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Contagion and Trade: Why Are Currency Crises Regional?

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Comments Welcome

Abstract

Currency crises tend to be regional; they affect countries in geographic proximity. This suggests that patterns of international trade are important in understanding how currency crises spread, above and beyond any macroeconomic phenomena. We provide empirical support for this hypothesis. Using data for five different currency crises (in 1971, 1973, 1992, 1994, and 1997) we show that currency crises affect clusters of countries tied together by international trade. By way of contrast, macroeconomic and financial influences are not closely associated with the cross-country incidence of speculative attacks. We also show that trade linkages help explain cross-country correlations in exchange market pressure during crisis episodes, even after controlling for macroeconomic factors.

Keywords: speculative; attack; exchange rates; reserve; international; macroeconomic; empirical; financial.

JEL Classification Number: F32.

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I. Introduction

Currency crises tend to be regional. In this paper, we attempt to document this fact, and to understand its implications.

Most economists think about currency crises using one of two standard models of speculative attacks. The "first generation" models of, e.g., Krugman (1979) direct attention to inconsistencies between an exchange rate commitment and domestic economic fundamentals such as an underlying excess creation of domestic credit, typically prompted by a fiscal imbalance. The "second generation" model of, e.g., Obstfeld (1986) views currency crises as shifts between different monetary policy equilibria in response to self-fulfilling speculative attacks. There are many variants of both models, and a number of empirical issues associated with both classes of models, as discussed in Eichengreen, Rose and Wyplosz (1995). What is common to both classes of models is their emphasis on macroeconomic and financial fundamentals as determinants of currency crises. But macroeconomic phenomena do not tend to be regional. Thus, from the perspective of most speculative attack models, it is hard to understand why currency crises tend to be regional, at least without an extra ingredient explaining why the relevant macro fundamentals are intra-regionally correlated.[1]

On the other hand, trade patterns *are* regional; countries tend to export and import with countries in geographic proximity.[2] *Prima facie* then, trade linkages seem like an obvious place to look for a regional explanation of currency crises. It is easy to imagine why the trade channel might potentially be important. If prices tend to be sticky, a nominal devaluation delivers a real exchange rate pricing advantage, at least in the short run. That is, countries lose competitiveness

[1] Rigobon (1998) provides an alternate theoretical framework that argues that the regional nature of currency crises is due to investors learning about a given model of development (assuming that such models tend to be regional).

[2] The evidence is overwhelming: Leamer and Levinsohn (1995) provide a recent survey.

when their trading partners devalue. They are therefore more likely to be attacked — and to devalue — themselves.

Of course, this channel may not be important in practice. Nominal devaluations need not result in real exchange rate changes for any long period of time. Devaluations are costly and can be resisted. Making the case for the trade channel is primarily an empirical exercise.

This paper is intended to contribute a single point to the growing literature on currency contagion. We argue that trade is an important channel for contagion, above and beyond macroeconomic influences. Countries who trade and compete with the targets of speculative attacks are themselves likely to be attacked.

Our point is modest and intuitive. We ignore a number of related issues. For instance, in trying to model "contagion" in currency crises, we do not rule out the possibility of (regional) shocks common to a number of countries. Moreover, we do not attempt to study the timing of currency crises. We *do* intend to show that, given the occurrence of a currency crisis, the incidence of speculative attacks across countries is linked to the importance of international trade linkages. That is, currency crises spread along the lines of trade linkages, after accounting for the effects of macroeconomic and financial factors.[3] This linkage is intuitive, economically significant, statistically robust, and important in understanding the regional nature of speculative attacks.

Section II motivates the analysis by discussing the regional nature of three recent waves of speculative attacks. This is followed by a section that provides a framework for our analysis. Our methodology and data are discussed in section IV; the actual empirical results follow. The paper ends with a brief conclusion.

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[3] Of course, currency crises may spread through other channels as well, such as international asset and debt relationships. However, these non-trade linkages tend to be correlated with trade flows.

II. Have Currency Crises Been Regional?

Substantially. But not exclusively.

The last decade has witnessed three important currency crises. In the autumn of 1992, a wave of speculative attacks hit the European Monetary System and its periphery. Before the end of the year, five countries (Finland, the UK, Italy, Sweden and Norway) had floated their currencies. Despite attempts by a number of countries to remain in the EMS with the assistance of devaluations (by Spain, Portugal and Ireland), the system was unsalvageable. The bands of the EMS were widened to ± 15% in August 1993. Eichengreen and Wyplosz (1993) provide a well-known review of the EMS crisis.

The Mexican peso was attacked in late 1994 and floated shortly after an unsuccessful devaluation. Speculative attacks on other Latin American countries occurred immediately. The most prominent targets of the "Tequila Hangover" were Latin American countries, especially Argentina and Brazil, but also including Peru and Venezuela. Not all Latin countries were attacked — Chile being the most visible exception — and not all economies attacked were in Latin America (Thailand, Hong Kong, the Philippines and Hungary also suffered speculative attacks). While there were few devaluations, the attacks were not without effect. Argentine macroeconomic policy in particular tightened dramatically, precipitating a sharp recession. Sachs, Tornell and Velasco (1996) provide one of many summaries of the Mexican crisis and its aftermath.

The "Asian Flu" began with continued attacks on Thailand in the late spring of 1997 and continuing with flotation of the baht in early July 1997. Within days speculators had attacked Malaysia, the Philippines, and Indonesia. Hong Kong and Korea were attacked somewhat later on; the crisis then spread across the Pacific to Chile and Brazil. The effects of "Bhatulism" linger on as this paper is being written; Corsetti, Pesenti and Roubini (1998) provide an exhaustive survey.

All three waves of attacks were largely regional phenomena.[4] Once a country had suffered a speculative attack – Thailand in 1997, Mexico in 1994, Finland in 1992 – its trading partners and competitors were disproportionately likely to be attacked themselves. Not all major trading partners devalued – indeed, not all major trading partners were even attacked. Macroeconomic and financial influences are certainly not irrelevant. But neither, as we shall see, is the trade channel irrelevant as a means of transmitting speculative pressures across international borders.

III. The Framework

Contagion in currency crises has come to be studied by economists only recently. Eichengreen, Rose and Wyplosz (1996) provide a critical survey and some early evidence.

For the purposes of this study, we think of a currency crisis as being contagious if it spreads from the initial target(s), for whatever reason. As is well known, it is difficult to distinguish empirically between common shocks and contagion. The evidence in favor of contagion is indirect at best. Still, we believe that the preponderance of evidence favors the existence of contagion effects; Eichengreen and Rose (1998) provide evidence.

There are at least two different types of explanations for why contagion spreads, transmission mechanisms that are not mutually exclusive. The first relies on macroeconomic or financial similarity. A crisis may spread from the initial target to another if the two countries share various economic features. The work of Sachs, Tornell and Velasco (1996) can be viewed in this light. Sachs et. al. focus on three intuitively reasonable fundamentals: real exchange rate

[4] Trade patterns have had important effects in spreading currency crises before the 1990s, as we document below.

over-valuation; weakness in the banking system; and low international reserves (relative to broad money). They find that their three variables can explain half the cross-country variation in a crisis index, itself a weighted average of exchange rate depreciation and reserve losses. They use data for twenty developing countries in late 1994 and early 1995. Similarly, similarity in terms of structural characteristics of the economy is analyzed in Rigobon (1998). Currency crises may be regional if macroeconomic features of economies tend to be regional.

The alternative view is that a devaluation gives a country a temporary boost in its competitiveness, in the presence of nominal rigidities. Its trade competitors are then at a competitive disadvantage; those most adversely affected by the devaluation are likely to be attacked next. Gerlach and Smets (1994) formalize this reasoning; Huh and Kasa (1997) provide related analysis. In this way, a currency crisis that hits one country (for whatever reason) may be expected to spread to its trading partners. Since trade patterns are strongly negatively affected by distance, currency crises will tend to be regional.

Eichengreen and Rose (1998) found both "macroeconomic" and "trade" channels of transmission to be empirically relevant in a large quarterly panel of post-1959 industrial country data; trade effects dominated. Thus it is not clear *a priori* which of the mechanisms for contagion, if any, might be present in the data we examine. For this reason, we try to account for both in our empirical work.

IV. Methodology

Our objective in this paper is to demonstrate that trade provides an important channel for contagion above and beyond macroeconomic and financial similarities. As a result, we focus on the incidence of currency crises *across countries*. We ask why some countries are hit during certain episodes of currency instability, while others are not.

Empirical Strategy

Our strategy keys off the "first victim" of a speculative attack. A country is attacked for some reason. We do not take a stance one way or another on whether this initial attack is warranted by bad fundamentals (as would be true in a first-generation model) or is the result of a self-fulfilling attack (consistent with a second-generation model). Instead, we ask: "Given the incidence of the initial attack, how does the crisis spread out from "ground zero?" Are the subsequent targets closely linked by international trade to the first victim? Do they share common macroeconomic similarities? We interpret evidence in favor of the first hypothesis as indicating the importance of the trade channel of contagion.

Clearly we do not deal with a number of related and important issues. We assume that there is contagion, and do not test for its presence. We do not attempt to explain the timing of currency crises. Finally, we do not ask why some crises become contagious and spread while others do not.

Our regression framework is of the form:

$$Crisis_i = \varphi Trade_i + \lambda M_i + \varepsilon_i$$

where: $Crisis_i$ is an indicator variable which is initially defined as unity if country i was attacked in a given episode, and zero if the country was not attacked; M_i is a set of macroeconomic 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.

We estimate this binary probit equation across countries via maximum likelihood. The null hypothesis of interest is Ho: $\varphi=0$. We interpret evidence against the null as being consistent with a trade contagion effect.

We also use a different set of regressands, exploring more quantitative crisis indicators. When the regressand is a continuous indicator of "exchange market pressure", we estimate this cross-country equation by OLS. In this case we consider not just the significance of φ, but also its sign.

The Data Set

We use cross-sectional data from five different episodes of important and widespread currency instability. These are: 1) the breakdown of the Bretton Woods system in the Spring of 1971; 2) the collapse of the Smithsonian Agreement in the late Winter of 1973; 3) the EMS Crisis of 1992-93; 4) the Mexican meltdown and the Tequila Effect of 1994-95; and 5) the Asian Flu of 1997-98. Our data set includes data from 161 countries, many of which were directly involved in *none* of the five episodes.[5]

Making our work operational entails: a) measuring currency crises; b) measuring the importance of trade between the "first victim" and country i; and c) measuring the relevant macroeconomic and financial control variables. We now deal with these tasks in order.

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[5] The exact list (in order of IFS country code) is: U.S.A.; U.K.; Austria; Belgium; Denmark; France; Germany; Italy; Netherlands; Norway; Sweden; Switzerland; Canada; Japan; Finland; Greece; Iceland; Ireland; Malta; Portugal; Spain; Turkey; Yugoslavia; Australia; New Zealand; South Africa; Argentina; Bolivia; Brazil; Chile; Colombia; Costa Rica; Dominican Republic; Ecuador; El Salvador; Guatemala; Haiti; Honduras; Mexico; Nicaragua; Panama; Paraguay; Peru; Uruguay; Venezuela; Bahamas; Barbados; Greenland; Guadeloupe; Guinea French; Guyana; Belize; Jamaica; Martinique; Suriname; Trinidad; Bahrain; Cyprus; Iran; Iraq; Israel; Jordan; Kuwait; Lebanon; Oman; Qatar; Saudi Arabia; Syria; United Arab Emirates; Egypt; Yemen; Afghanistan; Bangladesh; Myanmar; Cambodia; Sri Lanka; Taiwan; Hong Kong; India; Indonesia; Korea; Laos; Macao; Malaysia; Pakistan; Philippines; Singapore; Thailand; Vietnam; Algeria; Angola; Botswana; Cameroon; Central Africa Republic; Congo; Zaire; Benin; Ethiopia; Gabon; Gambia; Ghana; Guinea-Bissau; Guinea; Ivory Coast; Kenya; Lesotho; Liberia; Libya; Madagascar; Malawi; Mali; Mauritania; Mauritius; Morocco; Mozambique; Niger; Nigeria; Reunion; Zimbabwe; Rwanda; Senegal; Sierra Leone; Sudan; Swaziland; Tanzania; Togo; Tunisia; Uganda; Burkina Faso; Zambia; Fiji; New Caledonia; Papua New Guinea; Armenia; Azerbaijan; Belarus; Georgia; Kazakistan; Kyryz Republic; Bulgaria; Moldova; Russia; Tajikistan; China; Turkmenistan; Ukraine; Uzbekistan; Czech Republic; Slovak Republic; Estonia; Latvia; Hungary; Lithuania; Mongolia; Croatia; Slovenia; Macedonia; Bosnia; Poland; Yugoslavia/Macedonia; and Romania. This set of countries was determined by economies with bilateral exports of $5 million or more to at least one trade partner in 1971. Not all countries exist for all episodes, and not all countries with trade relations have sovereign currencies.

Currency Crises

To construct our simple binary indicator regressand, it is relatively easy to determine crisis victims from journalistic and academic histories of the various episodes (we rely on *The Financial Times* in particular). Our list of crisis countries is included in appendix table A1.

Table A1 also lists the “first victim” or “ground zero” countries first attacked. For some periods the “first victim” is relatively straightforward (Mexico in 1994, Thailand in 1997). For others, it is more arguable. In 1971 and 1973 we consider Germany to be ground zero. A case can be made that the U.S. should be ground 0 for the 1971 and 1973 episodes. However, since the U.S. dollar was the key currency of the international monetary system, the change in the value of the dollar during these periods can be interpreted more as a common shock. *A priori*, we choose to rule out such a common shock when testing for contagion effects transmitted through the trade channel. The 1992 crisis is more complex still. We think of the Finnish flotation as being the first important incident (making Finland “ground zero”), but one can make a case for Italy (which began to depreciate immediately following the Danish Referendum) or Germany because of the aftermath of Unification (though as the center of the EMS, German shocks are common). As we shall see, our probit results do not appear to be very sensitive to the exact choice of “first victim” country.

The five waves of currency crises we examine all appear to have a strongly regional nature. Table 1 is a series of cross-tabulations of currency crises and non-crises in our five episodes by regions. The chi-squared tests of independence confirm what the eye can see, namely that currency crises appear to be regional.

Trade Linkages

Once our "ground zero" country has been chosen, we need to be able to quantify the importance of international trade links between the first victim and other countries. We focus on the degree to which the two countries compete in third markets. Our default measure of trade linkage is

$$Trade_i \equiv \Sigma_k \{[(x_{0k} + x_{ik})/(x_{0.} + x_{i.})] \cdot [1 - |(x_{ik} - x_{0k})|/(x_{ik} + x_{0k}]\}$$

where x_{ik} denotes aggregate bilateral exports from country i to k (k ≠ i, 0) and $x_{i.}$ denotes aggregate bilateral exports from country i. This index is a weighted average of the importance of exports to country k for countries 0 and i. The importance of country k is greatest when it is an export market of equal importance to both 0 and i. The weights are proportional to the importance of country k in the aggregate trade of countries 0 and i. The top twenty trade partners linked to "ground zero" are tabulated in Table A2.[6]

This is clearly an imperfect measure of the importance of trade linkages between country i and "ground zero." It relies on actual rather than potential trade. It ignores direct trade between the two countries. Imports are ignored. Countries of vastly different size are a potential problem. Cascading effects are ignored.[7]

We have computed a number of different perturbations to our benchmark measure, and found that our trade measures are relatively insensitive to the exact way we measure the trade linkage. For instance, we have calculated a "direct" measure of trade and a "total" measure of trade. Our direct trade measure is defined analogously to our benchmark measure as

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6 This measure has an obvious similarity to the Grubel-Lloyd measure (1971) of cross-country intra-industry trade.

7 After Finland floated the markka in 1992, Sweden was immediately attacked. One might then ask how the crisis should spill over from both Finland and Sweden.

$$\text{DirectTrade}_i = 1 - |x_{i0} - x_{0i}|/(x_{i0} + x_{0i}).$$

This index is higher the more equal are bilateral exports between countries 0 and i. A measure of total trade, TotalTrade_i, is the weighted sum of Trade_i and DirectTrade_i, where the latter is weighted by $(x_{i0} + x_{0i})/(x_{0.} + x_{i.})$. We have also used a measure of trade linkages which uses trade shares, so as to adjust for the varying size of countries:

$$\text{TradeShare}_i \equiv \Sigma_k\{[(x_{0k} + x_{ik})/(x_{0.} + x_{i.})] \cdot [\, 1 - |\{(x_{0k}/x_{0.}) - (x_{ik}/x_{i.})\}|/\{(x_{0k}/x_{0.}) + (x_{ik}/x_{i.})\}]\}$$

We check extensively for the sensitivity our results to ensure that our results do not depend on the exact measure of trade linkage.

We computed our trade measures for our different episodes using annual data for the relevant crisis year taken from the IMF's *Direction of Trade* data set.[8, 9] The rankings of the top twenty trade competitors of the "first victim" are tabulated (by ranking of "Trade") in an appendix table, and seem sensible. For instance, the most important export competitors for Finland are Norway and Denmark. But some of the competitors are not intuitive. For instance, some countries enter the rankings that are probably not direct trade competitors (e.g., OPEC countries); this is an artifact of the aggregate nature of our data.

[8] The timing of our data is as follows: the 1971 episode uses control data for both macroeconomic and trade linkages from 1970; the 1973 episode uses 1972 data; 1992 uses 1992; 1994 uses 1994; and 1997 uses 1996.

[9] This data set was supplemented with Taiwan trade data from *Monthly Statistics of Exports and Imports, Taiwan Area*, Department of Statistics, Ministry of Finance, Taiwan, and macro data from *Financial Statistics, Taiwan District*, Central Bank of China, Taiwan, (various issues).

Macroeconomic Controls

Our objective is to use a variety of different macroeconomic controls to account for the standard determinants of currency crises dictated by first- and second-generation models. We do this so that our trade linkage variable picks up the effects of currency crises abroad that spill over because of trade; that is, *after* taking account of macroeconomic and financial imbalances that might lead to a currency crisis. Our most important controls are: the annual growth rate of domestic credit (IFS line 32); the government budget as a percentage of GDP (a surplus being positive; IFS line 80 over line 99b); the current account as a percentage of GDP (IFS line 78ald multiplied by line rf in the numerator); the growth rate of real GDP (IFS line 99b.r); the ratio of M2 to international reserves (IFS lines 34+35 multiplied by line rf over line1l.d); and domestic CPI inflation (IFS line 64); and the degree of currency under-valuation. We measure the latter by constructing an annual real exchange rate index as a weighted sum of bilateral real exchange rates (using domestic and real CPIs) in relation to the currencies of all trading partners with available data. The weights sum to one and are proportional to the bilateral export shares with each partner. The degree of currency under-valuation is defined as the percentage change in the real exchange rate index between the average of the three prior years and the episode year. A positive value indicates that the real exchange rate is depreciated relative to the average of the three previous years.[10]

Our data is annual, and was extracted from the IMF's *International Financial Statistics*.[11] It has been checked for outliers via both visual and statistical filters.

[10] It would be interesting to control for the health of the financial sector, if the data permits.

[11] Limited availability of macroeconomic data generally reduces the number of usable observations in our regression analysis far below the set of 161 countries for which we have trade data.

V. Some Results

Univariate Evidence on Trade and Macroeconomic Linkages

Table 2 is a series of t-tests that test for equality of cross-country means for countries affected and unaffected by currency crises. These are computed under the null hypothesis of equality of means between crisis and non-crisis countries (assuming equal but unknown variances). Thus, a significant difference in the behavior of the variable across crisis and non-crisis countries – for instance consistently higher money growth for crisis countries – would show up as a large (negative) t-statistic.

There are two important messages from Table 2. First, the strength of trade linkage to "ground zero" varies systematically between crisis and non-crisis countries. In particular, it is systematically higher for crisis countries at reasonable levels of statistical significance. Second, macroeconomic variables do not typically vary systematically across crisis and non-crisis countries. While some variables sometimes have significantly different means, these results are not consistent across episodes. And they are never as striking as the trade results. These findings are consistent with the importance of the trade channel in contagion.

Multivariate Probit Results for Binary Crisis Measure

Table 2 is not completely persuasive. One problem is that it consists of a set of univariate tests. We remedy that problem in Table 3. The top panel of Table 3 is a multivariate equivalent of Table 2, including a host of macroeconomic variables simultaneously with the trade variable. It reports probit estimates of cross-country crisis incidence on trade linkage and macroeconomic controls. The latter variables are dictated by a variety of different models of speculative attacks (as discussed in Eichengreen, Rose and Wyplosz (1995)) which can be viewed as primitive determinants of vulnerability to speculative pressure. Table 3b uses a wider range of countries (since many macroeconomic observations are missing in our sample) but restricts attention to the degree of currency under- or over-valuation. This is viewed by some as a summary statistic for macroeconomic misalignment.

Since probit coefficients are not easily interpretable, we report the effects of one-unit (i.e., one percentage point) changes in the regressors on the probability of a crisis (also expressed in probability values so that .01=1%), evaluated at the mean of the data. We include the associated z-statistics in parentheses; these test the null of no effect variable by variable. Diagnostics are reported at the foot of the table. These include a test for the joint significance of all the coefficients ("Slopes") which is distributed as chi-squared with seven degrees of freedom under the null hypothesis of no effect. We also include a p-value for the hypothesis that none of the macro effects are jointly significant (i.e., all the coefficients except the trade effect).

The results are striking. The trade channel for contagion seems consistently important in both statistical and economic terms. While the economic size of the effect varies significantly across episode it is consistently different from zero at conventional levels of statistical significance. Its consistently positive sign indicates that a stronger trade linkage is associated with a higher incidence of a currency crisis.

On the other hand, the macroeconomic controls are small economically and rarely of statistical importance. This is true both of individual variables, of all seven macroeconomic factors taken simultaneously, and of currency under-valuation.

Succinctly, the hypothesis of no significant trade channel for contagion seems wildly inconsistent with the data, while macroeconomic controls do not explain the cross-country incidence of currency crises.

Robustness

We have checked for the sensitivity of our probit results with respect to a number of perturbations to our basic methodology. A number of robustness checks are exhibited in the three different panels of Table 4.

The first part of Table 4 varies the macro control regressors. In place of the macroeconomic regressors of Table 3, we substitute: the growth rate of M1 (IFS line 34); the change in the budget/GDP and current account/GDP ratios; and the investment/GDP ratio (IFS 93e over line 99b). We also add the country credit rating from *Institutional Investor*.[12] However our trade linkage variable remains positive and statistically significant despite our substitutions. We have also tried a variety of other sets of macroeconomic controls, without changing the thrust of our results; for the sake of brevity, these experiments are not reported.

The second panel in Table 4 leaves the macro controls unchanged (and unreported, again for the sake of compactness) and substitutes different measures of trade linkages between the country and "ground zero." We use: the rank rather than the actual continuous measure of $Trade_i$ (with a rank of "1" denoting the most important trading partner, "2" being the second more important trade linkage and so forth), our measure of total trade, and our measure of trade share linkages. Our finding of a positive statistically significant role for trade linkages is not substantially altered.

We have also changed the regressand, that is, the way we measure the actual incidence of crises across countries. Results are reported in Table 4c. The first row shows the effect of treating the United States as "ground zero" in 1971 and 1973; the second and third rows use Germany

[12] These ratings are taken every six months, and range potentially from 100 (a perfect score) to 0. We thank Cam Harvey for providing this data set to us.

and Italy respectively as “ground zero” in 1992. Our finding of a significant trade effect is not destroyed by using other (reasonable) starting points for these contagion episodes.

Corsetti et. al. (1998) and Tornell (1998) use cross-sectional techniques and data similar to ours to examine the incidence of the Asian crisis; Tornell also considers the 1994-95 Tequila attacks. We have reproduced the results of both studies, using their own data. When we added our trade variable to the default Tornell regression (which explains crisis severity with a pooled data set from 1994 and 1997), it is correctly signed and significant at the .02 level. When we added our trade variable to the default Corsetti et. al. regression, our benchmark trade variable is again correctly signed and significant at better than the .01 level. The robustness of our key result – the important role played by trade linkages even after taking into account macroeconomic effects – is quite reassuring.

OLS Results for Continuous Crisis Measures

In the previous section we showed that our measure of trade competition worked well in explaining the incidence of currency crises defined in terms of a simple binary indicator. In this section we seek to explain both the direction and magnitude of a quantitative index of exchange market pressure during crisis episodes.[13]

We employ two continuous measures of exchange market pressure. The first measure is the cumulative percent change in the nominal devaluation rate with respect to the ground zero currency for six months following the occurrence of a crisis.[14] The second measure is a weighted

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[13] It would be interesting to extend this analysis by using financial measures (e.g., equity prices or interest rate spreads) as regressands.

[14] For the 1971 episode, the exchange rate change is measured from the end of April; for the 1973 episode the change is measured from the end of December 1972; for 1992, from the end of August; for 1994, from the end of November; for 1997, from the end of June.

average of the devaluation rate and the percent decline in international reserves for six months following the crises. (We check for robustness by also examining three- and nine-month horizons). Following others (Eichengreen, Rose, and Wyplosz (1995, 1996); Frankel and Rose (1996) and Sachs, Tornell and Velasco, 1996), we weight the components so as to equalize their volatilities; that is, we weight each component by the inverse of its variance over the sum of inverses of the variances, where the variances are calculated using three years of monthly data prior to each episode. This weighting scheme gives a larger weight to the component with a smaller variance.

Our continuous measures of exchange rate crises are not without their limitations. First, countries that successfully defend themselves against speculative attacks may show no sign of attack by experiencing either an exchange rate depreciation or reserve losses. A somewhat broader measure of possible responses to speculative attacks would include the interest rate. However, the lack of such data for many of the countries in our sample precluded doing so. Second, threatened or actual changes to capital controls are difficult to measure quantitatively, but may influence results. The same is true of international rescue packages organized by e.g., the IMF. We proceed bearing these limitations in mind.

Our null hypothesis is that in episodes in which the ground zero country depreciates (e.g., 1992, 1994, 1997) other countries will depreciate and/or lose reserves the more they compete in world export markets with country 0; i.e. Ho: $\varphi>0$. Conversely, when the ground zero currency appreciates (e.g. 1971, 1973) other countries should appreciate more (or depreciate less) the more they compete with ground zero in export markets; i.e., Ho: $\varphi<0$.

We test these hypotheses by regressing our continuous measures of exchange rate pressure on our basic trade competition variable, $Trade_i$, as well as on the same set of macroeconomic control variables as in Table 3a. Table 5a presents the coefficients on the trade variable from regressions of (three-, six-, and nine-month) depreciation rates. The analogue for exchange market pressure measured as a weighted average of reserve losses and depreciation is presented in Table 5b. For the sake of brevity, coefficients on the macro controls are not reported. For the sake of variety we use our trade share measure of trade linkages.[15, 16]

When we use depreciation as the regressand, the sign of the trade coefficient is sensible (at all horizons) for all five episodes. For 1992, 1994 and 1997, the coefficient is positive; countries that compete more intensely with "ground zero" (Finland in 1992, Mexico in 1994, and Thailand in 1997) tend to depreciate more, after accounting for macroeconomic factors. The sign is negative for the 1971 and 1973 episodes, implying that countries which competed more with Germany tended to appreciate more (along with Germany) following the appreciation of the Deutschemark. These results are generally significant at standard levels, particularly at the longer horizons. When we consider exchange market pressure – the weighted average of depreciation and reserve losses – as the crisis measure, the overall results for the six and nine month horizons are similar, though the significance level generally declines.[17]

Tables 6a and 6b report the complete results for the six-month horizon for depreciation and exchange market pressure respectively. Only inflation is generally significant across all episodes aside from inflation. In contrast, as noted above with our cumulative depreciation measure as the regressand, the trade variable appears to provide consistent explanatory power for all crisis episodes.[18]

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[15] We have omitted Chile from the samples for 1971 and 1973 because during both episodes it experienced depreciation rates of over 100%; Chile was an outlier in many respects during these periods.

[16] Using our default measure of trade reduces significance levels slightly, and reverses the coefficient on the trade measure for the 1994 episode, though it is not significant.

[17] For the 1971 and 1973 episodes the trade effect sign at three months is now positive, although these effects are not significant at standard levels.

[18] We get the same qualitative results using either the $Trade_i$ or $TotalTrade_i$ as the trade share measure.

We conclude that our continuous quantitative indicators, particularly the cumulative deprecation rate, provide support for the hypothesis that trade contributes significant power in explaining the magnitude as well as incidence of currency crises.

VI: Concluding Comments

We have found strong evidence that currency crises tend to spread along regional lines using both binary and more continuous measures of crises. This is true of five recent waves of speculative attacks (in 1971, 1973, 1992, 1994-95, and 1997). Accounting for a variety of different macroeconomic effects does not change this result. Indeed macroeconomic factors do not consistently help much in explaining the cross-country incidence of speculative attacks.

Our evidence is consistent with the hypothesis that currency crises spread because of trade linkages. That is, countries may be attacked because of the actions (or inaction) of their neighbors, who tend to be trading partners merely because of geographic proximity. This externality has important implications for policy. If this effect exists, it is a strong argument for international monitoring. A lower threshold for international and/or regional assistance is also warranted than would be the case if speculative attacks were solely the result of domestic factors.

Table 1: Regional Distribution of Currency Crises

1971	Americas	Europe	Asia	Africa	Total
No Crisis	27	8	31	41	107
Crisis	1	16	2	0	19
Total	28	24	33	41	126

Test for Independence $\chi^2(3) = 62$

1973	Americas	Europe	Asia	Africa	Total
No Crisis	27	9	32	41	109
Crisis	1	15	3	0	19
Total	28	24	35	42	128

Test for Independence $\chi^2(3) = 54$

1992	Americas	Europe	Asia	Africa	Total
No Crisis	28	15	37	41	121
Crisis	0	10	0	0	10
Total	31	25	37	41	131

Test for Independence $\chi^2(3) = 46$

1994	Americas	Europe	Asia	Africa	Total
No Crisis	22	30	39	40	131
Crisis	6	1	4	0	11
Total	28	31	43	40	142

Test for Independence $\chi^2(3) = 12$

1997	Americas	Europe	Asia	Africa	Total
No Crisis	25	29	35	38	127
Crisis	3	3	9	1	16
Total	28	32	44	39	143

Test for Independence $\chi^2(3) = 7$

Table 2: T-Tests for Equality by Crisis Incidence

	1971	1973	1992	1994	1997
Trade	-9.5	-10.9	-4.7	-6.9	-7.5
%∆ M1	0.8	1.1	1.2	-0.9	-0.1
%∆ M2	1.6	0.8	1.1	-0.6	0.0
%∆ Credit	0.8	1.3	0.4	-0.2	-0.4
%∆ Private Credit	1.2	0.1	0.7	-0.5	0.3
M2/Reserves	-3.5	-2.6	0.3	0.5	-0.3
%∆ Reserves	-1.8	0.7	1.3	1.4	2.1
%∆ Exports	-1.0	-0.9	0.1	-0.5	0.1
%∆ Imports	-1.5	-1.1	0.8	-1.1	-0.6
Current Account/GDP	-2.0	-2.1	-0.8	0.2	-0.8
Budget/GDP	-1.6	-1.9	1.4	-0.9	-0.4
Real Growth	0.7	0.5	1.1	-1.6	-2.7
Investment/GDP	-3.2	-2.8	1.0	-0.2	-2.7
Inflation	-0.3	0.7	1.5	-1.0	0.6
Under-valuation	-0.5	-0.9	0.6	1.5	-0.6

Values tabulated are t-statistics, calculated under the null hypothesis of equal means and variances. A significant negative statistic indicates that the variable was significantly higher for crisis countries than for non-crisis countries.

Table 3a: Multivariate Probit Results with Macro Controls

	1971	1973	1992	1994	1997
Trade	2.09 (2.7)	3.18 (2.7)	.003 (2.1)	.50 (2.9)	.68 (2.6)
%∆ Credit	-.01 (1.2)	-.01 (0.4)	.00 (1.1)	.00 .00	N/A
Budget/GDP	.01 (0.3)	0.04 (1.2)	-.00 (0.8)	.00 (0.9)	N/A
Current Account/GDP	.00 (0.2)	.03 (1.0)	.00 (0.1)	-.00 (1.7)	.00 0.0
Real Growth	.00 (0.2)	.04 (1.2)	-.00 (1.6)	.00 (0.1)	.04 (2.2)
M2/Reserves	.00 (0.2)	.01 (0.4)	.00 (1.0)	-.00 (0.5)	.00 (0.8)
Inflation	.01 (0.4)	.01 (0.5)	-.00 (1.3)	.00 (0.7)	.00 (0.3)
Observations	53	60	67	67	50
Slopes (7)	26	36	24	16	17 (5df)
McFadden's R^2	0.38	0.49	0.5	0.36	0.38
P-value: Macro=0	0.89	0.64	0.59	0.68	0.26

Absolute value of z-statistics in parentheses. Probit estimated with maximum likelihood.

Table 3b: Probit Results with Currency Misalignment

	1971	1973	1992	1994	1997
Trade	2.25 (4.5)	2.88 (4.2)	0.31 (3.2)	0.45 (3.8)	0.54 (4.5)
Under-valuation	0 (1.3)	0 (1.8)	0 (0.5)	0 (1.4)	0 (1.1)
Observations	80	85	111	109	107
McFadden's R^2	0.38	0.48	0.21	0.34	0.36

Absolute value of z-statistics in parentheses. Probit estimated with maximum likelihood.

Table 4a: Sensitivity Analysis: Macro Controls

	1971	1973	1992	1994	1997
Trade	1.28 (2.6)	1.21 (3.1)	0.002 (1.6)	0.0002 (2.1)	0.23 (1.6)
%Δ M1	-.01 (1.3)	-.00 (0.6)	-.00 (1.1)	-.00 (0.6)	-.00 (0.9)
Δ (Budget/GDP)	.03 (0.7)	-.01 (0.9)	.00 (0.4)	.00 (1.0)	-.01 (0.8)
Δ (Current Account/GDP)	.01 (0.9)	-.01 (1.2)	.00 (1.2)	-.00 (0.4)	-.00 (0.7)
Investment/GDP	.02 (1.8)	.02 (2.0)	-.00 (1.0)	.00 (1.1)	.00 (0.7)
Institutional Investor Rating	N/A	N/A	.00 (1.4)	-0.000001 (1.8)	-.00 (0.8)
Observations	54	60	62	63	27
Slopes (df)	26 (5)	38 (5)	24 (6)	24 (6)	13 (6)
McFadden's R^2	.41	.59	.61	.62	.58
P-value: Macro=0	.25	.40	.60	.71	.67

Absolute value of z-statistics in parentheses. Probit estimated with maximum likelihood.

Table 4b: Sensitivity Analysis: Trade Measure

Coefficients on Trade Variable; Macro Controls (from Table 3a) not reported

	1971	1973	1992	1994	1997
Rank of Trade	-.01	-.01	-.00	-.001	-.003
	(3.3)	(3.1)	(1.9)	(1.9)	(2.1)
Total Trade	2.05	3.15	.004	.51	.68
	(2.7)	(2.7)	(2.2)	(2.9)	(2.7)
Trade Share	1.54	2.04	.000	.23	.57
	(3.5)	(3.3)	(1.8)	(2.2)	(2.1)

Absolute value of z-statistics in parentheses. Probit estimated with maximum likelihood.

Table 4c: Sensitivity Analysis: Regressand

Coefficients on Trade Variable; Macro Controls not reported.

"Ground Zero"	1971	1973	1992
U.S.	1.39	1.85	N/A
	(2.1)	(2.6)	
Germany	N/A	N/A	0.95
			(3.0)
Italy	N/A	N/A	0.46
			(3.0)

Absolute z-statistics in parentheses. MLE Probit.

Table 5a: Multivariate OLS Results for Exchange Rate Pressure

Coefficient on Trade Share Variable; Macro controls not reported

Depreciation	1971	1973	1992	1994	1997
3 months	-4.24	-10.68	24	5.8	4.99
	(2.4)	(2.6)	(3.8)	(2.9)	(1.6)
6 months	-6.81	-21.78	32.92	10.06	56.69
	(2.1)	(3.4)	(4.0)	(3.1)	(3.4)
9 months	-7.60	-24.60	31.76	6.38	N/A
	(0.7)	(3.8)	(3.0)	(1.9)	

Absolute value of t-statistics in parentheses.

Table 5b: Multivariate OLS Results for Exchange Rate Pressure

Coefficient on Trade Share Variable; Macro controls not reported

Exchange Market Pressure	1971	1973	1992	1994	1997
3 months	-4.36	-10.30	22.40	4.91	6.60
	(1.3)	(2.1)	(3.2)	(2.4)	(1.6)
6 months	-4.96	-22.22	23.65	6.46	66.72
	(0.9)	(2.8)	(2.4)	(1.8)	(2.8)
9 months	-8.60	-27.55	32.40	6.01	N/A
	(0.6)	(3.2)	(2.6)	(1.6)	

Absolute value of t-statistics in parentheses. Regressand is weighted average of depreciation and reserve changes.

Table 6: Multivariate OLS Results for Exchange Rate Pressure: 6 month Horizon

	Depreciation					Exchange Market Pressure				
	1971	**1973**	**1992**	**1994**	**1997**	**1971**	**1973**	**1992**	**1994**	**1997**
Trade Share	-6.81	-21.78	32.92	10.06	56.69	-4.96	-22.22	23.65	6.46	66.72
	(2.1)	(3.4)	(4.0)	(3.1)	(3.4)	(0.9)	(2.8)	(2.4)	(1.8)	(2.8)
%Δ Credit	0.02	-0.01	0.01	0.05	-0.09	0.04	-0.08	0.23	0.05	-0.13
	(0.3)	(0.1)	(1.1)	(2.0)	(0.7)	(0.4)	(0.5)	(4.2)	(2.2)	(0.8)
Budget/GDP	-0.42	-0.68	-0.24	-0.04	-1.63	-0.53	-0.55	0.28	0.01	-3.28
	(2.7)	(2.3)	(0.7)	(0.6)	(1.3)	(2.4)	(1.8)	(0.6)	(0.2)	(1.3)
Current Account/GDP	-0.12	-0.13	0.07	-0.22	-0.39	-0.16	-0.17	-0.14	-0.26	-0.21
	(1.5)	(0.4)	(0.8)	(2.0)	(0.8)	(1.2)	(0.5)	(1.2)	(2.2)	(0.2)
Real Growth	0.26	0.46	0.06	0.61	1.57	0.14	0.82	-0.64	0.41	2.6
	(2.3)	(1.5)	(0.2)	(2.8)	(1.2)	(0.7)	(2.4)	(1.8)	(1.7)	(1.6)
M2/Reserves	0.02	0.04	-0.2	0.12	-0.2	0.04	0.25	-0.11	0.1	-0.34
	(0.8)	(1.7)	(1.5)	(1.7)	(1.3)	(0.6)	(1.5)	(0.8)	(0.9)	(1.2)
Inflation	0.39	0.6	0.42	0.23	0.29	0.24	0.75	-0.06	0.14	0.51
	(2.5)	(3.1)	(9.9)	(4.6)	(1.3)	(1.0)	(3.5)	(0.8)	(2.7)	(0.7)
Observations	53	59	66	67	25	36	47	62	64	17
R^2	0.48	0.4	0.75	0.49	0.48	0.45	0.46	0.43	0.37	0.58
P-value: Macro=0	0	0	0	0	0.41	0.01	0	0	0	0.45

Absolute value of t statistics in parentheses. Regressand is a weighted average of depreciation and reserve losses.

Appendix Table A1: Countries Affected by Speculative Attacks

	1971	1973	1992	1994	1997
U.S.A.	1	1			
U.K.	1	1	1		
Austria	1	1			
Belgium	1	1	1		
Denmark	1	1	1		
France	1	1	1		
Germany	0	0			
Italy	1	1	1		
Netherlands	1	1			
Norway	1	1			
Sweden	1	1	1		
Switzerland	1	1			
Canada				1	
Japan		1			
Finland	1	1	0		
Greece	1	1			
Iceland		1			
Ireland	1		1		
Portugal	1	1	1		
Spain	1		1		
Australia	1	1			
New Zealand	1	1			
South Africa					1
Argentina				1	1
Brazil				1	1
Mexico				0	1
Peru				1	
Venezuela				1	
Taiwan					1
Hong Kong				1	1
Indonesia				1	1
Korea					1
Malaysia					1
Pakistan					1
Philippines				1	1
Singapore					1
Thailand				1	0
Vietnam					1
Czech Republic					1
Hungary				1	1
Poland					1

"0" denotes "first victim"/"ground zero"; "1" denotes target of speculative attack

Appendix Table A2: Default Measure of Trade Linkage

Rank	1971	1973	1992	1994	1997
0	Germany	Germany	Finland	Mexico	Thailand
1	United Kingdom	France	Norway	Canada	Malaysia
2	France	United Kingdom	Denmark	Taiwan	Indonesia
3	Italy	U.S.A.	Portugal	Hong Kong	Saudi Arabia
4	U.S.A.	Belgium	Ireland	Korea	Australia
5	Japan	Italy	Turkey	Venezuela	India
6	Belgium	Japan	Poland	China	Korea
7	Netherlands	Netherlands	Russia	Singapore	Brazil
8	Canada	Canada	Austria	Brazil	Taiwan
9	Sweden	Sweden	Sweden	Malaysia	Philippines
10	Switzerland	Switzerland	India	Thailand	Singapore
11	Australia	Saudi Arabia	South Africa	United Kingdom	Israel
12	Denmark	Australia	Yugoslavia	Japan	Switzerland
13	Saudi Arabia	Brazil	Algeria	Israel	China
14	Brazil	Denmark	Israel	Saudi Arabia	South Africa
15	Hong Kong	Spain	Greece	Philippines	United Arab Emirates
16	Spain	Hong Kong	Hungary	Indonesia	Sweden
17	Austria	Norway	Iran	Nigeria	Finland
18	Norway	Taiwan	Brazil	India	Ireland
19	Libya	Austria	Switzerland	Switzerland	Hong Kong
20	Finland	Venezuela	Spain	Colombia	Denmark

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