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CONTAGIOUS CURRENCY CRISES

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ABSTRACT

This paper is concerned with the fact that the incidence of speculative attacks tends to be temporally correlated; that is, currency crises appear to pass "contagiously" from one country to another. The paper provides a survey of the theoretical literature, and analyzes the contagious nature of currency crises empirically. Using thirty years of panel data from twenty industrialized countries, we find evidence of contagion. Contagion appears to spread more easily to countries which are closely tied by international trade linkages than to countries in similar macroeconomic circumstances.

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I. Introduction

The scope for currency crises to spill contagiously across countries has been hotly debated in the wake of the Mexican meltdown. A frequently cited justification for the $50 billion of assistance provided by the IMF, the United States and other G-7 governments in early 1995 was that the effects of the Mexican crisis, if allowed to play themselves out, would not be limited to that country; rather, other emerging markets would have experienced serious repercussions. Because the Mexican authorities had little incentive to internalize these externalities, multilateral intervention was justified. In support of this view observers cite the reserve losses, interest-rate increases and weakening exchange rates suffered by countries like Argentina and Thailand in the early weeks of 1995. The contrary view is that investors were discriminating in the countries they attacked. Currencies other than the Mexican peso were subjected to relatively little pressure, and only countries with large current-account deficits, overvalued real rates and other weak fundamentals felt much of an effect. The implication is that the Mexican bailout, to the extent that it was justified by fears of contagion, was uncalled for.

A similar controversy arose at the time of the 1992-3 crises in the European Monetary System. In 1992 it was argued that the French franc and the Irish punt came under attack as a result of the earlier crises experienced by the British pound and the Italian lira. In 1993 it was argued that the attack on the French franc threatened to spill over to other European currencies. The implication drawn was that foreign support of the franc was essential to prevent chaos from spreading contagiously throughout the EMS. The rebuttal was that only European countries whose fundamentals were weak were subjected to speculative attacks; others like the Netherlands remained immune because they appropriately aligned their economic policies to the maintenance of their currency pegs. Thus, the argument went, only countries in particular economic and political circumstances were susceptible.

Clearly, the stakes for policy are immense. Ascertaining whether there exists contagion in foreign exchange markets – by which we mean a systematic effect on the probability of a speculative attack which stems from attacks on *other* currencies, and is therefore an additional effect above and beyond those of domestic "fundamentals" -- and under what conditions contagious currency crises arise should be a high priority for empirical research in open-economy macroeconomics. It is remarkable therefore that there exists little systematic analysis of the question. Our goal in this paper is to take a first step toward filling this gap.

We use a panel of quarterly data for 20 industrial countries for the period 1959-1993 to test for contagious currency crises. We ask whether the probability of a crisis in a country at a point in time is correlated with the incidence of crises in other countries at the same time, after controlling for the effects of political and economic fundamentals. The evidence is striking: a variety of tests and a battery of sensitivity analyses uniformly suggest that a crisis elsewhere in the world increases the probability of a speculative attack by an economically and statistically significant amount (our best estimate is eight percentage points), even after controlling for economic and political fundamentals in the country concerned. This would appear to be the first systematic evidence consistent with the existence of contagious currency crises. However, the evidence is suggestive rather than definitive, since it could also result from shocks to an unmeasurable but common shock (e.g., a shock to our center country which is not picked up by our control variables.)

One can think of a number of channels through which instability in foreign exchange markets might be transmitted across countries. One is the impact of a speculative attack on the current and prospective international competitiveness of the countries concerned and hence on their current accounts. Thus, the attack on the United Kingdom in September 1992 and sterling's subsequent depreciation are said to have damaged the international competitiveness of the Republic of Ireland, for which the UK is the single most important export market, and to have provoked the attack on the punt at the beginning of 1993. Finland's devaluation in August 1992 was widely regarded as having had negative repercussions for Sweden, not so much because of direct trade between the two countries but because their exporters competed in the same third markets. Attacks on Spain in 1992-3 and the depreciation of the peseta are said to have damaged the international competitiveness of Portugal, which relies heavily on the Spanish export market, and to have provoked an attack on the escudo despite the virtual absence of imbalances in domestic fundamentals.

Trade links may not be the only channel of transmission, of course. It is difficult to argue, for example, that the Tequila Effect -- the pressure applied to currencies in Latin America and East Asia following the crash of the Mexican peso in 1994 -- stemmed from strong trade links between Mexico and the other countries concerned. Argentina and Brazil may have traded extensively with Mexico, but the same was not true of Hong Kong, Malaysia, and Thailand. Rather than focusing on trade links, commentators pointed to similarities across countries in macroeconomic policies and conditions.

Thus, one can imagine a second model focusing on co-movements in macroeconomic policies and conditions in the countries subject to attack. Evidence that certain market participants are skeptical about the stability of a currency may lead their colleagues to suspect that they also skeptical about the prospects for the currencies of other countries in a similar macroeconomic position. Difficulties in one country pursuing a program of exchange-rate-based stabilization, for example, might lead currency traders to revise their assessment of the likelihood that other countries pursuing this macroeconomic strategy will carry it off. An attack on one currency and the issuing government's response to the pressure may thus provide new information relevant for expectations of how other governments will respond if placed in a similar position. For example, evidence that a country with an unusually high unemployment rate succumbed to a speculative attack and abandoned its currency peg out of reluctance to raise interest rates if that meant further aggravating unemployment might lead investors to revise their expectations of the likelihood that other countries in similar positions would be prepared to do so.

These two interpretations emphasizing different channels of international transmission of currency crises have different empirical implications. The interpretation emphasizing trade links suggests that currency crises will spread contagiously among countries that trade disproportionately with one another. The one emphasizing economic and political commonalties suggests that instability will instead infect countries in broadly economic and political positions.

To compare these different channels of contagion transmission, we weight crises elsewhere in the world by country characteristics intended to capture the extent to which contagion is transmitted through specific channels. We compare two different weighting schemes.

First, on the assumption that countries which trade disproportionately with one another are prone to contagion operating through the competitiveness effects of crisis-induced exchange rate changes, we weight crises in neighboring countries by the importance of trade with those countries. Second, on the assumption that crises and governments' reactions to them lead investors to revise their expectations of officials' resolve in similar ways with respect to countries in broadly similar macroeconomic positions, we weight crises by the similarity of macroeconomic policies and outcomes.

The results provide further support for the hypothesis that speculative attacks in foreign exchange markets spread contagiously across countries. Our trade-weighted measure of crises elsewhere in the world is important economically as well as being significant statistically at high levels of confidence; it is robust to a variety of sensitivity tests. Our macro-weighted measure of crises does not display the same level of significance. Although there is always the possibility that our empirical measures of macroeconomic contagion are not capturing these phenomena adequately, we are inclined to interpret these results as suggesting that trade, rather than revisions of expectations based on macroeconomic factors, has been the dominant channel of transmission for contagious currency crises for the bulk of the sample period.

Importantly, the trade- and macro-weighted specifications both outperform the naive model of contagion when they are included one at a time in alternative specifications. This supports the interpretation of our results in terms of contagion rather than omitted environmental variables. It is nevertheless appropriate to err on the side of caution, especially since our unweighted measure remains significant in the presence of the weighted variables.

The remainder of our paper is organized as follows. Section II provides an overview of the theoretical literature on speculative attacks in foreign exchange markets, with special reference to contagion. Section III reviews related empirical studies. In Section IV we present new evidence on contagion, while section V analyzes various channels of transmission for the contagion effect. Section VI concludes.

II. Theories of Speculative Attacks, Contagious and Otherwise

In this section we review the theoretical literature on speculative attacks in foreign exchange markets, starting with the seminal Krugman (1979) model, proceeding to models of multiple equilibria, and concluding with models of contagious currency crises.[1]

A. Speculative Attacks

Krugman's contribution was to show how inconsistencies between domestic economic conditions and an exchange rate commitment leads to the collapse of the currency peg. In his model, the overly expansionary stance of domestic policy causes domestic absorption to exceed production. The difference spills over into a balance-of-payments deficit, which the central bank finances by expending reserves. Eventually reserves fall to a critical threshold at which a speculative attack is launched, eliminating the authorities' remaining foreign assets. Once reserves are depleted, the exchange rate peg is abandoned, and the currency depreciates secularly over time, reflecting the more expansionary stance of policy at home than abroad.

This theory of balance of payments crises has produced four classes of insights. First, it helps to identify the relevant fundamentals. Most obviously, these should include macroeconomic

[1] A recent survey is Blackburn and Sola (1993).

determinants of the exchange rate and the balance of payments, as embodied in aggregate models of exchange rate determination and the literature on the monetary approach to the balance of payments. Given the forward-looking nature of these models, this list of determinants will necessarily include expected future values of the relevant series.[2] At the same time, the poor empirical performance of these models gives grounds for concern about the success with which speculative-attack models building on these foundations can be implemented empirically; we revisit this point below.

Second, the Krugman model demonstrates how crises can erupt before official reserves, which decline secularly over time, actually hit zero. Currency speculation takes the form of purchases and sales of domestic currency for foreign assets. Those transactions arise as traders exchange assets among themselves so as to equalize rates of return and, more generally, to balance their portfolios, trading off risk and return. They provoke a crisis when no one in the market is willing to acquire domestic currency at the prevailing price (given by the pegged rate of exchange). Under these circumstances, the only counterpart on the short side of the market is the central bank. Speculators have an incentive to liquidate their holdings of domestic currency while the central bank retains sufficient reserves to absorb the volume of sales. The timing of the attack is determined such that its magnitude just suffices to eliminate the central bank's entire stock of reserves.

A third implication of the basic model is that the central bank can only maintain a currency peg if it possesses adequate foreign exchange reserves. Once their reserves have been lost in the attack, the authorities have no choice but to abandon the peg. In the standard model, crises thus

[2] That expected future fundamentals can themselves depend on whether a speculative attack occurs is what

result in a transition to floating. The model thus implies that reserve stocks must be reconstituted before the exchange rate can be re-pegged. The standard formulation also helps us think about the meaning of "reserve adequacy." To defend the currency peg, the central bank must be capable of purchasing all of its liabilities that are put up for sale by other agents. In the standard model, the volume of sales is small: it corresponds to the decline in monetary base needed to ratify the fall in money demand associated with the higher interest rates that prevail following the shift from a pegged to a depreciating exchange rate. Normally, domestic residents continue to hold a significant proportion of the base following the collapse of the peg, since they need it for transactions purposes. But in highly dollarized economies, the transactions demand for domestic currency can be very small, as pointed out by, inter alia, Edwards (1989); in this case, the share of the monetary base subject to liquidation in a crisis may be quite large. More worrisome still is the possibility that the monetary authorities will also be required to purchase other domestic liabilities (i.e., M2) if the currency crisis provokes a banking crisis.[3]

A fourth implication of the standard model is that the authorities have little chance of fending off an attack. Even if the volume of speculative sales of domestic currency is less than the monetary base, the base still exceeds the net stock of foreign reserves of the central bank (except in very special circumstances like a fully-backed currency board). In principle, the authorities can augment their gross reserves by borrowing abroad, possibly to the point where reserves exceed the base. But if borrowed reserves are used to finance sterilized intervention, the monetary base increases *pari passu*, and there is no level of gross reserves sufficient to repel an attack. If the

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gives rise to the possibility of multiple equilibria, as we explain below.

[3] The link between financial and exchange crises is emphasized by Goldfajn and Valdés (1995), and is a point to which we return below.

authorities do not sterilize, then the attack can be repelled, but only at the cost of allowing the base to shrink and interest rates to rise. If a sizable proportion of the base is involved, the resulting interest rate increases may be so large that the exchange rate crisis precipitates a banking crisis. To avert the latter, the central bank may then have to resume sterilizing its intervention, which will again undermine its capacity to defend the currency peg.

B. Multiple Equilibria

A generic feature of theoretical macroeconomic models with rational expectations is that such models typically have multiple solutions. Since most of these solution paths do not converge to a steady state, standard practice for many years was to assume away divergent solutions by invoking transversality conditions. More recently however this non-uniqueness property – which allows for multiple equilibria -- has become the basis for a literature on speculative bubbles and sun-spot equilibria. Obstfeld (1986, 1995), following a suggestion by Flood and Garber (1984b), has provided examples of multiple equilibria and self-fulfilling attacks in foreign exchange markets. These offer a wholly new perspective on the causes of currency crises.

The possibility of multiple equilibria arises when market participants, while not questioning that current policy is compatible with the indefinite maintenance of the currency peg, anticipate that a successful attack will alter policy. In these circumstances, it is expected future fundamentals, conditional on an attack taking place, rather than current fundamentals and expected future fundamentals absent an attack, which are incompatible with the peg. Two equilibria thus exist: the first one features no attack, no change in fundamentals, and indefinite maintenance of the peg; the second one features a speculative attack followed by a change in fundamentals which validates, ex post, the exchange-rate change that speculators expected to take place.

In Obstfeld (1986), pre- and post-crisis policies are set arbitrarily. If an attack occurs, the government is simply assumed to shift policy in a more expansionary direction. The arbitrary nature of this contingent policy process is the obvious limitation of the model. Subsequently, Bensaid and Jeanne (1993), Ozkan and Sutherland (1995) and Obstfeld (1995) have proposed models of optimizing governments which find it in their self interest to follow the kind of contingent policy processes that can give rise to multiple equilibria and self-fulfilling attacks. Their analyses build on the literature on exchange rate escape clauses (Obstfeld, 1991; De Kock and Grilli, 1994; Drazen and Masson, 1994), in which it is optimal to maintain the currency peg under some circumstances and to abandon it under others.

In these models, the behavior of governments still derives from special utility functions. In this sense, the literature on multiple equilibria and self-fulfilling attacks in foreign exchange markets is merely a collection of examples and special cases. This point is emphasized by Krugman (1996), who establishes two further results. First, he suggests that multiple equilibria are, paradoxically, less likely when the fundamentals are wrong. When fundamentals are clearly inconsistent with the prevailing currency peg, investors have little doubt that a crisis will ultimately occur, and the model quickly converges to the equilibrium in which the currency is attacked and devalued; only when fundamentals are "good enough" that there remains uncertainty about whether a crisis will eventually result do there exist multiple equilibria. Second, Krugman shows that if the public does not know the authorities preferences, there may be "testing" by the markets -- that is, one may observe attacks that are unsuccessful but which reveal information about the preferences of the authorities.[4]

Models of self-fulfilling attacks imply that "good" fundamentals may not suffice to avert currency crises. To prevent an attack unjustified by fundamentals, the credibility of the central bank must be such that markets rule out a relaxation of policy once the peg is abandoned. Obstfeld (1986) provides such an example: there, the expectation that the central bank will react to a crisis by implementing a policy which implies an exchange rate appreciation eliminates the risk of a self-fulfilling crisis.

C. Contagion

Relatively little theoretical work has analyzed the conditions under which currency crises can spread contagiously across countries, though there has been some work of relevance. For instance, Willman (1988) and Goldberg (1993) endogenized relative prices, allowing events abroad to influence the real exchange rate and domestic competitiveness. Flood and Garber (1984a) and Claessens (1991) introduced uncertainty about the domestic policy process. Flood and Garber, followed by Obstfeld (1986), added the idea of a contingent policy process, in which one-time events could lead the authorities to substitute one policy for another, thereby introducing the possibility of self-fulfilling speculative attacks.

Perhaps the first systematic theoretical treatment of this question was Gerlach and Smets (1995). Inspired by the links between the fall of the Finnish Markka in 1992 and the subsequent attack on the Swedish Krona, they consider two countries linked together by trade in merchandise and financial assets. In their model, a successful attack on one exchange rate leads to its real

[4] While testing is not, strictly speaking, a case of self-fulfilling attacks, since markets anticipations are not

depreciation, which enhances the competitiveness of the country's merchandise exports. This produces a trade deficit in the second country, a gradual decline in the international reserves of its central bank, and ultimately an attack on its currency. A second channel for contagious transmission is the impact of crisis and depreciation in the first country on the import prices and the overall price level in the second. Post-crisis real depreciation in the first country reduces import prices in the second. In turn, this reduces its consumer price index and the demand for money by its residents. Their efforts to swap domestic currency for foreign exchange then deplete the foreign reserves of the central bank. This may shift the second economy from a no-attack equilibrium, in which reserves more than suffice to absorb the volume of prospective speculative sales and in which there consequently exist no grounds for a speculative attack, to a second equilibrium in which an attack can succeed and in which speculators thus have an incentive to launch it.[5]

Buiter et al. (1996) use an escape-clause model of exchange rate policy to analyze the spread of currency crises in a system of N+1 countries, N of which (denoted the "periphery") peg to the remaining country (the "center"). The center is more risk averse that the others and is hence unwilling to pursue a cooperative monetary policy designed to stabilize exchange rates. A negative shock to the center which leads it to raise interest rates then induces the members of the periphery to reconsider their currency-pegging policy. If the members of the periphery cooperate,

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fulfilled, it is a case of attacks unjustified by the fundamentals.

[5] A similar argument is developed by Andersen (1994), building on escape-clause models of exchange-rate policy. In his model, the government is prompted to abandon its currency peg by a shock coming from outside the currency market. An exogenous deterioration in domestic competitiveness which increases domestic unemployment, for example, may give the authorities an incentive to opt for a more expansionary policy which reduced unemployment through surprise inflation. Andersen argues that his model provides a plausible description of exchange rate policy in Northern Europe in 1991-92, when the collapse of Soviet trade with the Nordic countries

they may find it collectively optimal to leave the system -- an extreme case of contagion. More generally, some subset of peripheral countries -- those with the least tolerance for high interest rates -- will find it optimal to leave the system under these circumstances, and contagion will be limited to this subset. Importantly, however, their decision to leave stabilizes the currency pegs of the remaining members of the system, because monetary expansion and currency depreciation by some members of the periphery provides an incentive for the center country, which now finds itself with an increasingly overvalued exchange rate, to relax its monetary stance, relieving the pressure on rest of the periphery. In this model, contagion is selective: the shock to the center spills over negatively to some members of the periphery but positively to others.

Another paper providing an analysis of contagious currency crises is Goldfajn and Valdés (1995). They focus on the role of illiquidity in financial markets. A key feature of their model is the introduction of financial intermediaries. These authors show how, in the presence of such intermediaries, small disturbances can provoke large-scale runs on a currency. Intermediaries supply liquid assets to foreigners unwilling to commit to long-term investments; that is, they provide maturity-transformation services. By offering attractive terms on liquid deposits, their presence augments the volume of capital inflows. But when, for exogenous reasons, foreign investors withdraw their deposits, intermediaries unable to costlessly liquidate their assets face the risk of failure. Hence, a bank run can produce a self-fulfilling banking crisis (Diamond and Dibvig, 1983), in the same way that a run on the currency can provoke a self-fulfilling exchange-rate crisis. Moreover, the run on intermediaries can spill over into a run on the currency as foreign investors withdraw their deposits and convert them into foreign exchange. These crises

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first aggravated unemployment in Finland, leading its government to adopt a more expansionary policy which can spread contagiously to other countries when international investors encountering liquidity difficulties as a result of the banking crisis in one country respond by liquidating their positions in other national markets.

A related literature concerned with information, while not directly concerned with contagion in foreign exchange markets, provides a complementary approach to the issue. Shiller (1995) provides a model in which financial market participants share access to much of the same information (e.g. that which appears on Reuters screens) but interpret and process it in different ways. What they make of their shared information depends on their own experience, which in turn is shaped by local conditions which only they experience. Consequently, one market's reaction to a piece of new information can provide a signal about its global implications. It may suggest to traders in other markets how they too should react. The fact that one market draws dramatic conclusions from a some information may overcome local culture in other markets and lead to a revision of expectations (an "information cascade"). In the present context, one can see how this effect could lead to an attack on one exchange rate to prompt traders in other currency markets to attack those exchange rates as well.

A similar analysis, also based on informational issues, is Caplin and Leahy (1995). In their model, financial market participants expect a crisis but have diffuse priors over its timing. It is costly for traders to take a position in advance of a crisis, in other words to move too early. Each trader is unsure whether others share his or her belief that a crisis will eventually occur. They exchange "cheap talk" amongst themselves but draw inferences only from positions taken in the market. The result is normal market conditions ("business as usual") with no hint of crisis until it

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required abandoning the currency peg, and which then spilled over to the exchange rates of the rest of Scandinavia.

suddenly erupts. Once it occurs, however, market participants all claim that they knew that the crisis was about to happen and that they were readying themselves for the eventuality (they display "wisdom after the fact"). This model can give rise to contagion insofar as a crisis somewhere in the world confirms individually-held suspicions in other markets.[6]

III. Empirical Studies of Speculative Attacks, Contagious and Otherwise

While the literature on crises in foreign exchange markets is replete with models that highlight motives for and dynamics of speculative attacks, the process of systematically testing the predictions of those theories has barely begun. We put the emphasis in this last sentence on the word "systematically." Otherwise convincing studies of currency crises frequently assemble evidence from biased samples of episodes. It is not just that they consider a selective sample of episodes in which currency pegs collapsed without confirming that the collapses they analyze are representative of the underlying population. It is that episodes in which pegs were abandoned are themselves unrepresentative of the population of speculative attacks. Some pegs are abandoned without a speculative attack. Others are repelled. Thus, studies like Dornbusch, Goldfajn and Valdés (1995) and Krugman (1996), while informative about the characteristics of the episodes they consider, do not provide a representative characterization of speculative attacks.

In Eichengreen, Rose and Wyplosz (1994, 1995) we attempt to analyze currency crises systematically by constructing a measure of speculative attacks that excludes devaluations and

[6] An illustrative application of this model would be to the ERM crises of 1992-93. The story would go as follows. There was a widespread belief at the time that the ERM could not continue to operate indefinitely without a realignment. And yet its extraordinary stability since January 1987 led traders to accept the official view that the system could now function without further realignments. Extraneous circumstances (the political difficulties of ratifying the Maastricht Treaty) then triggered a crisis (which culminated in the devaluation of the Italian lira)

flotations not taken in a climate of crisis and includes unsuccessful attacks. We compare these with actual devaluations and other changes in exchange rate arrangements. Our measure of crises is a weighted average of changes in the exchange rate, changes in international reserves which can be paid out in response to speculative pressure, and changes in the interest differential since interest rates can be raised to fend off an attack. (A more detailed description of the methodology is presented below.) We analyze the experience of some two dozen OECD economies since 1959.

Our findings on the causes and consequences of devaluations and revaluations are consistent with the predictions of mainstream models. Countries which devalue experience problems of external balance in the period leading up to the event. Their trade deficits and reserve losses are associated with relatively expansionary monetary policies. In addition, the period leading up to devaluations is characterized by problems of internal balance as reflected in relatively high levels of unemployment; the expansionary monetary stance in these countries may be adopted partly in response to these domestic concerns. Broadly speaking, revaluations are mirror images of devaluations.[7] Other events in foreign exchange markets, in contrast, resist generalization. For example, transitions between exchange rate regimes (like movements from fixed to floating rates) are largely unpredictable.

We find that countries susceptible to crises are those whose governments have pursued accommodating monetary policies leading to high inflation and reserve losses, generally in response to deteriorating conditions on the unemployment front. Initially, the current account

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which put paid to this belief. It revealed to all traders that what they privately believed all along was true-- that realignments were still necessary.

[7] This evidence is consistent with models emphasizing the domestic determinants of external balance as well as with more recent models which focus instead on the decisions of governments concerned with internal balance and constrained by the exchange rate in their choice of policy response.

moves into deficit, and the capital account worsens as the crisis nears. Countries which take last-minute steps to defend the currency by significantly reducing the rate of money growth sometimes succeed in defending the rate. Those which retrench less dramatically may still be forced to capitulate but often do so without provoking a major crisis. In contrast, governments which rely on sterilized intervention to the exclusion of more fundamental policy adjustments are generally unable to avoid full-blown currency crises.

A few other studies have adopted this approach. For example, Moreno (1995) analyzes crises in the Pacific Basin economies from 1980 through 1994. He finds that periods of speculative pressure tend to be associated with large budget deficits and rapid rates of growth of domestic credit. There is some evidence that episodes of pressure arise when slow growth and relatively high inflation make it difficult for the government to maintain a stable exchange rate. In contrast, there is no evidence that indicators of external balance differ between crises and tranquil periods.

Kaminsky and Reinhart (1996) consider speculative attacks on currencies and banking crises, analyzing connections between the two. They focus on 20 countries in Asia, Europe, Latin America and the Middle East that experienced banking difficulties in the period 1970-1995. Their index of currency crises is constructed as a weighted average of exchange rate changes and reserve changes (because the relevant interest rate data are lacking for some countries). In their sample, crises tend to be preceded by declining economic activity, weakening export sectors, falling stock markets, and high real interest rates. In addition, crises are preceded by accelerating money growth and rapid rates of growth of the liabilities of the banking system. Banking crises are leading indicators of currency crises, but there are few instances where currency crises predict banking crises.

By comparison, empirical analyses of contagion are few. Typical of the literature are studies which provide informal comparisons of small groups of countries. Burki and Edwards (1995) contrast the experiences of Argentina, Brazil and Venezuela in the wake of the Mexican crisis with those of Chile and Colombia, suggesting that contagion, while present, was selective. Calvo (1996) provides a series of comparisons between Mexico and other countries in an effort to understand why some countries were more susceptible than others to the tequila effect.

We are aware of three statistical studies of contagion. Calvo and Reinhart (1995) report evidence of contagion in an econometric model in which capital flows to four small Latin American countries depend on their standard determinants but also on a contagion proxy, namely, capital flows to four large Latin American countries. Their results can be questioned, however, on the grounds that the flow of capital to neighboring countries is a less-than-ideal proxy for contagion and that the sample of countries is not random.

Schmukler and Frankel (1996) model contagion using data on closed-end country funds. Although their dependent variable, the level of stock prices, is different from the one with which we are concerned, the two are linked insofar as the rise in domestic interest rates needed to fend off an attack on the currency will tend to depress equity prices. Their evidence suggests that investors differentiated among countries to a greater extent after the 1994 Mexican crisis than after its 1982 predecessor. In the short run, a drop in Mexican prices tends to induce sell-offs in other markets motivated by the desire to raise cash; while there is evidence of contagion in Latin

America in the long run as well, the long-run effect of a Mexican sell-off on Asian markets is positive.[8]

Sachs, Tornell and Velasco (1996) analyzed the period immediately after the crash of the Mexican peso in December 1994, and found that the countries hit by the "Tequila Effect" had experienced lending booms, over-valued real exchange rates, and low reserves. Their sample is far from random (both in terms of time and country choice); in addition, they do not distinguish between attacks which are unwarranted by fundamentals but are triggered by macroeconomic similarity, and attacks warranted by macroeconomc factors.

IV. Analyzing Contagion Systematically

In this section, we test for the existence of "contagious" currency crises. The contagion effect with which we are concerned can be thought of as an increase in the probability of a speculative attack on the domestic currency which stems not from domestic "fundamentals" such as money and output but from the existence of a (not necessarily successful) speculative attack elsewhere in the world.

We analyze a panel of quarterly macroeconomic and political data covering twenty industrial countries from 1959 through 1993 (a total of 2800 observations). We pose the following question: is the incidence of a currency crisis in a particular country at a given point in time (e.g., France in the third quarter of 1992) correlated with the incidence of a currency crisis in

[8] In a similar exercise, Valdés (1996) analyzes the secondary market prices of sovereign debt, and shows that there exists a strong cross-country correlation of these prices even after controlling for macroeconomic fundamentals and "big news events" such as announcements of Brady Plan restructurings. This evidence of "contagion" in the markets for developing-country debt is much stronger than analogous evidence for the U.S. corporate bond market, where fundamentals explain essentially all of the observed correlation across issues, and

a different country (e.g., the United Kingdom) at the same point in time, even after taking into account the effects of current and lagged domestic macroeconomic and political influences? The finding of a strong positive partial correlation is consistent with the existence of contagion, since it implies that speculative attacks are temporally correlated even after conditioning on domestic factors. Still it is difficult to interpret this as definitive proof of contagion, since it may in fact reflect not contagion but an unmeasured common shock to economic fundamentals which strikes a number of counties simultaneously (e.g., from Germany, our center country), rather than actual spillovers from one country to another. For this reason, we continue, in the next section, to consider alternative channels of transmission of this contagion effect.

A. Measuring Currency Crises

The first issue that must be confronted is how to determine when a speculative attack has occurred. Having addressed this issue in a number of previous papers (Eichengreen, Rose and Wyplosz (1994, 1995)), we provide only a summary of our thinking here.

Currency crises cannot be identified with actual devaluations, revaluations and instances in which the currency is floated, for two reasons.[9] First, not all speculative attacks are successful. The currency may be supported through the expenditure of reserves by the central bank or by foreign central banks and governments.[10] Alternatively, the authorities may repel attacks by raising interest rates and adopting other policies of austerity. Further, many realignments are taken deliberately in tranquil periods, possibly to preclude future attacks.

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than in a group of medium-sized OECD countries, where fundamentals again explain all of the observed correlation of credit ratings.

[9] We refer to such actual changes in explicit exchange rate policy as "events" and think of them as overlapping in part with the currency crises that we are interested in.

[10] And occasionally by the actual or threatened imposition of capital controls.

Ideally, an index of speculative pressure would be obtained by employing a structural model of exchange rate determination, from which one would derive the excess demand for foreign exchange. In practice, however, empirical models linking macroeconomic variables to the exchange rate have little explanatory power at short and intermediate horizons.[11] In the absence of an empirically valid macro-model, we resort to an ad hoc approach, the underlying intuition for which is derived from the well-known model of exchange market pressure due to Girton and Roper (1977). The idea is that an excess demand for foreign exchange can be met through several (not mutually exclusive) channels. If the attack is successful, depreciation or devaluation occurs. But the monetary authorities may instead accommodate the pressure by running down their international reserves or deter the attack by raising interest rates. As a measure of speculative pressure, we therefore construct a weighted average of exchange rate changes, reserve changes, and interest rate changes. All of these variables are measured relative to those prevailing in Germany, the reference country. Germany is a logical choice for a center country, since it has had a strong currency throughout the post-war era, and has been a critical member of all important OECD fixed exchange rate systems (including the Bretton Woods system, the EMS, and the "snake" preceding the EMS).[12]

Our index of exchange market pressure is:

$$EMP_{i,t} \equiv [(\alpha\ \%\Delta e_{i,t}) + (\beta\Delta(i_{i,t} - i_{G,t})) - (\gamma(\%\Delta r_{i,t} - \%\Delta r_{G,t}))],$$

[11] Frankel and Rose (1995) provide a recent survey.

[12] Of course, idiosyncratic German shocks then acquire disproportionate importance. However, German Unification is typically considered to be the only important such shock; and our sensitivity analysis indicates that our results do not stem from this event.

where: $e_{i,t}$ denotes the price of a DM in i's currency at time t; i_G denotes the short German interest; r denotes the ratio of international reserves;[13] and α, β, and γ are weights.

We define crises as extreme values of this index:

$$Crisis_{i,t} = 1 \text{ if } EMP_{i,t} > 1.5\sigma_{EMP} + \mu_{EMP}$$
$$= 0 \text{ otherwise,}$$

where: μ_{EMP} and σ_{EMP} are the sample mean and standard deviation of EMP respectively.

A critical step is weighting the three components of the index. An obvious option is an unweighted average, which has the advantage of simplicity. But since the volatility of reserves, exchange rates and interest differential is very different, we instead weight the components so as to equalize the volatilities of the three components, thereby preventing any one of them from dominating the index. Below we then check the sensitivity of our results to this scheme.

We identify quarters in which our index of speculative pressure is at least one and a half standard deviations above the sample mean as instances of speculative attacks (although we again test for sensitivity with respect to this arbitrarily-chosen threshold). To avoid counting the same crisis more than once, we exclude the later observation(s) when two (or more) crises occur in successive quarters. Thus, our "exclusion window" is one quarter (though again we vary this parameter). We refer to our non-crisis observations as "tranquil" periods and use these as the

[13] Following Girton and Roper, r is actually the ratio of reserves to narrow money (M1).

control group.[14]

Our choice of a one quarter exclusion window (so that each country contributes no more than two observations annually) and a 1.5 standard deviation outlier threshold produce a sample of 77 crises and 1179 periods of tranquillity.[15]

The crisis observations are not randomly distributed. There are clusters of speculative attacks in 1973 (at the time of the breakup of the Bretton Woods system) and in 1992 (at the time of the European currency crises), separated by long periods of tranquillity. A time-series plot of the number of crises in each quarter is provided as Figure 1.

B. The Data

Most of the financial and macroeconomic variables are taken from the CD-ROM version of the International Monetary Fund's *International Financial Statistics* (IFS). The data set is quarterly, spanning 1959 through 1993 for twenty industrial countries.[16] It has been checked for transcription and other errors and corrected. Most of the variables are transformed into differential percentage changes by taking differences between domestic and German annualized fourth-differences of natural logarithms and multiplying by a hundred.

We employ the following variables: total non-gold international reserves (IFS line 1ld); period-average exchange rates (line rf); short-term interest rates (money market rates [line 60b] where possible, discount rates otherwise [line 60]); exports and imports (both measured in dollars,

[14] Just as we do not allow crises in successive quarters to count as independent observations by excluding the latter, we also do not allow two successive periods of tranquillity to count as independent observations. We do this by applying our exclusion window to periods of both crisis and tranquillity.

[15] However, missing data will preclude use of some of these observations; thus our panel is technically unbalanced.

[16] The countries in our sample include (in order of IMF country number): the USA, UK, Austria, Belgium, Denmark, France, Italy, Netherlands, Norway, Sweden, Switzerland, Canada, Japan, Finland, Greece, Ireland, Portugal, Spain and Australia, along with our center country, Germany.

lines 70d and 71d respectively); the current account (line 77a.d, converted to domestic currency) and the central government budget position (line 80), both measured as percentages of nominal GDP (frequently line 99a); long-term government bond yields (line 61); a nominal stock market index (line 62, which sets 1990=100); domestic credit (line 32); M1 (line 34); M2 (line 35+ M1); the CPI (line 64); and real GDP (usually line 99a.r). We also use the real effective exchange rate as a measure of competitiveness (line reu, which uses normalized relative unit labor costs), though this variable is only available from 1975.

We also utilize a number of labor market indicators not included in IFS. Data on total employment, the unemployment rate, and the business sector wage rate were drawn from the OECD's *Main Economic Indicators*. To capture political conditions we construct indicators of governmental electoral victories and defeats, using Keesing's *Record of World Events* and Banks' *Political Handbook of the World*.

Finally, we use a list of exchange market "events" (devaluations, flotations, changes in exchange rate band widths and so forth). These are gleaned from the IMF's annual report on *Exchange Arrangements and Exchange Restrictions*. These volumes also provide us the basis for constructing with dummy variables indicating the presence of capital controls.

The available data on international reserves are less than ideal for a number of well-known reasons. Off-balance sheet transactions, third-party intervention, stand-by credits, and foreign liabilities, all of which are relevant for foreign exchange intervention, tend to be omitted or incompletely reported. In addition, short-duration attacks (especially unsuccessful ones) may not be evident in quarterly data. Finally, subtle changes in actual or anticipated capital controls, while difficult to measure, may in fact be quite important, especially when countries are mounting defenses against speculative attacks.

C. Statistical Analysis

We can now test for the existence of contagion. We test the null hypothesis that the incidence of currency crises elsewhere in the world at the same point in time does not affect the probability of a speculative attack on the domestic currency. While our model attempts to control for the influence of a wide range of current and lagged macroeconomic variables, it is non-structural. This is one reason for viewing our evidence (which turns out to be inconsistent with the null at standard confidence levels) as consistent with, but not definitive proof of, contagion.

We estimate a binary probit model, linking our dependent variable (an indicator variable which takes on a value of unity for a speculative attack and zero otherwise) to our controls with maximum likelihood, including additional regressors to capture the effects of macroeconomic and political influences which affect crisis incidence. We cast our net as widely as possible, including: 1) the presence of capital controls; 2) electoral victory or defeat of the government; 3) the growth of domestic credit; 4) inflation; 5) output growth; 6) employment growth; 7) the unemployment rate; 8) the central government budget surplus (+) or deficit (-), expressed as a percentage of GDP; and 9) the current account surplus/deficit (again, a percentage of GDP). All these variables are included as deviations from German values.

Since the literature on currency crises does not provide much guidance about the time horizon for these influences, we consider a range of plausible alternatives. At the short end of the spectrum, we allow only contemporary influences to affect the probability of a crisis. We then allow for explanatory variables lagged up to two quarters, one year, and two years. We allow these lagged influences to operate jointly with the contemporaneous variables or by themselves (as would be appropriate if lags in data collection or processing preclude the consideration of contemporaneous developments). To conserve degrees of freedom, we model the lags using moving averages. Rather than including the first and second lags of inflation separately, for example, we include only a single term which is the average inflation differential in the two preceding quarters.

This leads us to estimate the following model:

$$Crisis_{i,t} = \omega D(Crisis_{j,t}) + \lambda I(L)_{i,t} + \varepsilon_{i,t} \quad \text{where}$$

$$D(Crisis_{j,t}) \quad = 1 \text{ if } Crisis_{j,t} = 1, \text{ for any } j \neq i$$

$$= 0 \text{ otherwise,}$$

where: $I(L)_{i,t}$ is an information set of ten contemporaneous and/or lagged control regressors; λ is the corresponding vector of nuisance coefficients; and ε is a normally distributed disturbance representing a host of omitted influences which affect the probability of a currency crisis.

The null of interest is Ho: ω=0. We interpret evidence of the null as being inconsistent with a contagion effect.

D. Results

Benchmark results are presented in Table I. Its five columns correspond to five assumptions about the appropriate time horizon for the regressors. Since probit coefficients are not easily interpretable, we report the effects of one-unit (percentage point) changes in the regressors on the probability of a crisis (also expressed in percentage points), evaluated at the mean of the data. We tabulate the associated z-statistics, which test the null of no effect. Statistics which are inconsistent with the null at the five per cent level are printed in bold. Diagnostics are reported at the foot of the table, including a test for the joint significance of all the coefficients.

The results are consistent with the existence of a contagion effect which is economically important and statistically significant. A speculative attack elsewhere in the world is associated with an increased probability of a domestic currency crisis by around eight percentage points.

The impact of the other regressors is not dramatic, though a few effects are worth noting. For example, higher inflation and unemployment are associated with increases in the odds of an attack. Generally speaking, however, the absence of robust partial correlations provides grounds for caution against over-interpreting the results.

Sensitivity analysis is reported in Table II. We consider six perturbations of our basic model. First, we change the definition of a speculative attack by raising the outlier threshold on our exchange market pressure index to two standard deviations (from one and a half) and by widening the exclusion band width to two quarters (from one). This marginally increases the magnitude of the contagion variable, although the change is not statistically significant. Second, we change the definition of a speculative attack by doubling the weight on actual exchange rate changes in our tripartite index. This has no discernible impact on the coefficient on the contagion variable. Third, we drop post-1978 data so as to focus on pre-EMS period. This increases the magnitude of the contagion coefficient further. Fourth, we limit the sample to EMS observations; here we get strikingly large contagion effects, with slope derivatives almost three times the size of the benchmark result in the first column of Table I. Fifth, we employ only observations where capital controls are present. Here, the coefficient on the contagion variable is indistinguishable from the benchmark result. Finally, we substitute for crises elsewhere in the world exchange market , actual "events" elsewhere in the world (e.g., actual devaluations or transitions to floating rates), a perturbation which leaves the baseline results relatively unaffected.

Our sensitivity tests confirm a key finding of this paper. Namely, a speculative attack elsewhere in the world seems to be significantly increase the odds of an attack on the domestic currency. But they do not allow us to distinguish among the various theories of contagion. For example, the relatively large contagion coefficient for the EMS sub-sample and the fact that "events" matter as much as crises point to the operation of the competitiveness channel modeled by Gerlach and Smets (1995) and Andersen (1994). But these results are also compatible with theories that emphasize the information-coordination effect of exchange market events.

We have also performed a number of further robustness checks that are not reported here. These include adding a lagged contagion term, which represents the incidence of a currency crisis (in a different country) in the preceding quarter (as opposed to contemporaneously); adding cross products of the contagion term and the remaining regressors; adding money growth, long interest rates, wages, exports and imports to the standard set of explanatory variables; using Huber-White covariance estimators instead of standard ones; and separating out the effects of contemporaneous and lagged regressors. Again, none of these tests disturbs our central finding that speculative attacks in other countries significantly increase the odds of a currency crisis.[17]

A limitation of this approach is that it does not allow us to distinguish the effects of crises in neighboring countries (contagion per se) and from the effects of global shocks (unobserved environmental factors). This situation is familiar to epidemiologists, for whom the problem is one of determining whether the spread of a virus reflects the contagious nature of the germ or the disease-conducive nature of the environment. Thus, our results could be the result of shocks to an unmeasured common (German?) fundamental and are therefore not definitive. We need therefore to place additional structure on the problem, and proceed to do so in the next section.

V. Channels of Transmission for Contagion

Having established *prima facie* evidence of contagion, we now explore two alternative channels of transmission for this effect.

A. Methodology

We begin by extending our estimation model slightly to:

$$Crisis_{i,t} = \omega W_{ij,t}(Crisis_{j,t}) + \lambda I(L)_{i,t} + \varepsilon_{i,t}$$

$$W_{ij,t}(Crisis_{j,t}) \quad = w_{ij,t} \text{ if } Crisis_{j,t} = 1, \text{ for any } j \neq i$$

$$= 0 \text{ otherwise,}$$

[17] One of the few indications of sensitivity stems from the inclusion of year-specific controls; this results in point-estimates of ω of around 4%, and correspondingly marginally statistical evidence against the hypothesis Ho: ω=0. Since contagion would result in the clustering of speculative attacks over time which could be well picked up by time-specific fixed effects, it is hard to interpret this result. Also, controlling for the IMF's real effective exchange rate (computed using relative normalized unit-value costs) reduces both the sample size since the series is only available from 1975 and the magnitude of ω by around a half. The estimate of ω falls to around four per cent and is of more marginal statistical significance.

where: $w_{ij,t}$ is a weight which corresponds to the "relevance" at time t of country j for country i. The null hypothesis of interest to us is Ho: $\omega=0$. We interpret evidence against the null as being consistent with the existence of a contagion effect. [18]

Our first weighting scheme quantifies the ties between countries i and j using trade data. We use the (MERM) weights that the International Monetary Fund has computed in the course of constructing its real multilateral effective exchange rates.[19] The IMF's methodology derives the weight for j in country i's effective exchange rate as a convex combination of bilateral import weights and double export weights, using trade in manufacturing. The weights use unit labor costs, which are widely considered to be reliable indicators of international competitiveness. They weights are time-invariant. They have been computed for our twenty-one industrial countries by the IMF, and were created in October 1994.

Thus, our trade-weighting scheme is:

$w_{ij,t} = EER_{ij}$ for any $j \neq i$, where

EER_{ij} is the weight for country j in country i's IMF effective exchange rate index.

Our second weighting scheme is intended to capture macroeconomic similarities whose existence is a potential channel for contagion. We think of two countries as being "similar" if they display similar macroeconomic conditions -- for example, if they have similar rates of growth of

[18] By way of contrast, Sachs, Tornell, and Velasco (1996) do not control for fundamentals when testing for contagion.

[19] Documentation and references regarding these weights are to be found in *International Financial Statistics*.

domestic credit. We then test the hypothesis that an attack on the currency of country j affects the probability of an attack on the currency of country i.

In practice, implementing this notion depends on being able to measure "similarity." We concentrate on seven "focus variables" that appear to be the subject of considerable attention among participants in foreign exchange markets: 1) domestic credit growth (as always, relative to Germany); 2) money growth; 3) CPI inflation; 4) output growth; 5) the unemployment rate; 6) the current account (as always, in nominal GDP percentage points); and 7) the government budget deficit.[20] We multiply the rate of GDP growth, the current account and the government budget by minus one in order to allow for easier comparison with the other four variables; this means that higher values are associated with greater risk. We standardize the variables by subtracting sample means and dividing the result by the sample standard deviation. In practice, we standardize in two ways: we take a country-specific approach in which a country is compared only with itself (so that, e.g., the average rate of growth of French domestic credit is subtracted from the raw series and then divided by the sample French credit growth standard deviation; alternatively, we take a time-specific approach in which the observations at one point in time are compared with observations for all 20 countries at that same point in time. The first approach is appropriate if currency speculators compare credit growth in a country in a quarter to that country's own past credit growth; the second is relevant if speculators compare the country's credit growth to that typical of other countries in the same quarter.

Having standardized the variables, we compute the macro weights as follows for the

[20] One could imagine adding focus variables. The presence of capital controls and the total stock of external debt would be interesting, especially in the case of developing countries. However, such variables tend to move slowly. In addition, our seven focus variables turn out to be extremely collinear in any case.

"country-specific" and "time-specific" standardizations respectively:

$$w_{ij,t} = \Sigma_j (1 - \{\Phi[(x_{jt} - \mu_i)/\sigma_i] - \Phi[(x_{it} - \mu_i)/\sigma_i]\}) \text{ for any } j \neq i, \text{ and}$$

$$w_{ij,t} = \Sigma_j (1 - \{\Phi[(x_{jt} - \mu_t)/\sigma_t] - \Phi[(x_{it} - \mu_t)/\sigma_t]\}) \text{ for any } j \neq i, \text{ where}$$

$\Phi(.)$ is the cumulative distribution function of the standardized normal function, μ_i (μ_t) is the country-specific (time-specific) sample average of variable x, σ_i (σ_t) is the country-specific (time-specific) standard deviation of variable x, and the x's are the seven macroeconomic "focus" variables.

This specification implies that if country j is attacked at time t and it is similar to country i, in the sense of having similar standardized growth rates of relevant macroeconomic variables, then it receives a high weight on the contagion variable. If j and i have identical (standardized) domestic credit growth rates, the weight is unity; the more dissimilar are the growth rates (in the sense of being distant in terms of the cumulative distribution), the lower is the weight. If i's credit growth is at the extreme lower-end of i's cumulative distribution while j's is at its upper end, then the weight is zero.

Since we have two standardizing techniques (country- and time-specific) and seven focus variables, we obtain fourteen sets of macroeconomic contagion weights.

B. Trade Weights

Table III substitutes our first set of weights – those based on the IMF's MERM weights and intended to capture bilateral trade linkages -- for the unweighted contagion variable.

Trade weighting the contagion variable improves the fit of the equation. In contrast to the unweighted results in Table I, however, it is not easy to interpret the size of the contagion variable, since this is no longer an indicator variable but is instead the product of a dummy and a trade weight. Nevertheless, the positive sign of the coefficient on the contagion variable indicates that an attack elsewhere in the world still increases the probability of a attack by a statistically significantly amount. The level of statistical significance for the contagion effect is higher than in Table I.

We interpret this evidence as supporting the hypothesis that currency crises are transmitted, at least in part, via bilateral trade ties. It leads us to the belief that there is contagion, rather than simply a shock to an unmeasured fundamental common to a number of countries.

C. Macro Weights

In Table IV we present results using the macro weights. We substitute all seven macro-weighted contagion variables for the trade-weighted measure.

The macro-weighted contagion proxies are generally insignificant at conventional statistical levels when considered individually.[21] However, the seven variables are jointly significant at high confidence levels (the relevant chi-square test statistic, labeled "Contagion Test," is at the foot of the table). This suggests collinearity among the seven contagion variables, as one would expect.

Table V provides direct evidence on the extent of this collinearity. It reports coefficients on the macro-contagion variables when the latter are included in the equation one by one. (The

[21] This result does not depend on the conditioning set -- specifically, on whether the traditional political and macroeconomic fundamentals are entered only contemporaneously or with moving-average lags as well. It is also insensitive to whether the macro weights are computed with variables standardized by country or time period.

coefficient estimates for the political and macroeconomic fundamentals are not reported for ease of presentation.) As expected, the estimated coefficients are positive, indicating that a currency crisis in a country which is similar, in the relevant macroeconomic sense, raises the probability of an attack on the domestic currency. The coefficients are statistically significant at standard confidence levels and do not vary much across macroeconomic focus variables, conditioning set, or standardization technique.

We interpret this evidence as consistent with the existence of macroeconomic contagion. But it answers only a subset of the relevant economic questions. For example, is contagion spread through both trade and macroeconomic links? Or does one channel dominate the other? We now proceed to these issues.

D. Comparing the Trade and Macro Channels

We are interested in testing the explanatory power of the different measures of contagion against each other. This requires dealing with the collinearity among our seven macro-contagion variables, for which purpose we employ factor analysis.

Factor analysis both verifies the existence of multicollinearity and provides a convenient method of rank reduction. We estimated a single-factor model for the seven macro contagion variables using the method of principal factors. The single-factor model works well for both the country-specific and time-specific standardizations.[22] We use the resulting factor -- a linear combination of the seven macroeconomic variables -- in place of the vector of standardized

[22] For instance, the first eigen-value is substantially higher than the second (for both the country-specific and time-specific factors, the first eigen-value is almost 6 while the second less than 0.2). In addition, the first factor explains a high proportion of the data variance (close to 100%); the individual factor uniquenesses are low (never more than 30%). Finally, all the scoring coefficients are all positive, as expected.

variables.[23]

Table VI reports estimates of the probit model when the effects of the different classes of contagion variables are estimated simultaneously. The three variables correspond to those used in Tables I, III and IV, they are unweighted, trade-weighted, and weighted by the macro factor, respectively. As always, the full set of political and macroeconomic controls is included.

Again there is overwhelming evidence consistent with contagion; a joint test of the hypothesis that all three contagion variables are significant, which appears at the foot of the table, is wildly inconsistent with the null of no contagion. The weighted measured designed to capture trade linkages remains positive and highly significant, consistent with contagion via the trade channel. The unweighted measure is also positive and moderately significant at standard confidence levels, perhaps indicating that there is still evidence of a shock to unmeasured common fundamentals. But now the macro factor is negative and insignificant for all three conditioning sets and both standardization techniques.

Thus, our results suggest that contagious currency crises tend to spread across countries mainly as a function of international trade links. In contrast, the influence of macroeconomic similarities disappears when the various classes of contagion measures are included simultaneously. The continuing significance of the unweighted measure of contagion, even when the trade- and macro-weighted measures are included simultaneously, suggests that contagion may also spread through other channels than those which we have emphasized.

E. Sensitivity Analysis

We have performed a number of robustness checks to investigate the sensitivity of our

[23] Of course, there are two factors, one for each of the two standardizations (country- and time-specific).

finding that trade linkages are more important than macroeconomic similarities. For instance, we split our sample into two parts (at e.g., 1974 and 1979) to check whether different models of contagion dominate different parts of the sample. We have split our sample into observations in which capital controls are present and absent. We have added additional macroeconomic fundamentals, and compared macroeconomic and trade contagion channels without our unweighted variable. None of these checks disturbs our basic finding that trade links are the more important conduit for the infectious spread of currency crises.

VI. Conclusion

We have reviewed the theoretical and empirical literatures on crises in foreign exchange markets with an eye toward the prevalence of contagion. While the possibility of contagious currency crises is a pressing policy issue, the debate surrounding it points up the limitations of existing research. The literature is replete with theoretical models highlighting the motives for and dynamics of speculative attacks on pegged currencies and potential channels of contagion, but empirical work has lagged behind. Stories of contagion abound, but systematic empirical analysis is lacking.

Here we have taken a first step toward such an analysis. Using data for 20 industrial countries spanning more than three decades, a battery of empirical specifications fails to reject, at high levels of significance, the hypothesis of contagion. We find that a speculative attack elsewhere in the world increases the odds of an attack on the domestic currency. Without conditioning on the size or relevance of these other attacks, our best estimate is that attacks on foreign currencies raise the probability of a domestic attack by eight per cent. But this does not disprove the hypothesis of common unobservable shocks, nor does it narrow down the channel by which contagion is transmitted. Accordingly, we have also sought to test for contagion in foreign exchange markets using a framework that distinguishes two channels of international transmission of speculative attacks.

The first channel is trade links, and the hypothesis is that attacks spill over contagiously to other countries with which the subject country trades. The second channel is macroeconomic similarities, where the hypothesis is that attacks spread to other countries where economic policies and conditions are broadly similar. The first approach emphasizes the implications for competitiveness of an attack elsewhere in the world. The second focuses on the information content of an attack (where the assumption is that an attack on one country reveals information about market sentiment regarding the viability of a particular economic strategy).

Using data for 20 industrial countries spanning more than three decades, we have compared these alternatives. Both the trade-weighted contagion proxy and the macro-weighted proxy outperform the naive unweighted contagion measure when they are included one at a time. We take this as confirmation that what our tests are picking up is contagion *per se*, and not only the effects of omitted environmental factors common to the countries in question (although the latter are still present).

The effect of contagion operating through trade is stronger than that of contagion spreading as a result of macroeconomic similarities. When measures of both mechanisms are included in the specification, trade-related contagion dominate macro effect. Admittedly, similarities in macroeconomic policies and performance across countries are more difficult to capture in a weighting scheme than is the intensity of bilateral trade; the stronger showing of trade-related contagion may simply reflect our greater success in proxying this effect. At the same time, considerable experimentation with alternative measures of macro-related contagion, all of which points to the same conclusion, lends some support to our favored interpretation that it is trade links rather than macroeconomic similarities that have been the dominant channel for the contagious transmission in the sample period.

In the 1960s, toward the beginning of our sample, the debate over contagion centered on the industrial countries. The fear was that a currency crisis in one industrial country might destabilize the exchange rate pegs of the other advanced industrial nations. The fallout from the 1967 devaluation of sterling provides some retrospective justification for these fears (see Eichengreen, 1996). Today the debate over contagion increasingly focuses on emerging markets, in Latin America, Asia and elsewhere (e.g., Sachs, Tornell and Velasco (1996)). The nature of the data makes systematic cross-country analyses of the sort we undertake here more difficult for emerging markets. But it is clear that this should be a high priority for future research.

Table I: Probit Results

	Contem-poraneous	MA of Contem-poraneous + 2 Lags	MA of 2 Lags	MA of Contem-poraneous + 4 Lags	MA of Contem-poraneous + 8 Lags
Crisis Elsewhere	**7.45 (3.8)**	**8.33 (4.0)**	**8.14 (4.3)**	**8.72 (4.0)**	**8.83 (3.8)**
Capital Controls	-1.66 (.7)	.22 (.1)	.66 (.3)	.48 (.2)	1.24 (.4)
Government Victory	-4.24 (1.0)	-1.71 (.3)	-.60 (.2)	5.30 (1.6)	-.45 (.2)
Government Loss	-3.45 (.9)	-7.44 (1.3)	-3.34 (1.2)	2.49 (.8)	-.63 (.2)
Credit Growth	.19 (1.8)	.11 (.8)	.10 (1.2)	-.00 (.0)	-.09 (.4)
Inflation Rate	**.75 (3.5)**	**.57 (2.4)**	.40 (1.9)	**.59 (2.1)**	.64 (1.8)
Output Growth	.21 (.6)	-.39 (.9)	-.50 (1.4)	-.74 (1.3)	-.36 (.4)
Employment Growth	.37 (.7)	.86 (1.5)	.78 (1.5)	1.08 (1.6)	1.30 (1.6)
Unemploy-ment Rate	**.86 (3.0)**	**.96 (3.2)**	**.92 (3.5)**	**1.04 (3.3)**	**1.19 (3.4)**
Budget Position/GDP	.47 (1.9)	.41 (1.6)	.35 (1.5)	.46 (1.6)	.57 (1.8)
Current Account/GDP	-.23 (.8)	-.36 (1.1)	-.51 (1.9)	-.42 (1.2)	-.34 (.8)
Number of Observations	645	626	703	608	572
McFadden's R^2	.15	.12	.13	.12	.10
Joint Test for Slopes $\chi^2(11)$	**55**	**46**	**53**	**43**	**36**

Probit slope derivatives (x100, to convert into percentages) and associated z-statistics (for hypothesis of no effect).
Model estimated with a constant, by maximum likelihood.
Slopes significantly different from zero at the .05 value are in bold.

Table II: Sensitivity Analysis

	2 quarter window, 2 threshold	Increased Weight on Exchange Rates	Pre 1979	EMS	Only Immobile Capital	With Contemporaneous Events
Crisis Elsewhere	**9.38 (3.5)**	**7.42 (3.3)**	**12.31 (2.8)**	**19.90 (3.4)**	**7.88 (2.9)**	**6.99 (3.4)**
Capital Controls	2.43 (1.1)	-.50 (.2)	5.41 (.8)	**10.05 (2.0)**	N/A	.18 (.1)
Government Victory	**5.67 (2.0)**	4.48 (.9)	-9.52 (.8)	2.22 (.3)	-1.64 (.2)	-1.13 (.2)
Government Loss	-1.74 (.4)	-1.90 (.3)	-14.57 (1.2)	-1.57 (.3)	-4.71 (.7)	-6.60 (1.2)
Credit Growth	.09 (.8)	.09 (.6)	.34 (1.3)	.13 (.7)	.22 (1.2)	.14 (1.0)
Inflation Rate	.26 (1.4)	.47 (1.7)	.17 (.4)	.01 (.0)	**.59 (2.0)**	**.58 (2.4)**
Output Growth	.19 (.8)	-.07 (.1)	-.97 (1.1)	-.70 (.9)	-.68 (1.2)	-.40 (.9)
Employment Growth	**1.27 (2.6)**	.52 (.8)	-.12 (.1)	1.51 (1.1)	.37 (.5)	.87 (1.5)
Unemployment Rate	.19 (.8)	.45 (1.4)	**4.06 (3.0)**	1.44 (1.7)	**.91 (2.4)**	**.99 (3.2)**
Budget Position/GDP	.05 (.3)	.47 (1.7)	1.16 (1.6)	-.10 (.3)	.38 (1.1)	.40 (1.5)
Current Account/GDP	-.47 (1.9)	**-.89 (2.6)**	-1.48 (1.7)	.08 (.2)	-.23 (.5)	-.36 (1.1)
Number of Observations	**326**	623	233	224	425	626
McFadden's R^2	**.32**	.09	.17	.21	.11	.12
Joint Test for Slopes $\chi^2(11)$	**55**	**36**	**31**	**28**	**28**	**45**

Probit slope derivatives (x100, to convert into percentages) and associated z-statistics (for hypothesis of no effect).
Model estimated with a constant, by maximum likelihood.
Slopes significantly different from zero at the .05 value are in bold.
All regressors are expressed as equally weighted moving averages of contemporaneous and two quarterly lags.

Table III: Probit Results with Contagion Variable Weighted by International Trade

	Contem-poraneous	MA of Contem + 2 Lags	MA of 2 Lags	MA of Contem + 4 Lags	MA of Contem + 8 Lags
Crisis Elsewhere	**.44 (5.0)**	**.66 (5.1)**	**.61 (5.3)**	**.72 (5.2)**	**.74 (5.2)**
Capital Controls	-1.8 (.8)	-.77 (.3)	-.06 (.0)	-.76 (.3)	.16 (.1)
Government Victory	-3.9 (.9)	.59 (.1)	.39 (.1)	3.7 (1.1)	-2.0 (.7)
Government Loss	-2.0 (.5)	-6.9 (1.1)	-3.5 (1.2)	3.0 (.9)	.43 (.2)
Credit Growth	.17 (1.6)	.05 (.3)	.09 (1.1)	-.09 (.5)	-.10 (.5)
Inflation Rate	**.82 (3.8)**	**.73 (3.0)**	**.53 (2.6)**	**.81 (2.8)**	**.79 (2.3)**
Output Growth	.10 (.3)	-.39 (.8)	-.48 (1.3)	-.49 (.8)	-.21 (.3)
Employment Growth	.44 (.8)	.99 (1.6)	.95 (1.8)	1.12 (1.7)	1.4 (1.6)
Unemploy Rate	**.71 (2.3)**	**.78 (2.5)**	**.76 (2.8)**	**.85 (2.5)**	**.97 (2.7)**
Budget Position/GDP	**.52 (2.1)**	.49 (1.8)	.40 (1.6)	**.58 (2.0)**	**.71 (2.2)**
Current Account/GDP	-.28 (1.0)	-.24 (.8)	-.31 (1.1)	-.33 (.9)	-.21 (.5)
Number of Observations	645	626	703	608	572
McFadden's R^2	.18	.19	.19	.19	.18
Joint Test for Slopes $\chi^2(11)$	**70**	**70**	**76**	**67**	**63**

Probit slope derivatives (x100, to convert into percentages) and associated z-statistics (for hypothesis of no effect).
Model estimated with a constant, by maximum likelihood.
Slopes significantly different from zero at the .05 value are in bold.

Table IV: Probit Results with Contagion Variable Weighted by Macro-Similarity

(All Seven Contagion Variables Included Simultaneously)

	---- Country-Specific Averages ----			---- Time-Specific Averages ----		
	Contem-poraneous	**MA of 2 Lags**	**MA of Contem + 8 Lags**	**Contem-poraneous**	**MA of 2 Lags**	**MA of Contem + 8 Lags**
Crisis*Credit Similarity	-.10 (.0)	1.68 (.7)	2.72 (.9)	-2.44 (.9)	-.10 (.0)	.01 (.0)
Crisis*Money Similarity	-.32 (.1)	1.06 (.4)	-.38 (.1)	.41 (.2)	.61 (.3)	.12 (.0)
Crisis*Inflat Similarity	2.54 (.8)	4.12 (1.4)	5.24 (1.5)	3.06 (1.1)	4.02 (1.5)	5.93 (1.9)
Crisis*GDP Similarity	-1.97 (.8)	-3.48 (1.5)	-3.42 (1.3)	-1.06 (.6)	-2.57 (1.6)	-2.77 (1.4)
Crisis*Unemp Similarity	-.60 (.3)	-.93 (.6)	-1.08 (.5)	3.35 (1.5)	3.66 (1.8)	3.55 (1.4)
Crisis *C/Acc Similarity	2.10 (.7)	1.19 (.4)	1.72 (.5)	4.25 (1.7)	3.07 (1.4)	3.59 (1.3)
Crisis*Budget Similarity	1.80 (.8)	.16 (.1)	-.39 (.2)	-4.19 (1.5)	-4.86 (1.9)	-5.99 (2.0)
Cap Controls	-2.56 (1.1)	-.43 (.2)	-.49 (.2)	-2.68 (1.1)	-.64 (.3)	-.84 (.3)
Gov't Victory	-3.81 (.9)	-.05 (.0)	-1.87 (.7)	-3.52 (.8)	-.36 (.1)	-2.02 (.7)
Gov't Loss	-2.62 (.6)	-3.74 (1.4)	-1.03 (.4)	-2.88 (.7)	-3.99 (1.4)	-.99 (.4)
Credit	..20 (1.7)	.09 (1.1)	-.16 (.7)	.22 (1.9)	.10 (1.2)	-.18 (.7)
Inflation	**.80 (3.6)**	**.48 (2.3)**	**.81 (2.3)**	**.71 (3.1)**	**.42 (2.0)**	**.75 (2.1)**
Growth	.10 (.3)	-.58 (1.6)	-.46 (.6)	.15 (.4)	-.58 (1.6)	-.38 (.5)
Employment	.24 (.5)	.57 (1.1)	1.08 (1.3)	.20 (.4)	.67 (1.3)	1.24 (1.5)
Unemploy't	**.86 (2.9)**	**.92 (2.4)**	**1.16 (3.2)**	**.65 (2.0)**	**.69 (2.4)**	**.91 (2.4)**
Budget/GDP	**.57 (2.2)**	.37 (1.5)	.62 (1.9)	.33 (1.1)	.20 (.8)	.40 (1.1)
C/Acc/GDP	-.23 (.8)	-.46 (1.7)	-.37 (.9)	-.08 (.3)	-.29 (1.1)	-.13 (.3)
NOBS	645	703	572	645	703	572
McFadden's R^2	.16	.16	.14	.17	.17	.15
Slopes $\chi^2(17)$	**63**	**64**	**49**	**65**	**67**	**53**
Contagion Test $\chi^2(7)$	**20**	**27**	**25**	**21**	**28**	**27**

Probit slope derivatives (x100, to convert into percentages) and associated z-statistics (for hypothesis of no effect).
Model estimated with a constant, by maximum likelihood.
Slopes significantly different from zero at the .05 value are in bold.

Table V: Probit Results with Contagion Variable Weighted by Macro-Similarity

(Contagion Variables Included One by One)

	--- Country-Specific Averages -----			---- Time-Specific Averages ----		
	Contem-poraneous	**MA of 2 Lags**	**MA of Contem + 8 Lags**	**Contem-poraneous**	**MA of 2 Lags**	**MA of Contem + 8 Lags**
Crisis*Credit Similarity	6.67 (3.7)	7.46 (4.4)	8.82 (4.1)	4.73 (2.7)	5.68 (3.4)	6.60 (3.2)
Crisis*Money Similarity	6.23 (3.8)	7.05 (4.4)	7.81 (3.8)	5.41 (3.3)	6.44 (4.0)	7.33 (3.7)
Crisis*Inflat Similarity	7.17 (4.1)	7.79 (4.7)	9.21 (4.4)	7.23 (4.2)	8.12 (4.9)	9.81 (4.8)
Crisis*GDP Similarity	6.03 (3.7)	5.74 (3.8)	6.84 (3.6)	5.41 (3.5)	4.81 (3.4)	5.90 (3.3)
Crisis*Unemp Similarity	5.10 (3.4)	5.25 (3.6)	5.82 (3.2)	6.66 (4.3)	7.00 (4.8)	8.02 (4.5)
Crisis *C/Acc Similarity	7.35 (4.3)	7.53 (4.7)	8.91 (4.4)	7.40 (4.1)	7.26 (4.5)	9.05 (4.3)
Crisis*Budget Similarity	6.15 (3.7)	5.78 (3.8)	6.13 (3.1)	5.13 (3.2)	5.40 (3.6)	5.87 (3.1)

Probit slope derivatives (x100, to convert into percentages) and associated z-statistics (for hypothesis of no effect). Each model is estimated by maximum likelihood with a constant and seven political and macroeconomic controls. All reported slopes differ significantly from zero at the .01 value.

Table VI: Probit Results with Three Different Measures of Contagion

----- Country-Specific Averages ---- ----- Time-Specific Averages ----

	Contem-poraneous	MA of 2 Lags	MA of Contem + 8 Lags	Contem-poraneous	MA of 2 Lags	MA of Contem + 8 Lags
Crises Elsewhere: Unweighted	**4.66 (2.0)**	**5.18 (2.3)**	4.80 (1.7)	**4.74 (2.0)**	**4.97 (2.2)**	4.44 (1.6)
Crises Elsewhere: Int'l Trade Weights	**.39 (3.6)**	**.58 (4.3)**	**.75 (4.3)**	**.40 (3.7)**	**.58 (4.2)**	**.73 (4.1)**
Crises Elsewhere: Macro Factor Weights	-.85 (.6)	-1.87 (1.3)	-2.18 (1.2)	-.94 (.7)	-1.64 (1.2)	-1.68 (1.0)
Capital Controls	-1.62 (.7)	.25 (.1)	.32 (.1)	-1.55 (.7)	.27 (.1)	.29 (.1)
Government Victory	-3.70 (.9)	.29 (.1)	-1.60 (.6)	-3.70 (.9)	.32 (.1)	-1.57 (.6)
Government Loss	-2.24 (.6)	-3.32 (1.1)	.44 (.2)	-2.23 (.5)	-3.31 (1.2)	.43 (.2)
Credit	.17 (1.6)	.08 (1.0)	-.09 (.4)	.17 (1.7)	.09 (1.0)	-.09 (.4)
Inflation	**.77 (3.7)**	**.47 (2.3)**	**.72 (2.1)**	**.77 (3.7)**	**.48 (2.4)**	**.74 (2.1)**
Growth	.09 (.3)	-.53 (1.5)	-.35 (.4)	.09 (.3)	-.52 (1.5)	-.34 (.4)
Employment	.39 (.8)	.93 (1.8)	1.29 (1.6)	.40 (.8)	.89 (1.8)	1.25 (1.5)
Unemploy't	**.69 (2.4)**	**.76 (2.9)**	**.96 (2.7)**	**.70 (2.4)**	**.78 (2.9)**	**.98 (2.7)**
Budget /GDP	**.48 (2.0)**	.37 (1.6)	**.68 (2.1)**	.47 (2.0)	.37 (1.6)	**.67 (2.1)**
Current Account/GDP	-.23 (.9)	-.33 (1.3)	-.26 (.6)	-.24 (.9)	-.36 (1.4)	-.29 (.7)
NOBS	645	703	572	645	703	572
McFadden's R^2	.20	.20	.19	.20	.20	.19
Slopes $\chi^2(13)$	**75**	**81**	**66**	**74**	**81**	**66**
Contagion Test $\chi^2(3)$	**31**	**38**	**34**	**31**	**37**	**33**

Probit slope derivatives (x100, to convert into percentages) and associated z-statistics (for hypothesis of no effect). Model estimated with a constant, by maximum likelihood.
Slopes significantly different from zero at the .05 value are in bold.

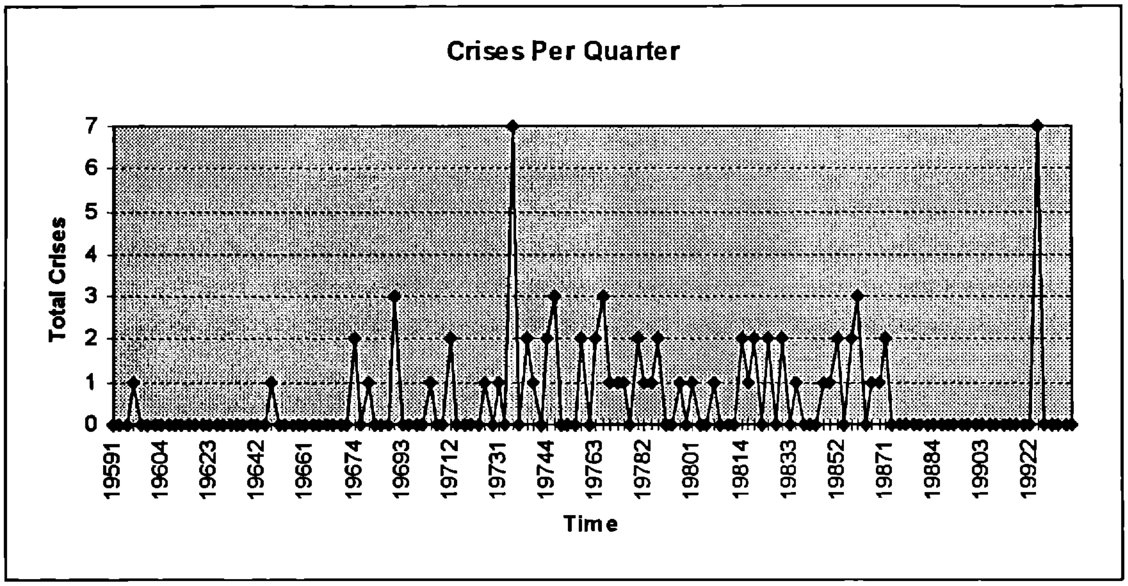
Crises Per Quarter
Total Crises
7
6
5
4
3
2
1
0
19591
19604
19623
19642
19661
19674
19693
19712
19731
19744
19763
19782
19801
19814
19833
19852
19871
19884
19903
19922
Time

Figure 1

References

Andersen, Torben (1994), "Shocks and the Viability of a Fixed Exchange Rate Commitment," CEPR Discussion Paper No. 969.

Bensaid, Bernard, and Olivier Jeanne (1993), "The Instability of Fixed Exchange Rate Systems When Raising the Nominal Interest Rate is Costly," unpublished manuscript, ENPC-CERAS, Paris.

Blackburn, Keith and Mario Sola (1993), "Speculative Currency Attacks and Balance of Payments Crises," *Journal of Economic Surveys* 7, pp.119-144.

Buiter, Willem, Giancarlo Corsetti and Paolo Pesenti (1996), *Financial Markets and International Monetary Cooperation*, Cambridge: Cambridge University Press.

Burki, Shahid and Sebastian Edwards (1995), "Latin America After Mexico: Quickening the Pace," unpublished manuscript, World Bank.

Calvo, Guillermo A. (1996), "Capital Flows and Macroeconomic Management: Tequila Lessons," unpublished manuscript, University of Maryland.

Calvo, Sara and Carmen Reinhart (1995), "Capital Inflows to Latin America: Is There Evidence of Contagion Effects," unpublished manuscript, World Bank and International Monetary Fund.

Caplin, Andrew and John Leahy (1994) "Business as Usual, Market Crashes, and Wisdom after the Fact," *American Economic Review* 84, pp.548-565.

Claessens, Stijn (1991), "Balance of Payments Crises in an Optimal Portfolio Model," *European Economic Review* 35, pp.81-101.

De Kock, Gabriel and Vittorio Grilli (1993), "Fiscal Policies and the Choice of Exchange Rate Regime," *Economic Journal* 103, pp.347-356.

Diamond, Douglas and Phillip Dibvig (1983), "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy* 91, pp.401-419.

Dornbusch, Rudiger, Ilan Goldfajn and Rodrigo Valdés (1995), "Currency Crises and Collapses," *Brookings Papers on Economic Activity* 2, pp.219-295.

Drazen, Allan and Paul R. Masson (1994), "Credibility of Policies versus Credibility of Policymakers," *Quarterly Journal of Economics* CIX, pp. 735-754.

Edwards, Sebastian (1989), *Real Exchange Rates, Devaluation, and Adjustment: Exchange Rate Policies in Developing Countries*, Cambridge, Mass: MIT Press.

Eichengreen, Barry, Andrew K. Rose and Charles Wyplosz (1994), "Speculative Attacks on Pegged Exchange Rates: An Empirical Exploration with Special Reference to the European Monetary System," in Matthew Canzoneri, Paul Masson and Vittorio Grilli (eds), *The New Transatlantic Economy,* Cambridge: Cambridge University Press.

Eichengreen, Barry, Andrew K. Rose, and Charles Wyplosz (1995) "Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks," *Economic Policy* 21, pp.249-312.

Flood, Robert and Peter Garber (1984a), "Collapsing Exchange Rate Regimes: Some Linear Examples," *Journal of International Economics* 17, pp.1-13.

Flood, Robert and Peter Garber (1984b), "Gold Monetization and Gold Discipline," *Journal of Political Economy* 92, pp.90-107.

Frankel, Jeffrey A. and Andrew K. Rose (1995) "An Empirical Characterization of Nominal Exchange Rates," in Gene Grossman and Kenneth Rogoff (eds), *Handbook of International Economics* 3, Amsterdam: North Holland, pp. 1689-1729.

Gerlach, Stefan and Frank Smets (1995) "Contagious Speculative Attacks," *European Journal of Political Economy* 11, pp.5-63.

Girton, Lance and Don Roper (1977) "A Monetary Model of Exchange Market Pressure Applied to Postwar Canadian Experience," *American Economic Review* 67, pp. 537-548.

Goldberg, Linda (1993), "Predicting Exchange Rate Crises: Mexico Revisited," *Journal of International Economics* (forthcoming).

Goldfajn, Ilan and Rodrigo Valdés (1995), "Balance of Payments Crises and Capital Flows: The Role of Liquidity," unpublished manuscript, MIT.

Grilli, Vittorio (1986) "Buying and Selling Attacks on Fixed Exchange Rate Systems," *Journal of International Economics* 20, pp.143-156.

Kaminsky, Graciela and Carmen Reinhart (1996), "The Twin crises: The Causes of Banking and Balance-of-Payments Problems," unpublished manuscript, Federal Reserve Board and International Monetary Fund.

Krugman, Paul (1979), "A Model of Balance of Payments Crises," Journal of Money, Credit and Banking 11, pp.311-325.

Krugman, Paul (1996), "Are Currency Crises Self-Fulfilling?" *NBER Macroeconomics Annual* (forthcoming).

Moreno, Ramon (1995), "Macroeconomic Behavior During Periods of Speculative Pressure or Realignment: Evidence from Pacific Basin Economies," *Economic Review* 3, Federal Reserve Bank of San Francisco, pp.3-16.

Obstfeld, Maurice (1986) "Rational and Self-Fulfilling Balance of Payments Crises," *American Economic Review* 76, pp. 72-81.

Obstfeld, Maurice (1991), "Destabilizing Effects of Exchange Rate Escape Clauses," NBER Working Paper No. 2603.

Obstfeld, Maurice (1995), "International Currency Experience: New Lessons and Lessons Relearned," *Brookings Papers on Economic Activity* 2, pp.119-220.

Ozkan, Gulcin and Alan Sutherland, "Policy Measures to Avoid a Currency Crisis," *Economic Journal* 105, pp.510-19.

Sachs, Jeffrey, Aaron Tornell, and Andrés Velasco (1996), "Financial Crises in Emerging Markets: The Lessons from 1995," NBER Discussion Paper 5576.

Schmukler, Sergio and Jeffrey Frankel (1996), "Crisis, Contagion and Country Funds," unpublished manuscript, University of California, Berkeley.

Shiller, Robert (1995) "Conversation, Information, and Herd Behavior," *American Economic Review Papers and Proceedings* 85, pp.181-85.

Valdés, Rodrigo O. (1996) "Emerging Market Contagion: Evidence and Theory" unpublished manuscript, MIT.

Willman, Alpo (1988), "The Collapse of the Fixed Exchange Rate Regime with Sticky Wages and Imperfect Substitutability Between Domestic and Foreign Bonds," *European Economic Review* 32, pp.1817-1838.