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

José De Gregorio†
Universidad de Chile

Rodrigo O. Valdés‡
Central Bank of Chile

First Draft: October 5, 1999
This Version: March 5, 2000

Abstract

This paper analyzes how external crises spread across countries. We analyze the behavior of four alternative crisis indicators in a sample of 20 countries during three well-known crises: the 1982 debt crisis, the Mexican 1994 crisis, and the 1997 Asian crisis. The objective is threefold: (i) to revisit the transmission channels of crises; (ii) to evaluate whether contagion has been similar in these episodes; and (iii) 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 pre-crisis growth also explain, to a less extent, which countries suffer more contagion. The evidence shows that the 1982 debt crisis was as contagious as the Asian crisis, while the Mexican crisis was considerably less so. Finally, both debt composition and exchange rate flexibility limit to some extent contagion, whereas capital controls do not appear to curb it.

JEL Classification Nos: F30, F32.
Key Words: Contagion; International Crisis; Transmission Mechanism; Capital Controls; Debt Structure; Exchange Rate Flexibility.

*This paper is part of the WIDER/World Bank research project "Contagion: How it Spreads and How it can be Stopped?" Valdés acknowledges partial financial support from FONDECYT, grant No. 1990338. We thank Leonardo Hernández, Ilan Goldfajn, Guillermo Perry, Carmen Reinhart, Roberto Rigobón for helpful suggestions and Pamela Mellado for excellent research assistance. All remaining errors are our responsibility. This paper presents the views of the authors and does not represent in any way positions or views of the Central Bank of Chile.

†Address: Center for Applied Economics, Department of Industrial Engineering, Universidad de Chile, República 701, Santiago, Chile. E-mail: jdegrego@dii.uchile.cl

‡Address: Research Department, Central Bank of Chile, Agustinas 1180, Santiago, Chile. E-mail: rvaldesx@condor.bcentral.cl

1 Introduction

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 is 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 paper we focus on a subset of them: (i) What are the propagation channels of international crises across countries (other than common shocks)? (ii) Was the debt crisis a contagious one? and (iii) Are there useful policy instruments to shield 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.

Discussing a number of crises helps us no only to check whether contagion is a new phenomenon, but also whether the nature of the crisis was all too different. Following each crisis, the developments in the area of international finance has followed what may have been the deep causes of each of them. With the debt crisis of the early eighties there were important analysis on policy inconsistencies as the main cause for triggering crisis (first-generation models). The existence of large fiscal deficits, hidden or not, with fixed or semi-fixed exchange rate regimes were inconsistent and unequivocally would lead to a collapse of the regime. All Latin America was hardly hit by the debt crisis. In the early nineties, with the breakup of the EMS[1], the issue of multiple equilibria was raised (second-generation models). But, with the Mexican crisis, and later on with the crisis in Asia, the links between financial markets, banking crisis and the foreign exchange market was emphasized (forthcoming third-generation models).

After so many different crisis, each round with new explanations about what went wrong, and in a financial world that has changed dramatically in the last 20 years, one may wonder whether the transmission channels across countries have changed. We examine a number of mechanisms, but of course, our examination is somewhat limited in the number of channels we can analyze. In particular, and as discussed later on, the main problem is to identify clearly financial links in the spreading of crisis. For this reason

[1]This crisis did not spread to emerging markets and apparently contagion was not a major issue, for this reason we exclude it from our sample.

most of the examination is base on trade links, direct or competition in third markets, neighbor effects, stemming from trade or financial connections, and macroeconomic similarities.

There is a deep discussion about the proper definition of contagion (see, e.g., Kaminsky and Reinhart, 1998; Forbes and Rigobón, 1999). We do not enter into this discussion and simply refer to it as the comovenment suffered by countries during crisis periods 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 issue is important from a policy perspective. Nevertheless, one has to be careful in identifying contagion with only large common shocks. As Rigobón (1999) has emphasized, contagion could be confused with the presence of a large common shock. In our empirical investigation we attempt to separate these two effects. However, since we select crisis periods we cannot strictly compare whether crisis periods are essentially of a different nature than tranquil times, something that has led to many to question the view that contagion is a particular phenomenon during crisis, and different from simply interdependence. In this regard we do not solve this problem, although we compare different transmission mechanisms through which interdependence across countries occur.[2]

This paper is closely related to other work that studies 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 both Eichengreen et al. (1997) and Glick and Rose (1998) trade links are the key transmission channel of crises across countries. While the first study focuses on 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". In other recent work, Kaminsky and Reinhart (1998) claim that financial links are potentially an important transmission mechanism. But, they argue that because of the high correlation between trade and financial links it is quite 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 a country suffers a crisis. This allows us to study the fact that many times contagion happens from country A to B, but what may cause problems in C is not a crisis in A, but the problems in B. A typical case we

[2]We use indistinctly the expressions contagion, interdependence and comovements.

have in mind is that a crisis in Mexico may affect more Chile for its impact on Argentina and Brazil, that the crisis in Mexico itself. For this reason focusing on "ground zero" countries could give an incomplete picture of the evidence.

The main results of the paper are as follows. We find that the channel of propagation of crisis depends on both indicators and horizons. Three months after the 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 (6-12 months). One could associate the high-frequency comovement to financial links. 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 depend on growth and external similarities (overvaluation and current account deficit) and direct trade links (although not third market competition). 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. But, 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 comovements explained by some other form of contagion are more important. To this end we conclude that while crises may be triggered by common shocks, its transmission across countries depend on regional, trade and macroeconomic characteristics of the countries.

We also find that the 1982 debt crisis was as contagious as the Asian crisis while the Mexican 1994 devaluation did not produce significant contagion. This finding is important when analyzed in the context of the so-called "XXIst century crises," which are presumed to be more contagious than previous experiences. Our results indicate that within the transmission mechanism we analyze contagious is similar. Perhaps the causes of the crises may have changed, but the channels through which its spread out not. Further, we find no evidence in favor of capital controls as a tool to ameliorate contagion. Countries with capital flow barriers do not suffer weaker contagion effects. However, we do find evidence that exchange rate flexibility and debt maturity structure tilted towards long-term significantly limit contagion measured by complements of country credit ratings (but not others).

The paper is organized as follows. Section 2 discusses our basic empirical approach.

Section 3 presents evidence of the existence of contagion and investigates the transmission channels behind this phenomenon. Section 4 analyzes whether contagion has been similar during different crises. Section 5 investigates the extent to which capital controls, exchange rate flexibility and debt structure shield countries against contagion effects. Finally, section 6 presents some concluding remarks.

2 Empirical Approach

This section describes the empirical methodology we use in the paper. In order to measure contagion or transmission of crises across countries we follow an approach that combines previous work by Sachs et al. (1995), Eichengreen et al. (1997) and Glick and Rose (1998). In particular, we try to explain the cross-sectional variation of 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 (e.g., an international interest rate shock). With (ii) we seek to measure and characterize contagion. Because alternative weighting schemes can be associated a priori to different transmission channels we are able to study what may drive contagion.

As mentioned before, we focus the analysis on three most important events of the last 25 years from the perspective of developing countries: the 1982 debt crisis, the 1994 Mexican devaluation, and 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. But this is used just to date the beginning of the crisis, and not to define how it spreads from there to the rest of the countries. We assume that when the crisis begin, all countries are subject to contagion. We only control with a dummy 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 of 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 1 presents the list of countries as well their neighborhood coding.

2.1 Measuring Contagion

In order to measure contagion we explain countries' crisis indicators performance using what happens in other countries. More formally, indexing countries by i ($i = 1, 2, \ldots, 20$) and crises by j ($j = 1, 2, 3$) we estimate cross-sectional models of the following form:

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

where $\Delta CI_{i,t,j}$ denotes the change of the 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 of country i prior to crisis j, $M_{i,k,j}$ is a parameter that weights ex-ante the importance of country k in explaining country i, $M_{1,1}$ is a parameter that weights equally all countries different from i, and $\epsilon_{i,t,j}$ is a random shock.

The parameter $M_{1,1}$ 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 would have 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—i.e., large changes in the crisis indicator—will have also a large weight in the average change of the crisis indicator, with an obvious an strong upward bias, since we could be including at the LHS the RHS variable. For this reason we exclude the country when computing the average external shock for each observation.

When the true β_2 is positive (i.e., there is contagion), the OLS estimation of (1) has a positive bias. A shock in $\epsilon_{i,t,j}$ that triggers a crisis in a country will affect, via contagion, the performance of other countries, and these, in turn, will affect country i's performance, introducing a positive correlation between the error term ($\epsilon_{i,t,j}$) and one of the regressors ($\sum_{k \neq i} M_{i,k,j} \Delta CI_{k,t,j}$). However, since this bias is monotonic in β_2, and hence there is no bias when β_2 is zero (and is negative when $\beta_2 < 0$), the issue is not a serious problem for our particular purposes. As long as we focus in comparing alternative models it is valid to compare different OLS estimates of β_2. The same is

true when we compare alternative measures to curb contagion. In a very large sample this effect would not exist since the feedback from a single country to others would be very small. Still in our case we presume this is also small, as long as there are about 20 countries per episode, and the effect of a particular $\epsilon_{i,t,j}$ should be small.

The four crisis indicators we consider are:

A foreign exchange market pressure index at 3-month horizon after the crisis, denoted by PI-3.

A foreign exchange market pressure index at 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.

To construct PI-3 and PI-12 we follow the standard procedure of combining the level of the real exchange rate and the stock of international reserves. In the case of crises 2 and 3 we also include (minus) the change in the real interest rate with respect to the 12 month average level observed prior to the crisis. As in Kaminsky and Reinhart (1996) 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.[3] We use IFS data for international reserves, interest rates (short-run deposits) and inflation, and the JP Morgan database on real exchange rates. In the latter, a downward movement in RER means depreciation.[4]

As for credit rating we use the credit risk indicator compiled by Institutional Investor. Since 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 consider the one-year change in the

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

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

index published in March, 1983; for crisis 2 we use the 6-month change published in September, 1995 (which seems to better capture a Mexican downgrade); and for crisis 3 we consider 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 be block diagonal with three 20×20 sub-matrices. Moreover, because we are not interested in explaining contagion suffered by ground-zero countries, the matrices 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 addition, it does not make sense own contagion.

Depending on the exact definition of contagion there are two alternative classes of weighting matrices. If contagion is defined as occurring exclusively from the ground-zero country to other countries then the matrix has to have non-zero elements only in the columns corresponding to the ground-zero countries. 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 non-zero elements could appear everywhere in the 20×20 matrices, except in the row of the ground zero country as explained before. This is the approach followed by Eichengreen et al. (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 in the second type of contagion, although we also analyze the first type of contagion.

To test for the presence of contagion we check whether β_2 in equation (1) is significantly different from zero. In order to compare the strength of contagion across different weighting matrices (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 crises indicators elsewhere in the crisis indicators of the average (non ground-zero) country. Then different weighting matrices allow us to identify the most important transmission channels.

[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 have matrices with ones in particular entries.

2.2 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 BoP crisis 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 percentage of GDP) in excess to the long-run trend of the ratio credit to GDP (calculated as in Gourinchas et al., 1998). We consider 1981, 1994 and 1996 as the initial condition in each crisis, respectively.

2. Credit Boom 2: Total credit (as percentage of GDP) in excess to the long-run trend of the ratio credit to GDP (calculated as in Gourinchas et al., 1998). Same years as before.

3. RER Overvaluation: 12-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 percentage of GDP. Same years as in Credit Boom.

5. Current Account/GDP: Current account balance as percentage of GDP. Same years as in Credit Boom.

6. GDP Growth: GDP annual growth rate. Same years as in Credit Boom.

7. Debt/GDP: Debt to GDP ratio. For OECD countries we estimate the stock of debt by adding up current account deficits since 1950. Same years as in Credit Boom.

8. Inflation: CPI 12 month inflation measured in the month before each crisis (measured as $\pi/(1+\pi)$).

[6] See Eichengreen et al. (1997), Kaminsky et al. (1998), and the recent comprehensive study by Berg and Pattillo (1998) for details.

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) when an international crisis has began. This is exactly the issue addressed by Sachs et al. (1996) although they only focus on the Tequila crisis. Their main result is that excess credit creation and RER misalignment are the most important variables to explain the extent of crises across countries. They did not find any relevant role for the current account deficit. Similar results are found by Berg and Pattillo (1998) for a number of alternative methodologies. They found 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 M2. They found that only in some cases (estimations) the current account deficit, the budget deficit and the composition of external liabilities are good predictors of external fragilities.

Table 1 presents the results of estimating equation (1) without contagion effects. In the equation we include zero-ground countries, so our estimations is 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, however, is not straightforward. By accounting we can decompose the current account deficit in a private and a public component, the latter being the budget balance. An increase 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. This is a "subjective" crisis indicator since it is based on the assessment of vulnerabilities assigned by the market.

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

3 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 matrices and presents some empirical results.

3.1 Weighting Matrices

There are several potential channels for the propagation of contagion. The most important are direct trade links, trade competition in third markets, alternative macroeconomic similarities, and financial links. Eichengreen et al. (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 to trade links as well as to financial links. A key problem is that the two are quite correlated. An additional problem is that measures to control for financial links are quite limited.

Controlling for the average shock elsewhere is a form to control for the international environment. But, if in addition we weight the shocks elsewhere by some characteristics of the relationship among countries we may capture the channels through which interdependence or contagion occurs. Thus different weighting matrices $M[i,k,j]$ allow us to investigate the importance of alternative transmission channels of contagion (from country i to country k). We consider the following matrices:

1. Equal weight for all countries k allowing us to control for differences across crises.

2. Direct trade links measured as the ratio between bilateral trade between countries i and k and total trade of i.

3. Trade competition in third markets measured trough a similarity index of the trade pattern based on the relative importance in total exports of 6 sectors (agriculture, food, fuel, ores, high-tech manufacturing, and low-tech manufacturing).

4. Neighborhood (regional) dummies for Latin American, Asian, and industrialized countries (see appendix 1 for details).

5. An overall macroeconomic similarity index that combines RER misalignment, current account balance, credit boom, fiscal balance and GDP growth.

6. Specific macroeconomic similarity indices including external similarity (encompassing RER and current account), credit boom and GDP growth.

7. All of the above measures, but only with respect to neighbor countries only.

Both trade-pattern similarity, because of data availability, and neighbor dummy matrices, by definition, are constant across crises. The rest of the matrices are crisis-specific. All matrices, except the one with direct trade links, are symmetric. 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, and hence although bilateral trade is symmetric, not its importance with respect to each country.

In order to construct a similarity index between countries i and k when considering a single variable (e.g, GDP growth and credit boom) we calculate:[7]

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

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 (e.g., trade pattern, external conditions and overall macroeconomic similarity) we calculate:

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

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.

In order to facilitate comparability across different matrices we re-scale the $\theta_{i,k,j}$'s so that maximum similarity takes the value 1 and minimum similarity takes the value zero. Thus, we calculate the weight $M_{i,k,j}$ as follows:

$$M_{i,k,j} = \frac{\theta_{i,k,j} - \min\langle\theta_{i',k',j}\rangle}{\max\langle\theta_{i',k',j}\rangle - \min\langle\theta_{i',k',j}\rangle}. \tag{4}$$

where (i', k', j) represent all possible country combinations in crisis j. Furthermore, to have a straightforward interpretation of the results we re-scale $M_{i,k,j}$ again so that

[7]Although the procedure to construct similarity indexes is somewhat ad-hoc because it introduces some non-linear transformations in the data 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.

$\sum_i M_{i,k,j} = 1$. Thus, as mentioned before, β_2 reflects the impact of a weighted average of what is happening elsewhere on the average country.

3.2 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 matrices 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 a neighborhood and direct trade effects. None of the "wider" matrices (those considering not only neighbors) yield a significantly coefficient that could indicate the presence contagion. Indeed when constraining weighting matrices to neighbor countries most of the results are significant. The point estimate of direct trade links is smaller than that of the neighbor dummies, and since we are constraining weights to be one, one can conclude that quantitatively the neighbor effect is stronger than that of direct trade. This probably reflects the close trade links that exist between neighbors rather than proper propagation channel. In fact, when we consider direct trade with neighbors countries only, the estimate is highly significant but the point estimate is still smaller than what the neighbor dummy matrix yields. Interestingly enough, macroeconomic similarities do not play any role in explaining the cross-country propagation of contagion at this 3-month horizon, neither the common shock proxy. Finally, it is worth mentioning that none of the variables measuring macroeconomic initial conditions changes in any important way when we incorporate the contagion index. Consequently, once the effects of interdependence across crisis are included the R^2 increases from 0.17 in table 1, to values around 0.5, This reveals the significant importance that contagion and transmission of crisis across countries has on the vulnerabilities to external crisis.

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, increasing the incidence of crisis. After controlling for the equal-weight matrix the R^2's 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 3-month exchange market pressures indicator. We found that with indicators comovement is almost exclusively driven by the common shock (proxied by

the equal weight matrix, that is crisis elsewhere). Transmission through trade, neighbor effects, or similarities, do not appear to play an important additional role. In fact, none of the weighting matrices yield significantly positive parameters. If we do not control for the equal weight matrix the results change dramatically, with several weighting matrices having significantly positive results. However, this follows from the fact that the equal weight and the other matrices are collinear across crises. In what follow we do not 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 comovement across countries).[9]

In the case of the indicator based on 12-month RER depreciation (table 4) we find that contagion indices are significantly positive when we consider direct trade links, neighbors, and growth similarity. The strong negative sign in 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. But, a crisis in a country, that most of the time is coupled with an output collapse, may create opportunities for its main competitors. This may be what is happening with the reverse sign we find, at least at a one-year horizon. It may also possible that trade pattern similarity is not measuring appropriately 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 both direct trade links, neighbors, overall macro similarity, and growth similarity matrices yield significant contagion coefficients. When considering only similarities with neighbor 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

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

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 matrices. Following Eichengreen et al. (1997), table 6 presents the results of estimating (1) but including competing relevant contagion indices simultaneously. We consider some of the matrices that appeared as more relevant in tables 2-5 in pairs and the same initial macroeconomic conditions as done 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 to be 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.[10]

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 matrices are highly significant when considered individually but are 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 matrices.[11]

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

[11]One can further analyze this issue of collinearity by estimating a model of the following form:

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

where γ measures the relatively 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 matrices would be valid.

3.3 Contagion from Ground-Zero Countries

As mentioned above, an alternative way of defining contagion is to limit it to propagate 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 contagious 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 to test 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 in ground-zero is able to explain changes in PI-12, RER and CR. The weighting matrices 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 (weighted average of what is happening elsewhere). For that reason we present 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. As discussed before 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 the on RER direct trade ties between countries and ground zero country appear to generate contagion. Finally, changes in credit rating can be explained for countries that belong to the neighbor of ground-zero (especially if they have similar initial external macroeconomic conditions) or have direct trade links with it.

4 Was Contagion Weaker during the Debt Crisis?

Analyzing contagion during a particular crisis makes sense if one compares it to other episodes. This section evaluates whether there were contagion effects during the debt crisis and if it was as important as it was during more recent crises. In other words, it tries to answer the question of whether contagion is a new phenomenon or not. There is clear evidence that crises have changed in nature, from current account to capital account according to some, in the effects that it had on economic conditions, etc.[12]

[12]See for example the discussion in chapter 1 of De Gregorio, et al (1999).

However, our focus is narrower and just look at whether in the crisis indicators we are studying there was different sort of contagion in the debt crisis compared to the Mexican and Asian crises.

In order to compare the extent of contagion across crises we estimate models similar to (1) but allowing for the contagion index to be crisis-specific. Thus, we estimate models of the following form:

$$\Delta CI_{i,t,j} = \beta_0 + \beta_1 X_{i,j} + \sum_j \beta_{2,j} D_j \left(\sum_{k \neq i} M_{i,k,j} \Delta CI_{k,t,j} \right) + \epsilon_{i,t,j}, \tag{5}$$

where D_j is a dummy variable that takes the value one during crisis j. Comparing $\beta_{2,j}$ across different crises sheds light regarding how strong was contagion in each episode.

Table 8 presents the results of this exercise for the three crises indicators that showed the presence contagion. In each case we report the three weighting matrices that appeared most relevant according to the analysis of previous sections. Overall, the results show that contagion during the debt crisis was as important as it was during the Asian crisis. The contagion coefficient of the debt crisis is significantly different from zero in almost all regressions and in most of them the point estimate is comparable in magnitude to that of the Asian crisis. In some cases we even find that during the debt crisis there was stronger contagion, although statistically it was not very different. These results is quite robust to different weighting matrices. The results also show that according to our definition there were no contagion effects during the Tequila crisis.

From this result we can conclude that contagion is not a new phenomenon. Trade links are not a new phenomenon, and hence, it is reasonable to expect contagion via trade links during the debt crisis. But, as argued above, contagion across neighbor countries is very important during the debt crisis, and to some extent this may be capturing financial contagion. An alternative interpretation is that macroeconomic similarities were large within Latin American countries during the debt crisis, and hence they suffer a similar kind of shock. We do not have the sample, nor the data to discriminate further, but our conclusion of the existence of contagion, or interdependence, during the debt crisis is robust.

5 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. At the end the question of contagion and alternative policies is an empirical one. This section evaluates the usefulness of these three policy measures to curb contagion, examining them one at a time.

5.1 Capital Controls and Contagion

Capital controls could curb contagion if financial links are an important propagation channel. However, it is less clear the usefulness of limiting financial integration if contagion arises due to trade links or initial macroeconomic conditions similarity and crises are the consequence of real shocks. One could argue, nevertheless, that capital controls might help to adjust in an orderly fashion, avoiding typical problems that an unregulated financial sector often produce, such as an overshooting of the exchange rate. Of course, capital controls have costs in tranquil times, as the country do not take full advantage of capital movements, but defenders of capital controls point down at contagion as one of the reasons to have them as a preventive measure.

Edwards (1999) evaluates whether capital controls in Chile were a useful device to avoid contagion. He measures it as the correlation between domestic and Asian interest rates (specifically, from Hong Kong) controlling for domestic devaluation and exchange rates in the US. 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, they have been used to avoid excess real exchange rate appreciation, curb capital inflows, and modify the foreign debt term structure.[13]

In order 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:

[13]See De Gregorio, Edwards, and Valdés (1999) for an evaluation of the Chilean experience.

$$\Delta CI_{i,t,j} = \beta_0 + \beta_1 X_{i,j} + [\beta_2 + \beta_3 CC_{i,j}] \sum_{k \neq i} M_{i,k,j} \Delta CI_{k,t,j} + \epsilon_{i,t,j}, \tag{6}$$

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

To construct the capital control index we use the standard dummy variables that appear in the IMF report *Exchange Arrangements and Exchange Restrictions*. We consider the entries restrictions on payments on capital transactions and surrender requirement of export proceeds and assign a 0, 1, 2 value depending on whether none, one or two of the restrictions apply. We consider the status as of December of 1981, 1994 and 1996 for the corresponding crises.

Table 9 presents the results of the estimation of equation (6) for our three crisis indicators that show contagion and the same weighting matrices used in last section. They 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 our definition of capital controls is very broad, and the most commonly used, and specific forms of controls or regulations cannot be captured with this 0 to 2 indicators. But the results clearly say that countries that had more pervasive forms of control did not avoid contagion more than countries with looser controls.

5.2 Exchange Rate Flexibility and Contagion

Exchange rate flexibility is expected to reduce contagion by avoiding some of the overvaluation episodes to begin with and limit 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 (6) 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 the IMF report *Exchange Arrangements and Exchange Restrictions*. They group exchange rate regimes into three categories: fixed (including narrow bands), flexible and floating.

Table 10 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 matrices.

This result is interesting since it indicates that the market evaluates better and as less vulnerable economies 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 two weighting matrices only. This latter result is not surprising as the exchange rate is the variable that adjust 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 that only for the CR indicator we find that having a flexible exchange rate may reduce contagion.

5.3 Debt Maturity Structure and Contagion

Finally, 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 (6) but with the ratio of short-term debt to total debt for country i in crisis j instead of $CC_{i,j}$. We use data published by the BIS in *The Maturity, Sectorial and Nationality Distribution of International Bank Lending* and consider short term 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" while another one (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 11 presents the results. They show that a tilt towards 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 matrices. With 12-month real depreciation and direct trade there is marginally significant positive effect.

6 Concluding Remarks

This paper 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 comovements. This relationship could be simply the result of common shocks hitting a number of countries. But, to understand how these external-common shocks, and shocks originating in other countries, spread to other places we construct weighted average of crisis indicators elsewhere. The weighting schemes attempt to capture different transmission mechanisms. We use the importance of bilateral (also called direct) trade, competition in third markets, regional relationship, and indices of similarities.

We have found that the weighting scheme with the quantitative stronger effect, and statistically the most robust, is the regional one. This implies that crisis spread mainly, not uniquely as the Russian crisis in 1998 witnessed, through regions. No wonder the debt crisis centered in Latin America, and more recently most Asia was in crisis. Part of this could be explained by direct trade links, since regions tend to have important trade relationship. But the effect of trade links, although very important, cannot account for the whole regional effect. Another candidate to explain this regional effect are financial links, through cross-border ownership of assets, stock market links, and others. At this stage we do not have good indicators to construct weighting matrices to control for financial links and is clearly an area that deserves further research.

The increased financial integration in the world has supported the presumption that contagion is more frequent and pervasive currently. Within our empirical framework we study this issue. We show that contagion during the debt crisis in the eighties and the Asian crisis of the late nineties is quite, and surprisingly, similar. In part this is due to the importance of trade links among countries. Indeed, with relatively more closed economies in the past, trade tended to be concentrated with some neighbors, and hence this could explain the strength of neighbor effects. Still, our analysis is concentrated in just a few indicators of crisis. Perhaps, financial volatility and economic performance could be alternative indicators of interdependence and provide different assessment for the eighties and the nineties.

There is debate on what does exactly means contagion, and whether what we observe are just comovements, or in crisis periods the nature of these comovements change, for example, they become more extreme. We cannot answer this question since we just look at crisis, and we do not compare with tranquil periods. But, our evidence shed light on this issue in two dimensions. First, by analyzing different contagion effects in the three crisis we are tackling this issue by showing that the debt and the Asian

crisis had greater interdependence than the Mexican crisis, even after controlling for the magnitude of common shocks. Second, we have tried to identify the mechanisms through which comovements occur. Here is where regional and trade effects stand up as the most important, although we also find some evidence that macroeconomic and external similarities also may play a role in the transmission of crisis. Of course, there could be many mechanisms, and we cannot discard any.

A question that crosses most of the literature on currency crisis and contagion is whether crisis are triggered by bad sentiments or some for of selfullfiling prophecies. In the context of contagion this implies that one could think that crisis happen just because of contagion. In this paper we show that although the crisis indicators are affected by contagion, a large fraction of the crises is explained by fundamentals. In particular, our market pressure indicators are affected by the current account deficit, exchange rate overvaluation, and credit boom. 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 what causes crisis to happen.

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 first issue one should address is on the optimality of contagion, but at this stage we have taken a practical view 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, while exchange rate flexibility and the structure of external debt have effects on some of our crisis indicators. Both affect the country credit rating, and the former affect the real depreciation after 12-moths.

References

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

De Gregorio, J., S. Edwards, and R. Vald´s. 1999. "Capital Controls: Do They Work?" Mimeo, Center of Applied Economics, University of Chile.

De Gregorio, J., B. Eichengreen, T. Ito, and C. Wyplosz. 1999. *An Independent and Accountable IMF*. Geneva Report on the World Economy 1. International Center for Monetary and Banking Studies and CEPR.

Edards, S. 1999. "How Effective are Capital Controls?" *The Journal of Economic Perspectives* 14(4): 65–84.

Eichengreen, B., A. K. Rose, and C. Wyplosz. 1997. "Contagious Currency Crises." Mimeo, University of California, Berkeley, July. Available at http://haas.berkeley .edu/˜arose.

Forbes, K. and R. Rigobón. 1999. "Measuring Contagion: Conceptual and Empirical Issues." Mimeo, MIT.

Glick, R. and A. K. Rose. 1998. "Contagion and Trade: Why are Currency Crises Regional?" Mimeo, University of California, Berkeley, August. Available at http://haas.berkeley.edu/˜arose.

Gourinchas, P. O., O. Landerretche, and R. O. Valdés. 1998. "Credit Booms: The Stylized Facts." Mimeo, Central Bank of Chile, August.

Goldfajn, I. y R. Valdés. 1999. "The Aftermath of Appreciations." *Quarterly Journal of Economics* 114(1): 229-62.

Kaminsky, G. L. and C. M. Reinhart. 1996. "The Twin Crises: The Causes of Banking and Balance of Payments Problems." Forthcoming in *American Economic Review*.

Kaminsky, G. L. and C. M. Reinhart. 1998. "On Crises, Contagion, and Confusion." Mimeo, University of Maryland, November.

Kaminsky, G. L., S. Lizondo, and C. M. Reinhart. 1998. "Leading Indicators of Currency Crises." *IMF Staff Papers*, March.

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

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

Table 1. Crisis Indicators and Initial Conditions

	Crisis Indicator			
	ΔPI in 3 months	ΔPI in 12 months	ΔCredit Rating	Δ RER in 12 months
Constant	-0.08	-4.62	-1.92	-1.25
	(-0.04)	(-2.94)	(-2.41)	(-0.68)
Credit Boom	-0.31	-	-0.16	-0.44
	(-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)		
R2	0.17	0.31	0.05	0.29
F-stat p-value	0.02	0.00	0.09	0.00
Observations	60	60	60	60

OLS regressions with constant (not reported). T-tests in parenthesis.
We report variables with at least 80% of significance.

Table 2. 3-Month Change in Pressure Index and Total Contagion

	Weighting Matrix								
	Direct Trade	Trade Pattern	Neighbor Dummy	Macro Similarity	External Similarity	Credit Similarity	Growth Similarity	Trade with Neighbors	Tr. Pattern 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	-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)
Curr. 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)
R2	0.51	0.46	0.60	0.46	0.47	0.46	0.46	0.56	0.53
F-stat 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

OLS regressions with constant, and dummy variables in the three ground-zero countries (not reported).
T-tests in parenthesis. External similarity combines Current Account and RER Overvaluation similarity.

Table 3. 12-Month Change in Pressure Index and Total Contagion

	Weighting Matrix								
	Direct Trade	Trade Pattern	Neighbor Dummy	Macro Similarity	External Similarity	Credit Similarity	Growth Similarity	Ext. Sim. Neighbors	Growth Neighbors
RER Overvaluation	-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)
Curr. 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)
R2	0.40	0.46	0.52	0.42	0.40	0.40	0.40	0.46	0.50
F-stat 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

OLS regressions with constant, and dummy variables in the three ground-zero countries (not reported).
T-tests in parenthesis. External similarity combines Current Account and RER Overvaluation similarity.

Table 4. 12-Month RER Depreciation and Total Contagion

	Weighting Matrix								
	Direct Trade	Trade Pattern	Neighbor Dummy	Macro Similarity	External Similarity	Credit Similarity	Growth Similarity	Ext. Sim. Neighbors	Growth 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)
Curr. 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)
R2	0.49	0.48	0.49	0.45	0.44	0.44	0.51	0.50	0.48
F-stat 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

OLS regressions with constant, and dummy variables in the three ground-zero countries (not reported).
T-tests in parenthesis. External similarity combines Current Account and RER Overvaluation similarity.

Table 5. Change in Credit Rating and Total Contagion

	Weighting Matrix								
	Direct Trade	Trade Pattern	Neighbor Dummy	Macro Similarity	External Similarity	Credit Similarity	Growth Similarity	Trade w. Neighbors	Ext. Sim. 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)
R2	0.48	0.45	0.62	0.45	0.41	0.48	0.46	0.61	0.65
F-stat 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

OLS regressions with constant, and dummy variables in the three ground-zero countries (not reported).
T-tests in parenthesis. External similarity combines Current Account and RER Overvaluation similarity.

Table 6. Contagion and Competing Weighting Matrices

	Pressure Indicator and Weighting Matrix									
	ΔPI 3 months	ΔPI 3 months	ΔRER 12 months	ΔRER 12 months	ΔRER 12 months	ΔCredit Rating	ΔCredit Rating	ΔCredit Rating	ΔCredit Rating	ΔCredit Rating
Credit Boom	0.00	0.01	-0.13	-0.10	-0.08	0.01	0.02	0.07	0.04	0.02
	(0.02)	(0.05)	(-0.69)	(-0.54)	(-0.44)	(0.12)	(0.26)	(1.2)	(0.59)	(0.24)
RER Overvaluation	-0.21	-0.22	-	-	-	-	-	-	-	-
	(-1.74)	(-1.78)								
Fiscal Budget/GDP	-	-	-0.68	-0.62	-0.68	-	-	-	-	-
			(-2.07)	(-1.92)	(-2.10)					
Curr. Account/GDP	0.37	0.38	1.08	1.10	1.10	-	-	-	-	-
	(1.95)	(1.92)	(4.06)	(4.19)	(4.17)					
Direct Trade M.	-0.22	-	0.50	0.37	-	-0.12	-	-	-	-
	(-0.74)		(1.47)	(1.12)		(-0.42)				
Neighbor Dum. M.	0.82	0.76	-	0.41	0.50	0.81	0.71	-2.00	-	0.54
	(3.48)	(2.22)		(1.26)	(1.91)	(4.36)	(5.09)	(-2.62)		(1.43)
Macro Sim. M.	-	-	-	-	-	-	0.13	-	-	-
							(0.48)			
Growth Sim. M.	-	-	0.40	-	0.47	-	-	-	-	-
			(0.89)		(1.22)					
Trade w. Neighbors	-	-0.08	-	-	-	-	-	-	1.04	0.25
		(-0.24)							(2.83)	(0.56)
External Sim. w. Neighbors M.	-	-	-	-	-	-	-	2.90	-0.25	-
								(3.64)	(-0.61)	
R2	0.60	0.60	0.49	0.50	0.50	0.58	0.62	0.69	0.66	0.62
F-stat p-value	0.00	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	60

OLS regressions with constants and dummy variables in the three ground-zero countries (not reported). T-tests in parenthesis.
External similarity combines Current Account and RER Overvaluation similarity.

Table 7. Contagion from Ground-Zero Country

	Pressure Indicator and Weighting Matrix					
	ΔPI in 12 months/ Equal Weights	Δ RER in 12 months/ Direct Trade	Δ Credit Rating/ Direct Trade	Δ Credit Rating/ Neighbor Dummy	Δ Credit Rating/ Ext. Similarity Neighbors	Δ 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	-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)
R2	0.37	0.41	0.41	0.52	0.54	0.43
F-stat p-value	0.00	0.00	0.00	0.00	0.00	0.00
Observations	60	60	60	60	60	60

OLS regressions with constant and dummy variables in the three ground-zero countries (not reported). T-tests in parenthesis.
Contagion index corresponds to the standardized parameter of a weighted average of ΔPI-3 according to a particular M matrix.
External similarity combines Current Account and RER Overvaluation similarity.

Table 8. Contagion in Three Different Crises

	Pressure Indicator and Weighting Matrix								
	ΔPI 3 months/ Direct Trade	ΔPI 3 months/ Neighbors	ΔPI 3 months/ Trade w. Neighbors	ΔRER 12 months/ Direct Trade	ΔRER 12 months/ Neighbors	ΔRER 12 months/ Growth Similarity	Δ Credit Rating/ Direct Trade	Δ Credit Rating/ Trade w. Neighbors	Δ Credit Rating/ Ext. Sim. Neighbors
Credit Boom	-0.08	0.03	-0.01	-0.13	-0.02	-0.11	-0.02	0.03	-0.04
	(-0.46)	(0.19)	(-0.07)	(-0.72)	(-0.12)	(-0.58)	(-0.24)	(0.41)	(-0.52)
RER Overvaluation	-0.26	-0.23	-0.23	-	-	-	-	-	-
	(-1.90)	(-2.08)	(-1.82)						
Fiscal Budget/GDP	-	-	-	-0.67	-0.54	-0.78	-	-	-
				(-2.20)	(-1.73)	(-2.34)			
Curr. Account/GDP	0.40	0.45	0.53	1.18	1.27	1.12	-	-	-
	(1.77)	(2.42)	(2.59)	(4.72)	(4.97)	(4.10)			
Contagion Crisis 1	0.76	0.57	0.52	1.14	0.39	2.32	0.90	0.75	0.83
	(2.47)	(2.90)	(2.39)	(2.90)	(0.93)	(2.12)	(3.21)	(3.95)	(5.20)
Contagion Crisis 2	-0.46	-1.59	-0.14	-0.90	-0.63	-5.01	0.34	0.88	0.78
	(-0.45)	(-1.66)	(-0.27)	(-1.70)	(-0.92)	(-1.41)	(0.15)	(1.51)	(0.70)
Contagion Crisis 3	0.76	0.98	0.88	1.21	1.13	2.00	0.70	1.00	0.83
	(2.57)	(5.20)	(3.97)	(4.85)	(4.88)	(3.01)	(2.11)	(4.70)	(4.69)
R2	0.53	0.66	0.59	0.58	0.57	0.50	0.49	0.61	0.65
F-stat 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

OLS regressions with constant and dummy variables in the three ground-zero countries (not reported). T-tests in parenthesis.
Contagion index of crisis *j* takes the value 0 in crises different from *j*.
External similarity combines Current Account and RER Overvaluation similarity.

Table 9. Capital Controls and Contagion

	Pressure Indicator and Weighting Matrix								
	ΔPI 3 months/ Direct Trade	ΔPI 3 months/ Neighbors	ΔPI 3 months/ Trade w. Neighbors	ΔRER 12 months/ Direct Trade	ΔRER 12 months/ Neighbors	ΔRER 12 months/ Growth Similarity	Δ Credit Rating/ Direct Trade	Δ Credit Rating/ Trade w. Neighbors	Δ Credit Rating/ Ext. Sim. 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	-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)			
Curr. 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)
R2	0.51	0.60	0.56	0.49	0.51	0.47	0.48	0.62	0.66
F-stat 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

OLS regressions with constant and dummy variables in the three ground-zero countries (not reported). T-tests in parenthesis.
External similarity combines Current Account and RER Overvaluation similarity.

Table 10. Exchange Rate Flexibility and Contagion

	Pressure Indicator and Weighting Matrix								
	ΔPI 3 months/ Direct Trade	ΔPI 3 months/ Neighbors	ΔPI 3 months/ Trade w. Neighbors	ΔRER 12 months/ Direct Trade	ΔRER 12 months/ Neighbors	ΔRER 12 months/ Growth Similarity	Δ Credit Rating/ Direct Trade	Δ Credit Rating/ Trade w. Neighbors	Δ Credit Rating/ Ext. Sim. 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	-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)			
Curr. 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 ×	-0.12	0.07	0.17	0.23	0.46	0.52	-0.68	-0.54	-0.43
XR Flexibility	(-0.42)	(0.31)	(0.71)	(0.94)	(1.74)	(1.81)	(-2.67)	(-2.12)	(-2.27)
R2	0.51	0.60	0.57	0.49	0.52	0.50	0.54	0.64	0.69
F-stat 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

OLS regressions with constant and dummy variables in the three ground-zero countries (not reported). T-tests in parenthesis.
External similarity combines Current Account and RER Overvaluation similarity.

Table 11. Capital Inflows Composition and Contagion

	Pressure Indicator and Weighting Matrix								
	ΔPI 3 months/ Direct Trade	ΔPI 3 months/ Neighbors	ΔPI 3 months/ Trade w. Neighbors	ΔRER 12 months/ Direct Trade	ΔRER 12 months/ Neighbors	ΔRER 12 months/ Growth Similarity	Δ Credit Rating/ Direct Trade	Δ Credit Rating/ Trade w. Neighbors	Δ Credit Rating/ Ext. Sim. 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)			
Curr. 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)
R2	0.51	0.60	0.56	0.51	0.52	0.48	0.57	0.72	0.70
F-stat 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

OLS regressions with constant and dummy variables in the three ground-zero countries (not reported). T-tests in parenthesis.
External similarity combines Current Account and RER Overvaluation similarity.

Appendix 1. Country List

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