In this case, we try to explain the cross-country variation of our crisis indicators using different weights of ground zero for each country. This definition of contagion is obviously more restrictive than the previous approach. Moreover, it is potentially misleading if the ground-zero country is not correctly identified. However, this exercise is useful for testing the robustness of our results.

Because the temporal evolution of the ground-zero country can be very different from what actually happened in other countries, we modify our strategy slightly. In particular, we analyze whether a weighted change in *PI-3* at ground zero is able to explain changes in *PI-12*, RER, and CR. The weighting matrixes are similar to those we used in the previous subsection, although we no longer have the straightforward intuition for the estimated parameter we had before (a weighted average of what is happening elsewhere). Therefore, we use standardized parameters.

Table 7 presents the results for the cases in which we find statistically significant contagion. It shows that with the *PI-12* indicator, contagion marginally arises only when we consider the equal-weight matrix. This result is proof of comovement, perhaps caused by a large shock, which is different across crises, but it is not necessarily evidence of contagion. With the indicator based on the RER, direct trade ties between countries and the ground-zero country appear to generate contagion. Finally, changes in credit rating can be explained for countries that are neighbors of the ground-zero country (especially if they have similar initial external macroeconomic conditions) or have direct trade links with it.

11. We cannot avoid making references to the case of Chile, which suffered contagion from Asia due to high trade links, but is also dependent on movements in Latin America, a region with weak trade links. Chile's trade with Argentina and Brazil, its main trade partners in the region, is well below 10 percent.

12. One can further analyze this issue of collinearity by estimating a model of the following form:

$$\Delta CI_{i,t,j} = \beta_0 + \beta_1 X_{i,j} + \beta_2 \times (\gamma \sum_{k \neq i} M_{i,k,j} \Delta CI_{k,t,j} + (1-\gamma) \sum_{k \neq i} M'_{i,k,j} \Delta CI_{k,t,j}) + \in_{i,t,j}$$

where γ measures the relative importance of $M_{i,k,j}$ vis-à-vis $M'_{i,k,j}$. The results for RER (not reported) show a significant β_2 but very imprecise estimates of γ, showing that any combination of the two matrixes would be valid.

TABLE 7. Contagion from a Ground-Zero Country

Variable	Pressure indicator and weighting matrix					
	Change in PI-12/equal weights[a]	Change in RER/direct trade[b]	Change in credit rating/ direct trade	Change in credit rating/ neighbor dummy	Change in credit rating/ external similarity of neighbors	Change in credit rating/ trade with neighbors
Credit boom	—	–0.23	–0.06	–0.04	–0.02	–0.05
		(–1.12)	(–0.80)	(–0.62)	(–0.46)	(–0.69)
RER overvaluation[b]	–0.48	—	—	—	—	—
	(–2.79)					
Fiscal budget/GDP	—	–0.57	—	—	—	—
		(–1.58)				
Current account/GDP	0.50	1.04	—	—	—	—
	(1.77)	(3.67)				
GDP growth	1.44	—	—	—	—	—
	(3.03)					
Contagion index	0.24	1.78	0.27	0.43	0.45	0.29
	(1.69)	(2.04)	(2.53)	(4.38)	(4.72)	(2.76)
R^2	0.37	0.41	0.41	0.52	0.54	0.43
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. Contagion index corresponds to the standardized parameter of a weighted average of change in PI-3 according to a particular matrix M. External similarity combines current account and RER overvaluation similarity.

[a] Foreign exchange market pressure index three months after the crisis.

[b] Level of the real exchange rate 12 months after the crisis.

Source: Authors' calculations.

III. Policies to Curb Contagion

One key policy question is how countries can curb (or even stop) contagion. A leading prescription is to limit financial integration. Other policy prescriptions to limit the extent of contagion are exchange rate flexibility and avoiding short-term debt. The issue of contagion and alternative policies is an empirical one. This section evaluates the usefulness of these three policy measures in curbing contagion.

Capital Controls and Contagion

Capital controls could curb contagion if financial links are an important propagation channel. However, the usefulness of limiting financial integration is less clear if contagion arises due to trade links, or if initial similarity in macroeconomic conditions and crises are the consequence of real shocks. Nevertheless, it could be argued that capital controls might help an orderly adjustment, avoiding typical problems that an unregulated financial sector often produces, such as overshooting the exchange rate. Of course, capital controls have costs in tranquil times because the country does not take full advantage of capital movements. However, defenders of capital controls point to contagion as one of the reasons for having capital controls as a preventive measure.

Edwards (1999) evaluates whether capital controls in Chile were a useful device for avoiding contagion. He measures contagion as the correlation between domestic and Asian interest rates (specifically, interest rates in Hong Kong), controlling for domestic devaluation and exchange rates in the United States. He concludes that controls on capital inflows may have been able to protect Chile from relatively small shocks, but were not able to prevent contagion stemming from large external shocks.

It should be mentioned that the objective of capital control measures goes beyond avoiding contagion. Among other objectives, capital controls have been used to avoid excess real exchange rate appreciation, to curb capital inflows, and to modify the foreign debt term structure.[13]

To evaluate whether financial integration facilitates contagion, we use a standard capital control index and analyze whether contagion is weaker in countries with a higher index. In particular, we estimate models of the following form:

$$\Delta CI_{i,t,j} = \beta_0 + \beta_1 X_{i,j} + [\beta_2 + \beta_3 CC_{i,j}] \sum_{k \neq i} M_{i,k,j} \Delta CI_{k,t,j} + \epsilon_{i,t,j}, \tag{5}$$

where $CC_{i,j}$ is a capital control index of country i during crisis j. If capital controls were effective in curbing contagion, the estimation should yield a negative and significant β_3.

To construct the capital control index, we use the standard dummy variables that appear in IMF (various years). For restrictions on payments on capital transactions and the surrender requirement of export proceeds, we assign values of

13. See De Gregorio, Edwards, and Valdés (2000) for an evaluation of the Chilean experience.

0, 1, or 2, depending on whether neither, one, or both of the restrictions apply. We consider the status as of December in 1981, 1994, and 1996 for the corresponding crises.

Table 8 presents the results of the estimation of equation 5 for our three crisis indicators that show contagion and for the same weighting matrixes used in last section. The results show that capital controls do not have any relevant effect in limiting contagion. Indeed, the associated parameter is generally not significantly different from zero. It has to be noted, however, that we use a broad definition of capital controls, and the most commonly used and specific forms of controls or regulations cannot be captured with these 0, 1, 2 indicators. However, the results indicate that countries that had more pervasive forms of control did not avoid contagion more than countries with looser controls.

Exchange Rate Flexibility and Contagion

Exchange rate flexibility is expected to reduce contagion by avoiding some of the overvaluation episodes to begin with and limiting the scope of speculation. To evaluate the effect of exchange rate flexibility on contagion, we use the same approach as with capital controls. In particular, we estimate an equation similar to equation 5, but with an indicator of exchange rate flexibility for country *i* in crisis *j* instead of $CC_{i,j}$. We use a 0, 1, 2 indicator (2 is maximum flexibility) based on data gathered by Goldfajn and Valdés (1999). The data were constructed using IMF (various years). That report groups exchange rate regimes into three categories: fixed (including narrow bands), flexible, and floating.

Table 9 presents the results. They show that flexibility has a significant effect in limiting contagion only when we measure contagion using changes in credit ratings. Point estimates show a large effect: Moving from a fixed exchange rate regime to a floating one reduces contagion by two-thirds. This result is robust to alternative weighting matrixes. It is interesting because it indicates that the market evaluates better and is less vulnerable to economies with flexible exchange rate regimes.

When measuring contagion with real depreciation, we find that flexibility *increases* contagion, although this result is marginally significant under only two weighting matrixes. This latter result is not surprising because the exchange rate is the variable that adjusts when external shocks hit the economy. Moreover, part of the adjustment may be an overshooting of the real exchange rate. We do not find significant effects of flexibility in the case of *PI-3*.

Overall, we can conclude only for the *CR* indicator that having a flexible exchange rate may reduce contagion.

Debt Maturity Structure and Contagion

Having debt maturity tilted toward the long run would limit the scope of financial runs against a particular country. To evaluate whether the debt maturity structure has any impact on the extent of contagion, we run an equation similar to equation 5, but with the ratio of short-term debt to total debt for country *i* in

Table 8. Capital Controls and Contagion

Variable	Pressure indicator and weighting matrix								
	Change in PI-3/direct trade[a]	Change in PI-3/ neighbors[a]	Change in PI-3/trade with neighbors[a]	Change in RER/direct trade[b]	Change in RER/ neighbors[b]	Change in RER/ growth similarity[b]	Change in credit rating/ direct trade	Change in credit rating/ trade with neighbors	Change in credit rating/ external similarity of neighbors
Credit boom	–0.04	0.01	–0.02	–0.16	–0.13	–0.17	–0.01	0.02	0.04
	(–0.23)	(0.07)	(–0.12)	(–0.86)	(–0.70)	(–0.84)	(–0.11)	(0.26)	(0.58)
RER overvaluation[b]	–0.26	–0.23	–0.22	—	—	—	—	—	—
	(–1.86)	(–1.76)	(–1.65)						
Fiscal budget/GDP	—	—	—	–0.57	–0.56	–0.76	—	—	—
				(–1.69)	(–1.75)	(–2.26)			
Current account/GDP	0.38	0.37	0.46	1.09	1.18	1.05	—	—	—
	(1.67)	(1.79)	(2.15)	(4.10)	(4.42)	(3.87)			
Contagion index	0.48	0.64	0.56	0.82	0.94	1.00	0.84	1.12	0.92
	(1.65)	(2.77)	(2.36)	(3.19)	(3.71)	(2.71)	(2.64)	(4.95)	(4.69)
Contagion ×	0.14	0.04	0.04	–0.15	–0.35	–0.06	–0.03	–0.23	–0.08
capital controls	(0.64)	(0.23)	(0.23)	(–0.69)	(–1.45)	(–0.20)	(–0.15)	(–1.53)	(–0.56)
R^2	0.51	0.60	0.56	0.49	0.51	0.47	0.48	0.62	0.66
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

[a]Foreign exchange market pressure index three months after the crisis.

[b]Level of the real exchange rate 12 months after the crisis.

Source: Authors' calculations.

TABLE 9. Exchange Rate Flexibility and Contagion

Variable	Pressure indicator and weighting matrix: Change in PI-3/direct trade[a]	Change in PI-3/neighbors[a]	Change in PI-3/trade with neighbors[a]	Change in RER/direct trade[b]	Change in RER/neighbors[b]	Change in RER/growth similarity[b]	Change in credit rating/direct trade	Change in credit rating/trade with neighbors	Change in credit rating/external similarity of neighbors
Credit boom	–0.05	0.02	–0.01	–0.18	–0.11	–0.23	–0.21	–0.05	–0.02
	(–0.30)	(0.14)	(–0.07)	(–0.92)	(–0.60)	(–1.19)	(–0.28)	(–0.67)	(–0.26)
RER overvaluation[b]	–0.22	–0.22	–0.23	—	—	—	—	—	—
	(–1.58)	(–1.79)	(–1.75)						
Fiscal budget/GDP	—	—	—	–0.60	–0.62	–0.72	—	—	—
				(–1.85)	(–1.96)	(–2.27)			
Current account/GDP	0.43	0.40	0.50	1.04	1.10	1.00	—	—	—
	(2.06)	(2.09)	(2.50)	(3.90)	(4.23)	(3.78)			
Contagion index	0.74	0.62	0.44	0.40	0.18	0.35	1.54	1.36	1.23
	(1.97)	(2.42)	(1.62)	(1.03)	(0.50)	(0.79)	(4.50)	(4.92)	(5.87)
Contagion × exchange rate flexibility	–0.12	0.07	0.17	0.23	0.46	0.52	–0.68	–0.54	–0.43
	(–0.42)	(0.31)	(0.71)	(0.94)	(1.74)	(1.81)	(–2.67)	(–2.12)	(–2.27)
R^2	0.51	0.60	0.57	0.49	0.52	0.50	0.54	0.64	0.69
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

[a]Foreign exchange market pressure index three months after the crisis.

[b]Level of the real exchange rate 12 months after the crisis.

Source: Authors' calculations.

crisis *j* instead of $CC_{i,j}$. We use data from the Bank of International Settlements (BIS) (various years) and consider the short term to be less than a year. Two of the countries in our sample (Sweden and Finland) have positive net external assets and report to the BIS from "within," and one country (Singapore) is considered a banking center and thus is highly leveraged. For these countries, we consider a zero in the ratio short debt/total debt and include a special dummy variable in the equation multiplying the contagion index.

Table 10 shows that a tilt toward short-term financing increases contagion when we measure it using changes in credit rating. The effects are economically relevant, highly significant, and robust to alternative weighting matrixes. With 12-month real depreciation and direct trade, there is a marginally significant positive effect.

IV. Concluding Remarks

This article has examined the channels through which crises spread across countries. For this purpose, we examined the behavior of crisis indicators as a function of initial conditions and the average of crisis indicators elsewhere. The latter variable attempts to capture interdependence or co-movements. This relationship could be simply the result of common shocks hitting a number of countries. To understand how these external common shocks and shocks originating in other countries spread to other places, we constructed a weighted average of crisis indicators elsewhere. The weighting schemes attempt to capture different transmission mechanisms. We used the importance of bilateral (also called direct) trade, competition in third markets, regional relationship, and indexes of similarities.

We found that the channel of propagation of crises depends on both indicators and horizons. Three months after a crisis, there are strong neighborhood effects. Rather than trade links and/or macroeconomic similarities, what seems to better explain cross-country correlation is the proximity of countries or regional effects. The same happens when we analyze changes in country credit ratings at longer horizons (6 to 12 months).

Thus the regional weighting scheme is the strongest quantitatively and is statistically the most robust. This implies that crisis spread mainly, but not uniquely, as the Russian crisis in 1998 witnessed, through regions. No wonder the debt crisis was centered in Latin America and the 1997 crisis in Asia. Part of this could be explained by direct trade links, because regions tend to have important trade relationships. But the effect of trade links, although important, cannot account for the whole regional effect. Another candidate for explaining this regional effect is financial links, through cross-border ownership of assets, stock market links, and others. At this stage, we do not have good indicators for constructing weighting matrixes to control for financial links. This is clearly an area that deserves further research.

A question that arises in most of the literature on currency crisis and contagion is whether crises are triggered by bad sentiments or by self-fulfilling prophecies. In

Table 10. Composition of Capital Inflows and Contagion

	Pressure indicator and weighting matrix								
Variable	Change in PI-3/direct trade[a]	Change in PI-3/ neighbors[a]	Change in PI-3/trade with neighbors[a]	Change in RER/direct trade[b]	Change in RER/ neighbors[b]	Change in RER/ growth similarity[b]	Change in credit rating/ direct trade	Change in credit rating/ trade with neighbors	Change in credit rating/ external similarity of neighbors
Credit boom	–0.05	–0.01	–0.03	–0.09	–0.07	–0.17	0.04	0.01	0.03
	(–0.28)	(–0.04)	(–0.16)	(–0.45)	(–0.34)	(–0.78)	(0.60)	(0.21)	(0.51)
RER overvaluation	–0.23	–0.22	–0.21	—	—	—	—	—	—
	(–1.72)	(–1.76)	(–1.65)						
Fiscal budget/GDP	—	—	—	–0.60	–0.55	–0.74	—	—	—
				(–1.83)	(–1.69)	(–2.22)			
Current account/GDP	0.47	0.34	0.45	1.08	1.11	1.05	—	—	—
	(2.04)	(1.61)	(2.07)	(3.99)	(4.10)	(3.77)			
Contagion index	0.70	0.53	0.50	0.75	3.86	1.17	0.35	0.35	0.34
	(1.79)	(1.32)	(1.50)	(1.96)	(1.74)	(2.02)	(0.84)	(1.20)	(1.15)
Contagion ×	0.57	–0.58	–0.51	3.60	–2.26	1.73	4.38	3.95	2.47
Short-term debt	(0.27)	(–0.40)	(–0.33)	(1.71)	(–1.68)	(0.79)	(2.91)	(4.14)	(2.32)
R^2	0.51	0.60	0.56	0.51	0.52	0.48	0.57	0.72	0.70
F-statistic p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60	60	60	60

Note: Data are for 20 countries for three crisis periods. See table A-1 for countries and text for crisis periods. Values are from OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). White's robust t-tests are in parentheses. External similarity combines current account and RER overvaluation similarity.

Source: Authors' calculations.

TABLE A-1. Country List

Country	Neighborhood code
Argentina	1
Brazil	1
Chile	1
Colombia	1
Ecuador	1
Mexico	1
Peru	1
Venezuela	1
Indonesia	2
Korea	2
Malaysia	2
Philippines	2
Singapore	2
Thailand	2
Sweden	3
Finland	3
Portugal	3
Australia	3
New Zealand	3
South Africa	3

the context of contagion, this implies that a crisis could occur just because of contagion. In this article, we show that, although the crisis indicators are affected by contagion, fundamentals explain a large fraction of the crises. In particular, the current account deficit, exchange rate overvaluation, and credit boom affect our market pressure indicators. Given the sample size, the results change in some specifications and some caveats could be added, but we can conclude that fundamentals matter and it is not just what is going on elsewhere that causes crisis to happen.

At a 12-month horizon, fundamentals matter and both trade links and initial macroeconomic conditions explain which countries suffer stronger contagion. We find that the cross-country variation of a 12-month real exchange rate depreciation depends on growth and external similarities (overvaluation and current account deficit) and direct trade links. At this horizon, neighborhood (regional) effects are still important. Common shocks seem to explain cross-country correlation of a 12-month change in a foreign exchange market pressure index. For the other indicators of crisis we use—the 3-month change in foreign exchange market pressure index, the 12-month real exchange rate depreciation, and the change in the credit rating—we find that co-movements explained by specific forms of contagion are more important. To this end, we conclude that although crises may be triggered by common shocks, transmission across countries depends on regional, trade, and macroeconomic characteristics of the countries.

A policy issue that has been in the middle of the discussion on contagion is the way in which links across countries could be limited during crisis periods. The issue of the optimality of contagion should be addressed first, but at this stage we have taken a practical view in analyzing whether there may be policies that could curb contagion. To this end, we analyze the impact of capital controls, exchange rate flexibility, and debt composition. We find that capital controls do not affect contagion. Exchange rate flexibility and the structure of external debt have effects on some of our crisis indicators, affecting the country credit rating. Exchange rate flexibility also affects the real depreciation after 12 months.

References

Berg, Andrew, and Catherine Pattillo. 1998. "Are Currency Crises Predictable? A Test." IMF Working Paper WP/98/154.

Bank of International Settlements (BIS). Various years. *The Maturity, Sectorial and Nationality Distribution of International Bank Lending*. Basle: BIS.

De Gregorio, José, Sebastian Edwards, and Rodrigo O. Valdés. 2000. "Capital Controls: Do They Work?" *Journal of Development Economics* 63(1):59–83.

Edwards, Sebastian. 1999. "How Effective Are Capital Controls?" *Journal of Economic Perspectives* 14(4):65–84.

Eichengreen, Barry, Andrew K. Rose, and Charles Wyplosz. 1997. "Contagious Currency Crises." Mimeo, University of California, Berkeley, July. Available online at http://haas.berkeley.edu/~arose.

Forbes, Kristin, and Roberto Rigobón. 1999. "Measuring Contagion: Conceptual and Empirical Issues." Mimeo, MIT.

Glick, Reuven, and Andrew K. Rose. 1998. "Contagion and Trade: Why Are Currency Crises Regional?" Mimeo, University of California, Berkeley, August. Available online at http://haas.berkeley.edu/~arose.

Gourinchas, Pierre Olivier, Oscar Landerretche, and Rodrigo O. Valdés. 2001. "Credit Booms: Is Latin America Different?" *Economía* 1(2):47–99.

Goldfajn, Ilan, and Rodrigo O. Valdés. 1999. "The Aftermath of Appreciations." *Quarterly Journal of Economics* 114(1):229–62.

International Monetary Fund (IMF). Various years. *Exchange Arrangements and Exchange Restrictions*. Washington, D.C.: IMF.

———. Various years. International Financial Statistics. Washington, D.C.: IMF.

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999. "The Twin Crises: The Causes of Banking and Balance of Payments Problems." *American Economic Review* 89(3):473–500.

———. 1998. "On Crises, Contagion, and Confusion." Mimeo, University of Maryland, November.

Kaminsky, Graciela L., Saul Lizondo, and Carmen M. Reinhart. 1998. "Leading Indicators of Currency Crises." *IMF Staff Papers*, March.

Rigobón, Roberto. 1999. "On the Measurement of the International Propagation of Shocks." Mimeo, MIT.

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