Notes on contagion

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Assessing Financial Vulnerability: An Early Warning System for Emerging Markets
From Chapter 6
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While, as noted, in most cases, the indicators did their task well and signaled ahead of crises, Indonesia, which has witnessed a meltdown in its currency and a collapse in its banking industry is firmly anchored at the bottom of the list presented in Table 5.5, as relatively few indicators gave advanced warning. True, the few signals that were coming were from the more reliable indicators, yet using this approach it would not have been labeled "vulnerable." In a similar vein, some of the countries that appear near the top of the list in terms of vulnerability are not the countries that have typically been buffeted by financial markets in the wake of bad news elsewhere. Following the crises in Mexico and Thailand, Argentina and Brazil were at the top of the "hit list" of financial markets--yet, particularly in the case of Argentina, this would be difficult to justify strictly on the basis of the fundamentals reviewed here.

Perhaps South Africa is in for a financial crisis in the near future (it has already been subject to some speculative attacks); perhaps it can muddle through with less-than-pristine fundamentals if they are not the usual targets of contagion. On the basis of the analysis presented here, it would appear that Indonesia, poor banking practices notwithstanding, was brought down by contagion. Of the 89 currency crises and nearly 30 banking crises, only a handful occur with as few indicators (22 percent) flashing as was the case for Indonesia. As noted in Kaminsky and Reinhart (1996), economies tend to be "frail" in the eve of a crisis. As shown in Table 6.7, less than 15 percent of the currency and banking crises shared the

Indonesian characteristic of the silence of signals.

Table 6.1 On contagion: the dogs that did not bark

Type of crisis and sample	Number of crises	Number of crises that occurred with five or less indicators signaling	Proportion of crises that occurred with five or less indicators signaling
Banking, 1970-95	29	3	10.3
Currency, 1970-95	87	12	13.5
Banking, 1996-1997	6	1	16.7
Currency, 1996-1997	6	1	16.7

The empirical evidence on contagion is still limited to a few papers, but the weight of the empirical results appears to suggest it important. Eichengreen, Rose, and Wyplosz (1996) examine the issue in the context of OECD countries. They find that knowing that there is a crisis elsewhere significantly increases the probability of a domestic crisis--even after controlling for domestic and external fundamentals. As in Glick and Rose (1998), they point to trade links as the channel that is a culprit for the transmission of disease. The evidence in Calvo and Reinhart (1996) suggests that cross border capital flows have a "contagious" element, at least in Latin America. Schmukler and Frankel (1996) find evidence of contagion in emerging market funds. Doukas (1988) found evidence of contagion in sovereign interest rate spreads. Indeed, one of the very few empirical studies that does not find evidence of contagion (or in this case, "excess comovement" in equity returns) is Wolf (1997).

In any case, to the extent that contagion is a force that is at play in international financial markets, being near the bottom of the "vulnerability" list does not preclude a country from having a crisis, as the Indonesian collapse and the recurring bouts of speculation against the Argentinean peso highlight. In what follows, we review briefly some of the theoretical

underpinnings for contagion and then move on to assess to what extent crises probabilities increased for other emerging markets following the Mexican crisis of 1994 and the Asian crisis of 1997.

Explaining Contagion: Theoretical Underpinnings

Most of the theoretical work on contagion has attempted to provide a framework that allows us to understand how shocks in one country are transmitted elsewhere. Our review of this literature emphasizes its empirical implications in terms of defining contagion, delineating its channels of influence, and testing for its presence.

Defining contagion: In the only paper (that we are aware of) that examined the issue of contagion in the context of Latin America's debt crisis (Doukas, 1989), contagion was seen as the influence of "news" about the creditworthiness of a sovereign borrower on the spreads charged to the other sovereign borrowers, after controlling for country-specific macroeconomic fundamentals. Other studies, such as Valdes (1995), defined contagion somewhat differently--as excess comovement across countries in asset returns, whether debt or equity. The comovement is said to be excessive if it persists even after common fundamentals, as well as idiosyncratic factors, have been controlled for. A recent variant to this approach is presented in Rigobon (1998) and Forbes and Rigobon (1998), who define contagion more narrowly by requiring an increase in excess comovement in crisis periods.

Eichengreen, Rose, and Wyplosz (1996) defined contagion as a case where knowing that there is a crisis elsewhere increases the probability of a crisis at home, even when fundamentals have been properly taken into account. This is the definition of contagion that we will explore in the remainder of this chapter.

Theories of contagion and their empirical implications: To explain why crises tend to be bunched, some recent models have revived Nurkse's story of competitive devaluations, which emphasized trade, be it bilateral or with a third party.[1] Once one country has devalued, it makes it costly (in terms of a loss of competitiveness and output) for other countries to maintain their parity. In this setting the devaluation in the second country is a policy decision and its effect on output is salutary. Hence, an empirical implication of this type of model is that we should observe a high volume of trade among the "synchronized" devaluers.[2]

[1] See Smets and Gerlach (1996) for a model that emphasizes bilateral trade and Corsetti et. al. (1998) for one in which emerging markets compete in a common third market.

[2] As a story of fundamentals-based contagion, of course, this explanation does not speak to the fact that central banks often go to great lengths to avoid the devaluation in the first place.

Another family of models has de-emphasized the role of trade in goods and services and stressed the role of trade in financial assets, particularly in the presence of information asymmetries. Calvo and Mendoza (1998) present a model where the fixed costs gathering and processing country-specific information give rise to herding behavior, even when investors are rational. Kodres and Pritsker (1998) also present a model with rational agents and information asymmetries. However, they stress the role played by investors who engage in cross-market hedging of macroeconomic risks. In either case, these models suggest that the channels of transmission come from the global diversification of financial portfolios. As such, they have the empirical implication that countries with have more internationally-traded financial assets and more liquid markets are likely to be more vulnerable to contagion. Small, highly illiquid markets are likely to be under represented in international portfolios to begin with and, as such, shielded from this type of contagion. In addition, cross-market hedging usually requires a moderately high correlation of asset returns. The implication is that countries whose asset returns exhibit a high degree of comovement with the infected country (such as Argentina with Mexico or Malaysia with Thailand) will be more vulnerable to contagion via the cross-market hedges that were in place as the crisis erupted.

In addition to these explanations of contagion, Calvo (1998) has stressed the role of liquidity. A leveraged investor facing margin calls needs to sell (to an uninformed counterpart) his or her asset holdings. Because of the information asymmetries, a "lemons problem" arises and the asset can only be sold at a firesale price.

A variant of this story can be told about an open-end fund portfolio manager who needs to raise liquidity in anticipation of future redemptions. In either case, the strategy will be not to sell the asset whose price has already collapsed but other assets in the portfolio. In doing so,

however, other asset prices are depressed and the original disturbance spreads across markets.

One potential channel of transmission that has been largely ignored in the contagion literature but that is stressed in this paper is the role of common lenders, in particular commercial banks. U.S. banks had an extensive exposure to Latin America in the early 1980s, much in the way that Japanese banks did during the Asian crisis of 1997. The behavior of foreign banks can both exacerbate the original crisis, by calling loans and drying up credit lines, but can also propagate crises by calling loans elsewhere. The need to rebalance the overall risk of the bank's asset portfolio and to recapitalize following the initial losses can lead to a marked reversal in commercial bank credit across markets where the bank has exposure.

Very few studies have gone beyond establishing that there is contagion or spillovers and attempted to assess the underlying causes. Eichengreen, Rose, and Wyplosz (1996) attempted to discriminate whether bilateral trade links or similarities to the crisis country in macroeconomic fundamentals, which may lead investors to reassess the risk of the others. Glick and Rose (1998) examined these issues further in a much broader country coverage, while Wolf (1997) attempted to explain the pairwise correlations in stock returns by bilateral trade and other common macroeconomic fundamentals. All studies conclude that trade linkages play an important role in the propagation of shocks. Because trade tends to be more intra- than inter-regional in nature, Glick and Rose (1998) conclude that this helps explain why contagion tends to be regional rather than global. Kaminsky and Reinhart (1998b), also look at trade links--both bilateral and third-party--but that paper emphasized financial sector links. The remainder of this chapter is devoted to addressing some of these issues for the Tequila crisis and the Asian flu.

Contagion in the Mexican and Asian Crises: Some Evidence

In this part of this chapter we turn our attention to two recent "contagious" episodes, the aftermath of the Mexican peso crisis and the floatation of the Thai baht. Identifying the countries that were affected by the initial crisis is easy; pinning down the channels through which the crisis spread remains the more challenging task.

Table 6.2 summarizes some of the possible channels through which the crisis can spread. Obviously, to the extent that there is herding behavior and investors lump all emerging markets, or perhaps only those in the infected region, together that adds yet another dimension through which the crisis spreads. As far as the affected countries' exchange rate arrangements at the outset of the crisis, these cover the range from currency board to managed float. Of course, it is widely agreed that both the Philippine and Malaysian central banks intervened heavily in the foreign exchange market. Hence, there was a good deal of "managing" in these managed floats. Nonetheless, it appears that none of these exchange rate arrangements succeeded in making the countries impervious to contagion.

As regards the potential role of bilateral and third party trade linkages, Malaysia would be the most closely linked with Thailand, with Korea and the Philippines having more moderate exposure. Trade can certainly not help explain Argentina and Brazil following the Mexican devaluation nor Indonesia following the Thai crisis. Exposure to Japanese banks, which pulled out rapidly across the region was common to all the affected countries except Hong Kong. While both Brazil and Argentina are in the same U.S. bank cluster as Mexico, banks were not at the heart of the problem in 1994 as they were in the early 1980s.

Most of the affected Asian countries, except Korea had high asset return correlations with Thailand, although none except Hong Kong had particularly liquid markets. The same is true of stock returns in Argentina, which have the highest correlation with Mexico of any country in the region. Here it is hard to separate cause and effect. A high correlation may reflect past contagion, but to the extent that current cross-hedging strategies use such historical correlations as a guide, it could be the vehicle for future contagion. In sum, it would appear that financial sector linkages, be it through banks of through international capital markets have much

to say in how shocks are propagated in recent crises episodes, particularly for Argentina, Brazil, and Indonesia.

Table 6.2 Recent episodes: Possible Channels of Transmission

Affected countries	Exchange rate regime at the onset of the crisis	Nature of contagion or spillover	Common bank lender	High correlation of returns	Liquid market/high representation in mutual fund. Percent of emerging market portfolio.	Bilateral trade: Percent of exports to affected country	Trade with common third party in same commodities: Percent of exports competing with top exports of affected country
Tequila crisis: 1994-95		First crisis: Mexico, December 1994					
Argentina	Currency board	turbulence	Yes	High, 0.56	Moderate, 2.98	Low, 1.7	Low, 15.6
Brazil	Peg	turbulence	Yes	Moderate, 0.36	High, 13.07	Low, 2.4	Low, 10.9
Asian flu: 1997-1998		First crisis: Thailand, July 1997					
Malaysia, July	Managed float	crisis	Yes	High, 0.60	Moderate, 5.88	Moderate, 4.1	High, 44.4
Philippines, July	Managed float	crisis	Yes	High, 0.68	Low, 2.40	Moderate, 3.8	Low, 19.2
Indonesia, August	Narrow band	crisis	Yes	High, 0.54	Moderate, 4.35	Low, 1.8	Low, 15.5
Hong Kong, October	Currency board	turbulence	No		High, 15.33	Low, 1.0	Low
Korea, November	Crawling band	crisis	Yes	Low, 0.24	Moderate, 6.16	Low, 2.0	Moderate, 27.9

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APPENDIX A: DATA AND DEFINITIONS

Crisis index: The index is a weighted average of exchange rate and reserve changes, with weights such that the two components of the index have equal conditional volatilities. Since changes in the exchange rate enter with a positive weight and changes in reserves have a negative weight attached, readings of this index that were three standard deviations or more above the mean were cataloged as crises. For countries in the sample that had hyperinflation, the construction of the index was modified. While a 100 percent devaluation may be traumatic for a country with low-to-moderate inflation, a devaluation of that magnitude is commonplace during hyperinflations. A single index for the countries that had hyperinflation episodes would miss sizable devaluations and reserve losses in the moderate inflation periods, since the historic mean is distorted by the high-inflation episode. To avoid this, we divided the sample according to whether inflation in the previous six months was higher than 150 percent and then constructed an index for each subsample. Our cataloging of crises for these countries coincides fairly tightly with our chronology of currency market disruptions. Eichengreen, Rose, and Wyplosz (1995) also include interest rates in this index, however, our data on market-determined interest rates for developing countries does not span the entire sample.

The indicators:

Sources: International Financial Statistics (IFS), International Monetary Fund; Emerging Market Indicators, International Finance Corporation (IFC); World Development Indicators, the World Bank, when data was missing from these sources, central bank bulletins and other country-specific sources were used as supplements. Unless otherwise noted, we used **12-month percent changes**.

1. M2 multiplier: The ratio of M2 to base money, (IFS lines 34 plus 35) divided by IFS line 14.

2. Domestic credit/nominal GDP: IFS line 52 divided by IFS line 99b (interpolated). Monthly nominal GDP was interpolated from annual or quarterly data.

3. Real interest rates on deposits: IFS line 60l, monthly rates, deflated using consumer prices (IFS line 64) expressed in percentage points.

4. The ratio of lending rates to deposit rates: IFS line 60p divided by IFS line60l; was used in lieu of differentials to ameliorate the distortions caused by the large percentage point spreads observed during high inflation. In levels.

5. "Excess" real balances: M1 (IFS line34) deflated by consumer prices (IFS line 64) less an estimated demand for money. The demand for real balances is determined by real GDP (interpolated IFS line99b), domestic consumer price inflation, and a time trend. Domestic inflation was used in lieu of nominal interest rates, as market-determined interest rates were not available during the entire sample for a number of countries; the time trend (which can enter log-linearly, linearly, or exponentially) is motivated by its role as a proxy for financial innovation and/or currency substitution. Excess money supply (demand) during pre-crisis periods (mc) is reported as a percent relative to excess supply (demand) during tranquil times (mt)--that is, 100 x (mc-mt)/mt.

6. M2 (in US dollars)/reserves (in US dollars): IFS lines 34 plus 35 converted into dollars (using IFS line ae) divided by IFS line 1L.d.

7. Bank deposits: IFS line 24 plus 25.

8. Exports (in US dollars): IFS line 70.

9. Imports (in US dollars): IFS line 71.

10. The terms of trade: the unit value of exports (IFS line 74) over the unit value of imports

(IFS line 75). For those developing countries where import unit values (or import price indices) were not available, an index of prices of manufactured exports from industrial countries to developing countries was used.

11. The real exchange rate: This measure used is based on consumer price indexes (IFS lines 64) and is defined as the relative price of foreign goods (in domestic currency) to the price of domestic goods. If the central bank of the home country pegs the currency to the dollar (Deutsche mark), the relevant foreign price index is that of the United States (Germany). Hence, for all the European countries the foreign price index is that of Germany while for all the other countries, consumer prices in the United States were used. The trend was specified as, alternatively, log-linear, linear, and exponential; the best fit among these was selected on a country-by-country basis. Deviations from trend during crisis periods (dc) were compared to the deviations during tranquil times (dt) and are shown in Figures 2 and 3 as a percent of the deviations in tranquil times (i.e.,100 x (dc-dt)/dt).

12. Reserves: IFS line 1L.d**.**

13. Domestic-foreign interest rate differential on deposits: Monthly rates in percentage points. IFS lines 60l. Interest rates in the home country are compared with interest rates in the United States (Germany) if the domestic central bank pegs the currency to the dollar (Deutsche mark). The real interest rate is given by $100 \times [((1+ i_t)p_t / p_{t+1-1}]$.

14. Output: For most countries, the measure of output used is industrial production (IFS line 66). However, for some countries (the commodity exporters) an index of output of primary commodities is used (IFS lines 66aa).

15: Stock returns (in dollars): IFC global indices are used for all emerging markets; for industrial countries the quotes from the main bourses are used.

16. Overall budget balance/GDP: Consolidated public sector balance as share of nominal GD