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Emerging Currency Blocs

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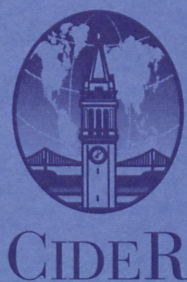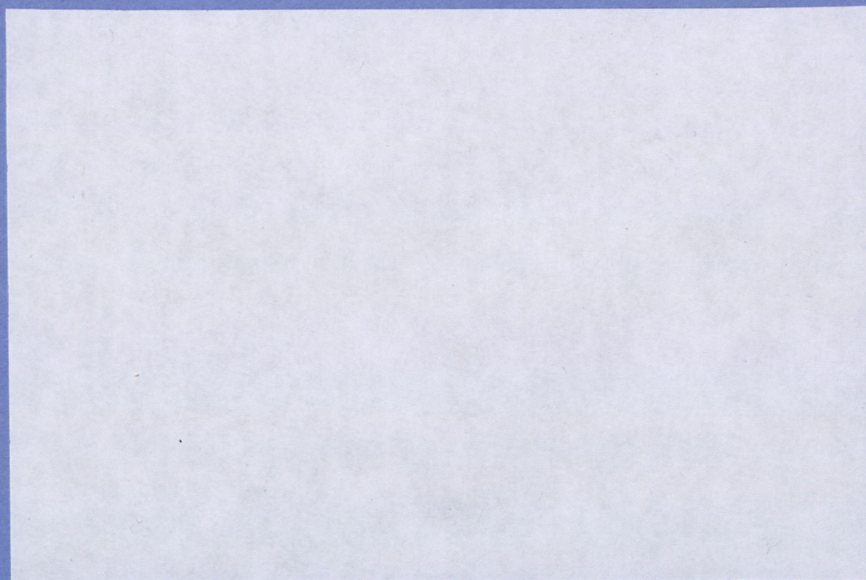Kennedy School of Government, Harvard University

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Abstract

Using the gravity model to examine bilateral trade patterns throughout the world, we find clear evidence of trading blocs in Europe, the Western Hemisphere, East Asia, and the Pacific. In Europe, it is the EC that operates as a bloc, not including EFTA. Two EC members trade an extra 55 percent more with each other, beyond what can be explained by proximity, size, and GNP/capita.

Turning to the possibility of currency blocs, we find a degree of intra-regional stabilization of exchange rates, especially in Europe. Not surprisingly, the European currencies link to the DM, while Pacific currencies link to the dollar. We also find some cross-section evidence that bilateral exchange rate stability may have had a (small) role in promoting intra-bloc trade during the period 1965-1980. In 1980, lower exchange rate variability within Europe, compared to the worldwide norm, increased trade by 4.4 percent, by one estimate (less, in an estimate that corrects for simultaneity). Even the small negative effects we estimate appear to have disappeared during the course of the 1980s, perhaps due to the proliferation of instruments to hedge exchange risk.

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Emerging Currency Blocs

Suddenly, the possible breakup of the world economy into economic blocs has become a special focus of interest -- largely in response to such projects as the European Monetary System, Europe 1992, European Monetary Union, the North American Free Trade Agreement, and suspicions of a Japanese sphere of influence in Asia.

This paper concerns two key aspects of the possible regionalization of economic relations, and the interaction between the two. They are trade links and currency links. That the two may be closely intertwined is evident in that a major motivation behind attempts to strengthen currency links within Europe is to reduce the extent to which exchange rate risk discourages imports and exports, and thereby to promote stronger trade links. Other important aspects, such as financial links within regions or the extent to which countries within a region share common economic disturbances, are not considered here.

1. Introduction

There is more talk of regionalization, of whether the world is breaking up into three great trading blocs or currency blocs (Europe, Western Hemisphere, and East Asia; or mark, dollar, and yen blocs), than there are attempts at hard quantitative analysis. Often studies simply report measures of the relative size of the blocs, such as shares of world trade, and measures of the extent of intra-regional trade, such as the fraction of countries' trade

conducted with others in the region. But these are not measures of intra-regional bias, the extent to which countries are concentrating their economic activity with others in the region.[1]

This paper looks econometrically at three questions: (1) Is trade biased toward intra-regional partners, within each of the three potential major blocs? (2) Are exchange rates more stable within each of the three potential blocs than across them? (3) To the extent exchange rates are stabilized within a bloc, does that contribute to intra-bloc trade?

Frankel (1993) applied to the trading bloc question the natural framework for studying bilateral trade, the gravity model. The gravity model assumes that trade between two countries is proportional to the product of their sizes and inversely related to the distance between them. These two factors are presumably the source of the name, by analogy to the formula for gravitational attraction between two masses. It has a fairly long history.[2] There are only a few recent applications to a large cross-section of countries throughout the world, however. Three others are Wang and Winters (1991), Hamilton and Winters (1992), and Havrylyshyn and Pritchett (1991).[3]

Frankel (1993) and Frankel and Wei (1994) found that: (1) there are indeed intra-regional trade biases in the EC and the Western Hemisphere, and perhaps in East Asia; but (2) the greatest intra-regional bias was in none of these three, but in the APEC grouping, which includes the U.S. and Canada with the Pacific

countries; (3) the bias in the East Asia and Pacific groupings did not _increase_ in the 1980s as it did in Europe and the Americas; and (4) bilateral exchange rate variability may have had a small negative effect on bilateral trade in 1980, but there is little evidence of an effect in 1985 or 1990.

This paper extends those results in a number of directions. First, we consider some econometric extensions of the original gravity model estimation (allowing for heteroscedasticity and zero-valued observations), to see how well the basic results hold up. Second, we consider some economic extensions of the gravity model estimation, allowing roles for factor endowments and linguistic links in trade. At the same time, we extend the results back in history, to 1965. Third, we look more carefully at the possible role of stabilization of bilateral exchange rates in promoting intra-regional trade. We examine the extent to which exchange rates have been stabilized within regional groupings such as the EC and EFTA. Then we test whether the stabilization of bilateral exchange rates promotes bilateral trade, on the entire data set, running from 1965 to 1990.

Besides these extensions, the paper focuses relatively more on Europe, including both the EC and EFTA, whereas the earlier papers focused relatively more on East Asia and the Pacific. In particular, a central motivating question is the extent to which stabilization of exchange rates within Europe has been a contributing factor to the increase in intra-regional trade there. One view, labelled "American" by Charles Wyplosz, is that

3

stabilization of exchange rates within a region is not a prerequisite for trade integration, with the example of U.S.-Canadian integration frequently cited in support, whereas the "European" view is that it is a prerequisite.[4] The set-back that European Monetary Union received in the Exchange Rate Mechanism crisis of September 1992 means that a return to the higher levels of exchange rate variability that held in the past is a real possibility. To what extent would that reduce intra-European trade?

2. Is Europe a trade bloc?

2.1 The gravity model

One cannot meaningfully investigate the extent to which regional policy initiatives are influencing trade patterns without holding constant for natural economic determinants. A systematic framework for measuring what patterns of bilateral trade are normal around the world is offered by the gravity model. A dummy variable can then be added to represent when both countries in a given pair belong to the same regional grouping. One can check how the level and time trend in, for example, Europe compares with that in other groupings.

The variable to be determined is trade (exports plus imports), in log form, between pairs of countries in a given year. We have

4

63 countries in our data set, so that there are 1,953 data points (=63x62/2) for a given year.[5] The goal, again, is to see how much of the high level of trade within each region can be explained by simple economic factors common to bilateral trade throughout the world, and how much is left over to be attributed to a special regional effect.

One would expect the two most important factors in explaining bilateral trade flows to be the geographical distance between the two countries, and their economic size. These factors are the essence of the gravity model.

A large part of the apparent bias toward intra-regional trade is certainly due to simple geographical proximity. Indeed Krugman (1991b) suggests that most of it may be due to proximity, so that the three trading blocs are welfare-improving "natural" groupings, as distinct from "unnatural" trading arrangements between distant trading partners such as the United Kingdom and a Commonwealth member.

Despite the obvious importance of distance and transportation costs in determining the volume of trade, empirical studies surprisingly often neglect to measure this factor. Our measure is the log of distance between two major cities (usually the capital) of the respective countries. We also add a dummy "Adjacent" variable to indicate when two countries share a common land border.

Entering GNPs in product form is empirically well-established in bilateral trade regressions. It can be justified by the modern theory of trade under imperfect competition.[6] In addition there is

reason to believe that GNP per capita has a positive effect on trade, for a given size: as countries become more developed, they tend to specialize more and to trade more.

The equation to be estimated, in its most basic form, is:

(1)
$$\log(T_{ij}) = \alpha + \beta_1 \log(GNP_i GNP_j) + \beta_2 \log(GNP/pop_i GNP/pop_j)$$

$$+ \beta_3 \log(DISTANCE_{ij}) + \beta_4 (ADJACENT_{ij}) + \gamma_1 (EC_{ij}) + \gamma_2 (WH_{ij}) + \gamma_3 (EASIA_{ij}) + u_{ij}.$$

The last four explanatory factors are dummy variables. *EC*, *WH*, and *EASIA* are three of the dummy variables we use when testing the effects of membership in a common regional grouping.

The results are reported in Tables 1, 2, and 3. These differ from the tables in Frankel (1993) principally by the explicit distinct consideration of (1) the EC, (2) EFTA, and (3) Europe overall, and the inclusion of terms to capture any possible trade-diversion effects in Europe. We found all four standard gravity variables to be highly significant statistically (> 99% level).

The adjacency variable indicates that when two countries share a common border, they trade with each other approximately twice as much as they otherwise would [exp(.7)=2]. The coefficient on the log of distance is about -.56, when the adjacency variable is included at the same time. This means that when the distance between two non-adjacent countries is higher by 1 per cent, the trade between them falls by about .56 per cent.

The estimated coefficient on GNP per capita is about .29 as of 1980, indicating that richer countries do indeed trade more, though

this term declines during the 1980s, reaching .11 in 1990. The estimated coefficient for the log of the product of the two countries' GNPs is about .75, indicating that, though trade increases with size, it increases less-than-proportionately (holding GNP per capita constant). This presumably reflects the widely-known pattern that small economies tend to be more open to international trade than larger, more diversified, economies.

We now add a few checks for econometric robustness regarding the sample of countries and their size. We try running the equation in multiplicative form, instead of log-linear, so as to allow the inclusion of pairs of countries that are reported as undertaking zero trade. (Under our log-linear specification, any pair of countries that shows up with zero trade must necessarily be dropped from the sample.) We find that the inclusion or omission of such countries in the multiplicative specification makes little difference to the results. The results are reported in Table A1-A2 in the Appendix.[7] A correction for heteroscedasticity based on the size of the countries also makes little difference (reported in Table A3).

As another extension, we have tried disaggregating total trade into three categories: manufactured products, agricultural products, and other raw materials. Perhaps surprisingly, the effect of distance is as high or higher for manufactures as for the other categories. But the findings are in general little affected by the disaggregation.[8]

2.2 Estimation of trade-bloc effects

Our subject here is the empirical question of whether the regionalization of world trade is in fact taking place, not whether it would be good or bad. But first we briefly raise the issue of economic welfare.

It is possible that the amount of intra-regional bias explained by proximity, as compared with explicit or implicit regional trading arrangements, is small enough in our results that those arrangements are welfare-reducing, in other words that the existing degree of regionalization of world trade is excessive. This could be the case, in terms of traditional customs union theory, if trade-diversion outweighs trade creation.

Stein (1992) and Frankel, Stein and Wei (1993) have made a start on the economic welfare analysis by explicitly introducing inter-continental transportation costs into the Krugman model, and showing how the desirability of trade blocs depends on them. Simulations show, for certain parameter values, that the worldwide formation of regional free-trade areas between neighbors would raise welfare if the parameter representing transportation costs exceeds a certain critical level, and would lower welfare if the parameter is less than that critical level. We refer to the observed intra-regional trade bias in the latter (welfare-reducing) case as evidence of "super-natural" trading blocs, inspired by Krugman's (1991a,b) "natural trading bloc" terminology. [For plausible parameter values, and an estimate of intra-continental

transport costs drawn from the gravity estimates such as those reported in Tables 1-3, we find that negative returns to regionalization set in when intra-bloc preferences reach around 30 per cent, and that preferences above 50 per cent enter the super-natural zone.]

How high do intra-regional preferences appear to be in the data? If there were nothing to the notion of trading blocs, then the basic economic variables in our gravity regressions would soak up most of the explanatory power. There would be little left to attribute to a dummy variable representing whether two trading partners are both located in the same region. In this case the level and trend in intra-regional trade would be due solely to the proximity of the countries, and to their rate of overall economic growth.

But we found that dummy variables for intra-regional trade are highly significant statistically. If two countries are both located in the Western Hemisphere for example, in 1980 they traded with each other by an estimated 86 per cent more than they would have otherwise [exp(.62) = 1.86], after taking into account distance and the other gravity variables.

The strongest bloc effect in our gravity estimates is not any of the three most often discussed, but is the Pacific bloc that includes the United States and Canada along with East Asia, Australia and New Zealand. (This dummy variable is labelled APEC, after the membership of the Asian Pacific Economic Cooperation

forum.) The coefficient in 1980 suggests that two APEC members trade five times as much as a typical pair of countries [exp(1.6)=5.06]. The group of East Asian countries alone also constituted a significant distinct trade bloc, with a coefficient suggesting that it doubles trade between members [exp(.8) = 2.23].

Both coefficients declined a bit during the decade, reflecting that the rapid growth in Asian/Pacific trade which many observors have remarked was entirely the result of economic growth among the individual countries. [Indeed, the East Asian bloc effect virtually loses significance in 1985 and 1990, if one allows for the greater openness of East Asia in general, and Hong Kong and Singapore in particular, simultaneously with the APEC bloc effect.[9]]

The blocs that strengthened in the 1980s lay elsewhere, in the Americas and Europe. The Western Hemisphere coefficient started the decade with an implied 1.86 multiplier, as noted above, and rose to 2.46 [=exp(.9)]. The rise came entirely between 1985 and 1990. We turn now to Europe.

2.3 The European Community and EFTA

The results suggest that Europe may not even have been an operational trade bloc in 1980. The estimated coefficient on the EC is only of borderline significance (The point estimate of the effect on trade is 26 per cent [exp(.23)=1.26]). Furthermore, it

diminishes when a dummy variable is added to capture the overall openness of European countries. This dummy variable is defined to equal one when <u>either</u> <u>one</u> of the two countries in a given pair is located in Europe, as opposed to both. The results indicate that, as of 1980, the high level of intra-regional trade in Europe can be mostly explained by a combination of proximity, high income, and openness (as compared to the average level of openness in the sample, which includes many LDCs).

By 1985 the EC dummy had become statistically significant. The coefficient implies that two EC members trade an extra 58 per cent with each other [exp(.46) = 1.58]. It is clear that it is the European Community in particular that is having an influence, as terms for EFTA or for Europe overall are not significant.[10] Furthermore, when the term is added to capture the greater openness of European countries, even though it is again significantly positive, the significance of the EC bloc effect rises a bit rather than falling.

Why did the EC strengthen in the early 1980s? One possibility is the accession of Spain, Portugal and Greece during this period, and of the United Kingdom, Ireland and Denmark not long before. (For ease of comparison across time, these countries are included in the definition of the EC grouping throughout the sample.) Another possible contributing factor, considered below, is the stabilization of exchange rates under the European Monetary System.

The EC coefficient in 1990 is a little larger than in 1985. The effect is 68 per cent [exp(.52)=1.68]. The EFTA and Europe

11

effects are again insignificant. The major change relative to 1985 is that the coefficient on European openness, which was previously significantly greater than zero, is now less than zero, and borderline-significant. This finding bears on the famous distinction between trade-diversion and trade-creation in the literature on the welfare effects of customs unions.

The 1980 and 1985 results suggest that trade-diversion is not greater than zero, indeed that it is negative. One might wonder how the formation of a free-trade area like the EC could produce a negative "trade-diversion coefficient," or what we have called a positive openness coefficient. In theory, the reduction of trade barriers within the region should not encourage trade with other countries; if anything, it should discourage it. The answer is that countries in a given region may somewhat reduce barriers with respect to non-members, at the same time that they reduce or eliminate barriers internally. Indeed, the two policy changes may be related in a political economy sense. Some have argued that the constellation of political forces that allows liberalization with respect to trade with regional neighbors may be similar to what is required to allow liberalization more generally. The best example is Mexico's decision to negotiate the NAFTA soon after undertaking unilateral liberalization and joining GATT (Lawrence, 1991).

The 1990 result suggests a shift toward trade-diversion. While a typical European country now trades 68 per cent more with other European countries than can be explained by natural factors, it trades an estimated 11 per cent less with non-European

12

countries. [Further results, not reported here, suggest that the trade diversion takes place among the EFTA countries, not the EC countries.]

2.4 Factor endowments

We have also tried to capture classic Heckscher-Ohlin effects. First we tried including bilateral absolute differences in GNP/capita figures, reported in Table 4. The variable did not have the positive effect that one would expect if countries traded capital-intensive products for unskilled-labor-intensive products. Rather, it had a moderately signficant <u>negative</u> effect, as in the Linder hypothesis that similar countries trade more than dissimilar ones.

Next we tried, in Table 5, gravity estimates that include more direct measures of factor endowments: the two countries' differences in capital/labor ratios, educational attainment levels, and land/labor ratios. The data (for a subset of 656 of our 1,953 pairs of countries) was generously supplied by Gary Saxonhouse (1989). There is a bit of support for these terms, particularly for capital/labor ratios and educational attainment in 1980. The other coefficients are little affected.

2.5 Common languages

The earlier results were incapable of distinguishing between regional biases reflecting discriminatory trade policies, and those that might derive from historical, political, cultural and

linguistic ties. We now add a dummy variable to represent when both countries of a pair speak a common language or had colonial links earlier in the century. We allow for English, Spanish, Chinese, Arabic, French, German, Japanese, Dutch, and Portuguese.[11] The results, reported in Table 6, show that two countries sharing linguistic/colonial links tended in 1965 or 1970 to trade roughly 65 per cent more than they would otherwise [exp(.5)=1.65]. The bloc variables remain significant even when holding constant for these links.

We tested whether some of the major languages were more important than the others. Chinese is the only one to qualify, and its apparent effect is probably spurious.[12] French, Spanish, and Arabic, if anything, have less effect than other common languages, though the differences are not very significant statistically. When all nine linguistic/colonial links are constrained to have the same coefficient, it is significant at the 99 per cent level.[13] The 1980 effect is again 65 per cent.

To summarize, allowing for the linguistic links has little effect on the statistical significance of the bloc coefficients, as was also true of allowing a role for factor endowments and other econometric extensions.

3. Currency blocs

Does the stabilization of exchange rates within regions help promote trade within those regions? The question bears on the

larger literature on the implications of fixed versus floating exchange rate regimes.

3.1 Stabilization of exchange rates within the blocs

Table 7 reports statistics on the variability of exchange rates among various groupings of countries. [This is nominal exchange rate variability, but perhaps it would be good to look at real as well.] Worldwide, monthly exchange rate variability rose in the 1980s, from a standard deviation of .33 per cent in 1980 to .38 per cent in 1990. The latter figure suggests that for a typical pair of countries, approximately 5 per cent of monthly exchange rate changes are larger than .76 per cent (two standard deviations, under the simplifying assumption of a log-normal distribution).

There is a tendency for exchange rate variability to be lower within each of the groups than across groups, supporting the idea of currency blocs. The lowest variability occurs within Europe. The 1980 statistic is a standard deviation of .04 per cent, and it falls by half during the course of the decade.

Even though the members of the EC correspond roughly to the members of the European Monetary System,[14] non-EC members in Europe show as much stability in exchange rates (both vis-a-vis themselves and vis-a-vis other European countries) as EC members. The EC members show slightly more stability than the EFTA members in 1990, but slightly less in 1980. These results no doubt in part reflect

that the United Kingdom and the Mediterranean countries have not been consistent members of the Exchange Rate Mechanism, especially not with the narrow margins set by the others. [Presumably bilateral exchange rate variability in the EC rose sharply in 1992.] But it also reflects that such EFTA countries as Austria are loyal members of the currency club _de facto_, even though they are not at all in _de jure_. We saw in the first part of the paper that the statistical significance of intra-European trade links applies only to the EC, not to EFTA. Observing that the EFTA members have stabilized bilateral exchange rates as much or more than EC members, one immediately suspects that the stabilization of exchange rates must not have been the dominant source of the intra-EC trade links.

The members of APEC also have a relatively low level of intra-regional exchange rate variability, especially considering the diversity of the countries involved. It too fell by half in the course of the 1980s. The level of exchange rate variability is a bit higher within East Asia considered alone. This reflects that the international currency of Asia is not the yen, but rather the dollar. Results on the determination of exchange rates for nine East Asian countries in Frankel and Wei (1994) show that all place very heavy weight on the dollar in their implicit baskets.[15]

The Western Hemisphere considered alone in Table 7 shows much higher levels of exchange rate variability than any of the other groupings (in 1985 and 1990).

3.2 The influence of the dollar, yen, and DM on the values of smaller currencies

We now examine the influences which the most important international currencies have on the determination of the values of currencies of smaller countries. One way that countries in a given area could achieve the lower levels of intra-regional bilateral exchange rate variability observed in Table 7 is to link their currencies to the single most important currency in the region. In a simple version of the currency-bloc hypothesis, one would expect that the dollar has dominant influence in the Western Hemisphere, the yen in East Asia, and the mark (or ECU[16]) in Europe.

The equation to be estimated is

(2) Δ *(value of currency i) =*

$\alpha + \beta_1 \Delta$ *(value of \$)* $+ \beta_2 \Delta$ *(value of yen)* $+ \beta_3 \Delta$ *(value of DM)* $+ e$,

where the change in the value of each currency is computed logarithmically. The goal is to see whether countries try to stabilize their currencies in terms of a particular major currency. Such an equation is exceptionally well-specified under a particular null hypothesis, namely that the value of the local currency is determined as a basket peg (perhaps a crawling peg, since we allow for a constant term). By "exceptionally well-specified", we mean that the coefficients should be highly significant and the R^2 should be close to 1.

In 1988, for example, there were 31 countries that were

officially classified by the IMF as following a basket peg of their own design (plus another eight pegged to the SDR). They included Austria, Finland, Norway, Sweden, Iceland, and Thailand. [Some who claimed to define the value of their currency in terms of a basket, in fact followed an extremely loose link.] Most basket-peggers keep the weights in the basket secret, so that one can only infer the weight statistically from observed exchange rate movements. Previous tests have suggested that countries that are officially classified as basket-peggers in practice often exhibit a sufficiently wide range of variation around the basket index, or else alter the parity or weights sufficiently often, that they are difficult to distinguish empirically from countries classified as managed floaters.[17]

In applying equation (2) to a wide variety of countries, we realize that most do not even purport to follow a basket peg. Policy-makers in some countries monitor an index that is a weighted average of their trading partners, even though they allow the exchange rate to undergo large deviations from the index depending on current macroeconomic considerations or speculative sentiments. We can still meaningfully estimate the coefficients in the equation under the (restrictive) assumption that these local deviations -- the error term -- are uncorrelated with the values of the major currencies.

There is a methodological question of what numeraire should be used to measure the value of the currencies. Here we use the SDR as numeraire. Under the basket-peg null hypothesis, the choice of

numeraire makes no difference in the estimation of the weights (though more generally it does make some difference).[18]

Table 8 reports estimates for nine EC currencies. The sample period is 1979-90, broken into three sub-samples. We also allow for the possibility of some effect of a fourth major currency, pound sterling, in memory of the role it once played as the world's international currency. We impose the constraint that the weights on the four currencies sum to 1 (by subtracting the change in the value of the pound from each of the other variables).

The EC countries, as expected, give heavy weight to the DM. In the case of Belgium, the other three major currencies get no weight, and the weight on the DM is insignificantly different from 1 during most of the period. France, Denmark and the Netherlands show some sign of a small weight on the dollar. For Italy the weight on the dollar is statistically significant, and estimated at just over 0.1; the weight on the mark is around 0.8. Greece gave heavy weight to the dollar during the sub-period 1979-82, but this diminished thereafter. Ireland and Portugal also give some weight to the dollar in 1987-90, but, as with the others, give dominant weight to the DM throughout. No European country gives significant weight to the yen.

The implicit coefficient on the pound is equal to 1 minus the sum of the three coefficients reported. For Ireland, for example, the implicit coefficient on the pound ranges between .1 and .2. The pound is not generally significant, however. Multicollinearity between the pound and DM is very high, as one would expect. When

all four major currencies are entered on the righthand side without imposing the constraint that their coefficients sum to 1, the pound loses out to the mark, and is not significantly greater than zero for any of the EMS countries. (These results are not reported here, to save space.)

The DM also dominates among the six EFTA countries, shown in Table 9. Austria exhibits a very tight peg to the DM, as expected. (The R^2 is .98 or .99.) Switzerland also gives heavy weight to the DM. It, like some Nordics, appears to give significant weight to the yen as well at times. The four Nordic countries have a weight on the dollar which is highly significant statistically, though still less than the DM. The weight on the pound is seen also sometimes to be statistically significant for the Nordics, in the unconstrained estimation (not reported). But the pound gets less weight than either the DM or the dollar. Overall, the DM dominates.

Similar tests among five major Western Hemisphere currencies show the dollar dominant. [Colombia is close to a dollar peg (though with a large significant trend depreciation). Canada, Chile, and Mexico also have dollar weights in the neighborhood of 1.0. Argentina is the only country that consistently shows a weight on another currency (.5 on the DM) that is significant and larger than the dollar weight (.2). Its estimated weight on the pound is similar (.2). However the pound is not significant for any of the Latin American countries.][19]

In each region considered thus far, Europe and the Western

Hemisphere, almost all countries give dominant weight to the major currency of the region. This pattern is broken in East Asia, however.[20] The weight on the dollar is very high in most countries. Only in Indonesia, and to a lesser extent Singapore, is there sigificant evidence of a yen weight exceding 10 per cent. Each of the Asian countries is more properly classed in a dollar bloc than in a yen bloc.

We have also tried regression tests that do not impose the constraint that the weights on the major currencies sum to one (and that also exclude the pound). The results are similar: the DM reigns supreme in Europe, the dollar in the Western Hemisphere, and the dollar -- not the yen -- is also dominant in East Asia. A t-test does not reject the constraint that the sum of the three coefficients is 1 for the Western Hemisphere and Asian countries, but often does reject this constraint for the European countries, perhaps reflecting the absence of the pound and French franc.[21]

3.3. An attempt to estimate the effect of exchange rate variability on trade

One rationale for a country to assign weight to a particular currency in determining its exchange rate is the assumption that a more stable bilateral exchange rate will help promote bilateral trade with the partner in question. This is a major motivation for exchange rate stabilization in Europe. There have been quite a few time-series studies of the effect of exchange rate uncertainty on

21

trade overall,[22] but fewer cross-section studies of bilateral trade.

One exception is De Grauwe (1988), which looks at ten industrialized countries. Two others are Abrams (1980) and Brada and Mendez (1988). We will re-examine the question here using a data set that is more recent as well as broader, covering 63 countries. The updating of the data set turns out to be qualitatively important. A problem of simultaneous causality should be noted at the outset: if exchange rate variability shows up with an apparent negative effect on the volume of bilateral trade, the correlation could be due to the government's deliberate efforts to stabilize the currency vis-a-vis a valued trading partner, as easily as to the effects of stabilization on trade. Therefore we will also use the method of instrumental variable estimation to tackle the possible simultaneity bias.

Volatility is defined to be the standard deviation of the first difference of the logarithmic exchange rate. We start with the volatility of nominal exchange rates and embed this term in our gravity equation (1) for 1980, 1985 and 1990. The results are reported in Table 10, which does not include the trade bloc dummies. Most of the standard gravity coefficients are similar to those reported in the earlier results without exchange rate variability (Tables 1-6). Nominal exchange rate variability appears to have a statistically significant negative effect on the volume of trade in 1980; but the negative effect disappears in 1985 if we hold constant for distance and adjacency, and also in 1990

[whether we hold constant for the two geographic variables or not].

A presumably more relevant measure of exchange rate uncertainty is the volatility of the real exchange rate, which takes into account the differential inflation rates in the two countries in addition to movements in the nominal exchange rate. Table 10 also reports the gravity equation with real exchange rate volatility included. It has a statistically significant negative effect in every year, even when holding constant for the geographic variables. From these results, it would appear that the conventionally hypothesized effect of exchange rate uncertainty on trade is borne out.

We know that stabilization of bilateral exchange rates is correlated, not only with whether countries are neighbors, but also with whether they are located in the same continental area. When we add the bloc variables back into the equation, the statistical significance of the exchange rate variability term falls somewhat. OLS regressions are presented in Table 11. In addition to adding variables for the major continental groupings, this table extends the results by adding the EFTA bloc variable, and by measuring volatility as the level of the standard deviation rather than its log. The latter change allows the experiment of asking how much trade would go up if exchange rate variabilities like those reported in Table 7 were reduced to zero. The magnitude of the coefficients on the variability in level form is not, of course, to be compared with the magnitude in log form.[23]

In 1980, the coefficient[s] for the volatility term are still negative and statistically significant at the 99% level. In comparison to the earlier gravity results that did not include a role for exchange rate volatilities, the EC and Western Hemisphere bloc dummy variables appear with lower coefficients, suggesting that a bit of the bloc effect may have been attributable to exchange rate links. In 1985, the volatility parameter[s] are no longer significant (with the point estimate turning slightly positive). Clearly, much of the apparently significant effect of exchange rate variability in Table 10 was a spurious stand-in for the effect of regional trading arrangements like the EC. In 1990, the coefficient on real volatility returns to a negative sign, and is statistically significant, but only at the 90 per cent level. (Henceforth we concentrate our discussions on the regressions involving the real exchange rates.)

By way of illustration, these point estimates can be used for some sample calculations. They suggest that if the level of EC exchange rate variability that prevailed in 1980, a standard deviation of 0.050 per cent in Table 7, had been eliminated altogether, the volume of intra-EC trade would have increased by .77 per cent (=15.26 x.0504). In 1990, when both the standard deviation and its coefficient were smaller, the estimated effect on trade of eliminating real exchange rate variability within the EC would have been only .15 per cent (=8.04x.019).

Worldwide, the average level of exchange rate variability in 1990 was still .376 per cent. The estimated effect of adopting

fixed exchange rates worldwide was thus 3.02 per cent (=8.04x.376).

The exchange rate disruptions of September 1992 and August 1993 may herald a return to the level of variability among the EMS countries that prevailed in 1980. Table 7 shows that this would represent an approximate doubling of the standard deviation of exchange rates, relative to the stability that had been achieved by 1990. What would be the predicted effects on trade? The estimate in Table 11 suggests that trade would fall by .25 per cent (=8.04x(.050-.019)).[24]

Even if the stabilization of exchange rates achieved in Europe in the 1980s indeed raised trade on the order of .25 per cent, that is tiny compared to the 1/3 increase in trade bias estimated in our gravity model of Section 2 during the decade [1.68/1.26 = 1.34]. The exchange rate stabilization effect is only 7/10 of one per cent of the increase in the bias, which is in turn only half the total estimated 68 per cent European intra-regional trade bias in 1990. [It is also only a fraction of the total increase in intra-regional trade; recall from the first part of the paper that changes in such variables as GNP explain much of the variation in intra-regional trade flows.]

Interpretations of the estimates in Table 11, small as they may be, are complicated by the likelihood of simultaneity bias in the above regressions. Governments may choose deliberately to stabilize bilateral exchange rates with their major trading partners. This has certainly been the case in Europe. Hence, there could be a strong observed correlation between trade patterns

and currency linkages even if exchange rate volatility does not depress trade. To address this problem, we use the method of instrumental variable estimation, with the standard deviation of relative money supply as our instrument for the volatility of exchange rates. The argument in favor of this choice of instrument is that relative money supplies and bilateral exchange rates are highly correlated in theory (they are directly linked under the monetary theory of exchange rate determination), and in our data as well,[25] but monetary policies are less likely than exchange rate policies to be set in response to bilateral trade patterns. The results are reported in Table 12.

In 1980, the volatility parameter is still negative and significant at the 95% level. But the magnitude is much smaller than without using the instrument, suggesting that part of the apparent depressing effect of the volatility was indeed due to the simultaneity bias. Strong confirmation comes from an examination of the trade bloc coefficients for the EC and the Western Hemisphere: when the simultaneity is corrected, the presence of the volatility variable no longer reduces the trade bloc coefficient.

In 1990, the volatility parameter in Table 12 turns again into a positive number. The results suggest that if exchange rate volatility has depressed bilateral trade in the past, its negative effect diminished over the course of the 1980s. This sharp change is somewhat surprising.

Theoretical models of the behavior of the firm often produce the result that, because of convexity in the profit function,

exports can be an _increasing_ function of exchange rate variability. Only when the firm is sufficiently risk-averse does the intuitive negative effect on trade emerge. Several empirical studies have taken this possibility seriously, and perhaps we should as well.[26]

Before we put too much weight on the econometric findings for 1985 and 1990, it would be desirable to look at more data. Our final tests, reported in Tables 13-15, extend the results 15 years further back in history. The OLS results show a negative trade effect of exchange rate volatility (whether nominal or real) that is highly significant in 1965, 1970, and 1975, as well as 1980. Only in 1985 and 1990 does it turn positive. The Instrumental Variables results, reported in Table 15, show the same sign pattern across the years (though the negative effect is only statistically significant in 1965). One possible explanation is the rapid development of exchange risk hedging instruments.

In short, these results, while less robust than most of the other gravity equation findings, are generally consistent with the hypothesis that real exchange rate volatility has depressed bilateral trade a bit in the past. More specifically, they would appear to be a piece of evidence that the stabilization of exchange rates within Europe helped to promote intra-European trade from 1965 to 1980. But the evidence for a (small) negative trade effect, which starts out relatively strong in 1965, diminishes steadily in the 1970s and 1980s. The proliferation of currency options, forward contracts, and other hedging instruments may explain why even the small effect that appears once to have been

there has more recently disappeared.

4. Summary of conclusions regarding Europe

Trade within Europe was at a high level even before the 1980s, and increased rapidly during that decade. Much of the tendency to trade intra-regionally can be explained by natural economic factors: the size of the GNPs, the levels of GNP/capita, the proximity of the countries, the sharing of common borders and common languages, and the openness of the economies. Some of the increase in intra-regional trade in the 1970s and 1980s can be explained by an increase in GNP per capita (though to a lesser extent than in Pacific Asia).

There was also a highly significant increase in the degree of intra-regional trade bias in the course of the 1980s, most readily explained by deliberate policy initiatives of the European Community. (The same was true in the Western Hemisphere.) Our estimates in Table 3 suggest that a country joining the EC would in have experienced an increase in trade with other members of 68 per cent by 1990.[27] No such effect is observed for EFTA.

We have considered in this paper the possibility that the stabilization of exchange rates was a significant contributor to the increase in intra-regional trade. The standard deviation of exchange rates fell among EFTA countries by about half in the 1980s, and among EC countries by slightly more. Among both groups, the currencies in effect linked themselves to the mark, much as

28

Western Hemisphere (and East Asia) currencies in effect link themselves to the dollar.

We have found some possible cross-section evidence that real exchange rate variability has had an effect on trade volume. There is much more evidence that this factor is statistically significant in the period 1965-1980 than in 1985 or 1990. A possible explanation is the spread of hedging instruments. But even when the estimated effect is at is peak, it explains only a very small fraction of the intra-regional trade bias. It does not appear that the stabilization of European exchange rates in the 1980s played a large role in the increase in intra-regional trade.

*   *   *

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32

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<p style="text-align: center">*   *   *</p>

Table 1: EFTA and EEC as trade blocs, 1980

GNP	GNP/capita	Dist	Adja	WH2	EAEC2	APEC2	EUR2	EUR1	EEC2	EFTA2	EFTA-EEC	adj.R² /SEE	#OBS
.73**	.29**	-.56**	.71**	.52**	.78**	1.49**			.23			.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18			.18				
.73**	.29**	-.56**	.71**	.53**	.78**	1.49**			.23	.06		.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18			.18	.32			
.73**	.29**	-.56**	.71**	.52**	.78**	1.49**	-.01		.23			.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18	.16		.18				
.73**	.29**	-.56**	.71**	.52**	.78**	1.49**	-.02		.25	.07		.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18	.17		.22	.35			
.73**	.27**	-.53**	.75**	.63**	.76**	1.61**		.20**	.23			.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18		.07	.18				
.73**	.27**	-.53**	.75**	.63**	.76**	1.61**		.20**	.23	.06		.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18		.07	.18	.32			
.73**	.27**	-.54**	.75**	.62**	.76**	1.61**		.20**	.22		-.02	.71 / 1.20	1708
.02	.02	.04	.18	.15	.27	.18		.07	.18		.17		

Notes:

1. **, (*), [#], {##} denote "significant at the 99%, (95%), [90%] and {85%} levels, respectively.

2. All regressions have an intercept, which is not reported here. All variables except the dummies are in logs.

Table 2: EFTA and EEC as trade blocs, 1985

GNP	GNP/capita	Dist	Adja	WH2	EAEC2	APEC2	EUR2	EUR1	EEC2	EFTA2	EFTA-EEC	adj.R² /SEE	#OBS
.76**	.25**	-.70**	.75**	.34*	.57*	1.25**			.46**			.74/ 1.17	1647
.02	.02	.04	.18	.16	.26	.18			.18				
.76**	.25**	-.70**	.75**	.34*	.57*	1.25**			.46**	-.07		.74/ 1.17	1647
.02	.02	.04	.18	.16	.26	.18			.18	.32			
.76**	.25**	-.68**	.75**	.35*	.58*	1.26**	.10		.39#			.74 / 1.17	1647
.02	.02	.04	.18	.15	.27	.18	.16		.21				
.76**	.25**	-.69**	.76**	.35*	.58*	1.26**	.13		.37##	-.16		.74 / 1.17	1647
.02	.02	.04	.18	.15	.27	.18	.17		.22	.34			
.76**	.23**	-.67**	.79**	.45**	.56*	1.38**		.20**	.46**			.74 / 1.17	1647
.02	.02	.04	.18	.15	.26	.19		.07	.18				
.76**	.23**	-.67**	.79**	.45**	.56*	1.38**		.20**	.46**	-.05		.74 / 1.17	1647
.02	.02	.04	.18	.16	.26	.19		.07	.18	.32			
.76**	.22**	-.66**	.79**	.46**	.57*	1.39**		.20**	.49**		.14	.74 / 1.17	1647
.02	.02	.04	.18	.15	.26	.19		.07	.18		.16		

Table 3: EFTA and EEC as trade blocs, 1990

GNP	GNP/capita	Dist	Adja	WH2	EAEC2	APEC2	EUR2	EUR1	EEC2	EFTA2	EFTA-EEC	adj.R² /SEE	#OBS
.75**	.09**	-.55**	.79**	.93**	.66**	1.25**			.52**			.77/ 1.07	1647
.02	.02	.04	.16	.14	.24	.18			.18				
.75**	.10**	-.55**	.79**	.93**	.66**	1.33**			.52**	-.05		.77/ 1.07	1647
.02	.02	.04	.16	.14	.24	.16			.16	.29			
.75**	.09**	-.54**	.79**	.94**	.67**	1.34**	.17		.40*			.77 / 1.07	1647
.02	.02	.04	.16	.14	.24	.16	.14		.19				
.75**	.09**	-.54**	.80**	.94*	.67**	1.34**	.20		.37#	-.19		.77 / 1.07	1647
.02	.02	.04	.16	.14	.24	.16	.15		.20	.31			
.75**	.11**	-.56**	.77**	.89**	.67**	1.25**		-.11##	.51**			.77 / 1.07	1647
.02	.02	.04	.16	.14	.24	.17		.07	.16				
.75**	.11**	-.57**	.77**	.88**	.67**	1.25**		-.11##	.50**	-.07		.77 / 1.07	1647
.02	.02	.04	.16	.14	.24	.17		.07	.16	.29			
.75**	.10**	-.55**	.78**	.90**	.68**	1.26**		-.10	.56**		.19	.77 / 1.07	1647
.02	.02	.04	.16	.14	.24	.17		.07	.16		.15		

Table 4: A Gravity Equation of International Trade Volume (1990 Data)

Equation	Const	GNP	GNP/capita	Difference in GNP/capita	Dist	Adja	WH	EEC	APEC	R^2/S.E.E.
(1)	3.23**	.79**	.09**	-.06*	-.62**	.98**				.74/1.14
	.35	.02	.02	.02	.04	.17				
(2)	2.89**	.76**	.10**	-.04#	-.58**	.74**	.88**	.42**	1.63**	.77/1.07
	.34	.02	.02	.02	.04	.16	.14	.16	.12	

Notes:

(1) **, (*), [#] denote significant at the 99%, (95%), [90%] level.

(2) "R^2" is degree-of-freedom adjusted R^2. "S.E.E." is "standard error of regression."

(3) All variables (dependent variable and regressors) except the dummies are in logarithm.

(4) GNP - Product of two GNPs   GNP/capita - Product of two per capita GNPs
    Difference in GNP/capita - Absolute value of the difference in two per capita GNPs
    Dist - "Great circle distance" between the economic centers of two countries.
    Adja - Dummy for countries with a common land border.   WH - dummy for membership in Western Hemisphere (North, Central and South America).
    EEC - Dummy for membership in the EEC.   APEC - dummy for membership in the Asia Pacific Economic Cooperation forum.

Table 5 Factor Endowment in a Gravity Model

	GNP	GNP/capita	Dist	Adja	WH2	EAEC2	APEC2	EEC2	EFTA2	K/L	Edu	Land/L	adj.R² / SEE	#OBS
1980	.71**	.38**	-.49**	.54*	1.07**	.95**	1.70**	.30#	.03	.08*			.78 / .98	656
	.02	.02	.06	.21	.27	.26	.19	.17	.34	.03				
	.65**	.44**	-.48**	.51*	1.00**	.95**	1.67**	.28#	.06		.10**		.79 / .98	656
	.03	.03	.06	.21	.27	.26	.19	.17	.19		.03			
	.72**	.41**	-.45**	.55**	1.06**	.80**	1.79**	.29#	-.01			-.08*	.78 / .99	656
	.02	.03	.06	.21	.28	.27	.19	.17	.34			.03		
	.65**	.42**	-.46**	.56**	1.06**	.86**	1.72**	.31#	.10	.08*	.10**	-.06*	.79 / .98	656
	.03	.03	.06	.21	.27	.27	.19	.17	.33	.03	.03	.03		
1985	.73**	.40**	-.60**	.52*	.79**	.73**	1.34**	.46**	-.27	.03			.80 / .95	652
	.02	.03	.05	.21	.28	.25	.18	.16	.33	.03				
	.74**	.40**	-.60**	.51*	.78**	.72*	1.34**	.46**	-.29		-.004		.80 / .96	652
	.02	.03	.05	.21	.28	.25	.18	.16	.33		.03			
	.74**	.41**	-.57**	.53**	.79**	.62*	1.40**	.47**	-.29			-.06#	.81 / .95	652
	.02	.03	.05	.21	.28	.25	.18	.16	.32			.03		
	.74**	.40**	-.58**	.54*	.81**	.63**	1.40**	.47**	-.27	.03	-.01	-.06	.81 / .95	652
	.02	.03	.05	.21	.28	.26	.18	.16	.32	.03	.03	.03		
1990	.65**	.15**	-.48**	.75**	1.36**	.51*	1.34**	.40**	-.31	.01			.82 / .87	655
	.02	.02	.05	.21	.24	.23	.17	.15	.30	.03				
	.62**	.17**	-.48**	.74**	1.33**	.52**	1.33**	.40**	-.29		.04		.82 / .87	655
	.03	.03	.05	.19	.24	.23	.17	.15	.30		.03			
	.64**	.15**	-.50**	.72**	1.33**	.63**	1.28**	.39**	-.32			.06*	.82 / .87	655
	.02	.02	.05	.19	.24	.24	.17	.15	.30			.03		
	.62**	.17**	-.51**	.72**	1.32**	.67**	1.26**	.39**	-.28	.02	.04	.07*	.82 / .87	655
	.02	.02	.05	.19	.24	.24	.17	.15	.30	.03	.03	.03		

Notes: 1. **, (*), [#], (##) denote "significant at the 99%, (95%), [90%] and {85%} levels, respectively.
2. All regressions have an intercept, which is not reported here. All variables except the dummies are in logs.
3. "K/L, Edu, and Land/L" are differences in capital-labor ratio, educational attainment, and land-labor ratio, respectively.
4. The endowment variables are for 1980 only, but used in regressions for 1985 and 1990 as well.

Table 6
Linguistic Links in Trade
(Total Trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.63** (0.02)	0.64** (0.02)	0.72** (0.02)	0.74** (0.02)	0.53** (0.02)	0.76** (0.33)
GNP per capita	0.27** (0.02)	0.37** (0.02)	0.28** (0.02)	0.74** (0.02)	0.06* (0.02)	0.10** (0.02)
Distance	-0.45** (0.04)	-0.54** (0.04)	-0.70** (0.05)	-0.57** (0.04)	-0.36** (0.05)	-0.55** (0.04)
Adjacent	0.53** (0.17)	0.65** (0.17)	0.50** (0.18)	0.65** (0.18)	0.68** (0.20)	0.75** (0.16)
WH2	-0.07 (0.18)	-0.19 (0.17)	0.16 (0.18)	0.57** (0.18)	0.47* (0.21)	0.89** (0.17)
EAEC2	1.56** (0.29)	1.64** (0.30)	0.95** (0.32)	0.92** (0.27)	-0.37 (0.29)	0.63* (0.25)
APEC2	0.26 (0.21)	0.62** (0.21)	0.79** (0.22)	1.17** (0.19)	1.36** (0.20)	1.15** (0.17)
EEC2	0.26 (0.16)	0.08 (0.17)	-0.07 (0.18)	0.22 (0.18)	1.56** (0.19)	0.53** (0.16)
EFTA2	0.05 (0.30)	0.02 (0.29)	-0.05 (0.32)	0.06 (0.32)	0.10 (0.35)	-0.01 (0.29)
English	0.22 (0.30)	-0.09 (0.30)	0.22 (0.32)	0.42 (0.31)	-0.14 (0.34)	0.32 (0.29)
Spanish	-0.60# (0.34)	-0.24 (0.33)	-0.12 (0.36)	-0.31 (0.35)	-0.47 (0.40)	0.07 (0.33)
Chinese	0.76 (0.59)	1.77* (0.82)	0.63 (0.90)	0.77 (0.60)	0.58 (0.65)	1.35* (0.54)
Arabic	-0.29 (0.33)	-0.68* (0.33)	-0.42 (0.35)	-0.64# (0.35)	-0.68 (0.43)	-0.31 (0.34)
French	-0.29 (0.32)	-0.39 (0.32)	-0.24 (0.35)	-0.20 (0.34)	-0.42 (0.40)	0.27 (0.32)
Common language	0.51# (0.28)	0.50* (0.28)	0.28 (0.30)	0.37 (0.30)	0.76* (0.33)	0.12 (0.28)
# observations	1194	1274	1453	1708	1343	1573
SEE	1.05	1.07	1.17	1.18	1.26	1.06
adj. R^2	0.69	0.71	0.72	0.72	0.53	0.77

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummies are in logarithms
(4) "Common" -- dummy for common linguistic link
(German, Japanese, Dutch, Portugese and 5 languages in table)

MEAN VOLATILITY OF MONTHLY EXCHANGE RATES
(Standard Deviation of the first difference of the logs)

"Entire World" (63 countries)

80	0.0033326
85	0.0038924
90	0.0037581

Western Hemisphere

# OF OBS:	Among Members 36	With the Rest-of-the-World 344
80	0.00082119	0.0023124
85	0.0089124	0.0075748
90	0.0092027	0.0063593

E C

# OF OBS:	Among Members 45	With the Rest-of-the-World 375
80	0.00050407	0.0023273
85	0.00051604	0.0023506
90	0.00018748	0.0024069

EFTA

# OF OBS:	Among Members 15	With the Rest-of-the-World 239
80	0.00039787	0.0021484
85	0.00019827	0.0022575
90	0.00021040	0.0022201

Europe

# OF OBS:	Among Members 105	With the Rest-of-the-World 527
80	0.00044489	0.0024422
85	0.00039840	0.0026458
90	0.00020584	0.0025362

EAEG

# OF OBS:	Among Members 15	With the Rest-of-the-World 237
80	0.0010283	0.0023404
85	0.00072587	0.0022070
90	0.00044533	0.0023494

APEC

# OF OBS:	Among Members 28	With the Rest-of-the-World 308
80	0.00083386	0.0022884
85	0.00060796	0.0022079
90	0.00039396	0.0024002

Table 8
Currencies in the
European Community
Table 'a: Weights Assigned to Foreign Currencies in Determining Changes in Value
(Constrained Estimation)

Time Period	Const	USD	Yen	DM	Pound	adj.R²/DW	#Obs	S.E.R.
France-Franc								
79.1-82.12	-.005*	-.010	.074	.872**		.737/2.31	47	.013
	.002	.071	.056	.070				
83.1-86.12	-.003##	.066	-.005	.853**		788/1.95	48	.012
	.002	.062	.086	.085				
87.1-90.12	-.000	.054*	-.023	.897**		.911/1.80	48	.005
	.001	.026	.038	.044				
79.1-90.12	.003**	.031	.033	.868**		.800/2.09	143	.011†
	.009	.029	.033	.038				
Italy-Lire								
79.1-82.12	-.006**	.118*	.052	.782**		.747/2.13	47	.011
	.002	.060	.047	.059				
83.1-86.12	-.004**	.144**	.085	.857**		.866/2.15	48	.008
	.001	.045	.063	.062				
87.1-90.12	-.001	.120**	-.055	.808**	?	.879/1 6/	48	.006
	.001	.027	.039	.046				
79.1-90.12	-.003**	.121**	.050#	.821**		.818/1.85	143	.009
	.001	.025	.028	.033				
Belgium-Franc								
79.1-82.12	-.005*	-.042	.043	.897**		.756/1.76	47	.013
	.002	.070	.055	.069				
83.1-86.12	-.007	.017	-.015	.958**		.975/1.84	48	.004
	.001	.022	.030	.030				
87.1-90.12	.001	.021#	-.035#	.966**		.980/1.51	48	.003
	.000	.013	.019	.022				
79.1-90.12	-.002**	-.001	.015	.931**		.887/1.64	143	.008
	.001	.023	.025	.030				

Notes: (1) All currencies are measured in terms of SDR (USD 0.42, DM 0.19, Yen 0.15, French Franc 0.12, Pound 0.12).

(2) **, (*), [#], (##), denotes "significant at the 99%, (95%), [90%], (85%) level."

Table b: Weights Assigned to Foreign Currencies in Determining Changes in Value
(Constrained Estimation)

Time Period	Const	USD	Yen	DM	Pound	adj.R²/DW	#Obs	S.E.R.
Denmark-Krone								
79.1-82.12	-.005**	.018	.122**	.873**		.853/2.07	47	.009
	.001	.051	.040	.051				
83.1-86.12	-.001	.041	-.026	.955**		.942/2.46	48	.001
	001	.032	.045	.045				
87.1-90.12	-.000	.052*	.002	.951**		.913/1.90	48	.006
	.001	.026	.038	.045				
79.1-90.12	-.002**	.019	.061*	.913**		.895/1.90	143	.008
	.001	.021	.024	.028				
Netherlands-Guilder								
79.1-82.12	-.000	-.040##	.053##	.924**		.968/2.20	48	.005
	.001	.025	.035	.034				
83.1-86.12	-.004**	.144**	.085	.857**		.866/2.15	48	.008
	.001	.045	.063	.062				
87.1-90.12	-.000	.000	-.014	.998**		.982/2.94	48	.003
	.000	.012	.018	.021				
79.1-90.12	-.000	-.007	.000	.935**		.960/2.14	143	.009
	.000	.013	.014	.017				
Greece-Drachma								
79.1-82.12	-.011**	.427**	.074	.383**		.122/1.82	47	.018
	.003	.099	.078	.098				
83.1-86.12	-.017**	.186	.069	.688**		.150/1.71	48	.036
	.005	.191	.266	.262				
87.1-90.12	-.000	.078**	-.046##	.822**		.927/2.00	48	.005
	.001	.021	.032	.037				
79.1-90.12	-.011**	.230**	.073	.543**		.215/2.01	143	.024
	.002	.066	.073	.086				

Notes: (1) All currencies are measured in terms of SDR (USD 0.42, DM 0.19, Yen 0.15, French Franc 0.12, Pound 0.12).

(2) **, (*), [#], (##), denotes "significant at the 99%, (95%), [90%], (85%) level."

Table c: Weights Assigned to Foreign Currencies in Determining Changes in Value
(Constrained Estimation)

Time Period	Const	USD	Yen	DM	Pound	adj.R²/DW	#Obs	S.E.R.
Ireland-Pound								
79.1-82.12	-.003*	.057	.022	.825**		.861/2.21	47	.008
	.001	.044	-.034	.043				
83.1-86.12	-.004*	-.056	.152##	713**		.770/1.72	48	.013
	.002	.067	.094	.093				
87.1-90.12	-.000	.078**	-.046##	.822**		.927/2.00	48	.005
	.001	.021	.032	.037				
79.1-90.12	-.002**	.036	.017	.813**		.829/1.95	143	.009
	.001	.026	.029	.033				
Portugal-Escudo								
79.1-82.12	-.010**	.211#	.064	.510**		.225/1.95	47	.020
	.003	.109	.085	.108				
83.1-86.12	-.013**	.035	.175	.471**		.441/1.83	48	.020
	.003	.106	.147	.145				
87.1-90.12	-.003**	.152**	.034	.636**		.6889/1.80	48	.005
	.001	.022	.032	.037				
79.1-90.12	-.008**	.136**	.050	.548**		.430/1.79	143	.017
	.001	.047	.052	.061				
Spain-Peseta								
79.1-82.12	.016	1.920	.534	-.108		-.060/2.39	47	.557
	.082	3.031	2.373	2.99				
83.1-86.12	-.016*	-1.687**	.367	2.125**		.758/2.06	48	.044
	.007	.237	.330	.325				
87.1-90.12	-.034	-1.266	.413	3.421		-.051/2.28	48	.593
	.087	2.777	4.106	4.767				
79.1-90.12	-.006	-.421	.376	1.487		-.012/2.31	143	.460
	.039	1.289	1.432	1.680				

Notes: (1) All currencies are measured in terms of SDR (USD 0.42, DM 0.19, Yen 0.15, French Franc 0.12, Pound 0.12).

(2) **, (*), [#], (##), denotes "significant at the 99%, (95%), [90%], (85%) level."

Table 9

Currencies in EFTA

Table a: Weights Assigned to Foreign Currencies in Determining Changes in Value
(Constrained Estimation)

Time Period	Const	USD	Yen	DM	Pound	adj.R²/DW	#Obs	S.E.R.
Austria-Schilling								
79.1-82.12	.001*	-.014	-.007	1.035**		.987/2.03	47	.003
	.000	.017	.013	.016				
83.1-86.12	-.000	.016	-.010	.994*·		.992/2.59	48	.002
	.000	.012	.017	.016				
87.1-90.12	-.000	.011	.005	1.005**		.951/2.31	48	.004
	.001	.021	.031	.036				
79.1-90.12	.000	.008	-.008	1.011**		.981/2.28	143	.003
	.000	.009	.010	.012				
Finland-Markka								
79.1-82.12	-.003	.266**	.110	.477**		.256/1.80	47	.018
	.003	.100	.078	.098				
83.1-86.12	-.001	.138**	.097	.558**		.911/2.01	48	.005
	.001	.028	.039	.039				
87.1-90.12	-.001	.188**	.012	. 09**		.711/1.79	48	.007
	.001	.035	.052	.060				
79.1-90.12	-.000	.182**	.088*	.526**		.577/1.90	143	.012
	.001	.033	.036	.043				
Norway-Krone								
79.1-82.12	-.003#	.280**	.097#	.489**		.463/1.37	47	.012
	.002	.066	.051	.065				
83.1-86.12	-.004*	.066	.129	.583**		.654/2.17	48	.014
	.002	.072	.100	.099				
87.1-90.12	.001	.281**	.077	.434**		.523/1.60	48	.008
	.001	.039	.058	.067				
79.1-90.12	-.002	.198**	.083*	.529**		.568/1.99	143	.012
	.001	.033	.037	.043				

Notes: (1) All currencies are measured in terms of SDR (USD 0.42, DM 0.19, Yen 0.15, French Franc 0.12, Pound 0.12).

(2) **, (*), [#], (##), denotes "significant at the 99%, (95%), [90%], (85%) level."

Table b: Weights Assigned to Foreign Currencies in Determining Changes in Value
(Constrained Estimation)

Time Period	Const	USD	Yen	DM	Pound	adj.R²/DW	#Obs	S.E.R.
Sweden-Krona								
79.1-82.12	-.007#	.240#	.136	.354*		.070/1.84	47	.027
	.004	.145	.113	.143				
83.1-86.12	-.001#	.245**	.104**	.48?**		.910/2.05	48	.004
	.001	.023	.031	.J.				
87.1-90.12	-.000	.290**	.048	.473**		.713/1.41	48	.006
	.001	.026	.038	.045				
79.1-90.12	.003*	.246**	.115*	.430**		.328/1.72	143	.016
	.001	.044	.049	.058				
Switzerland-Francs								
79.1-82.12	-.002	-.115	.121#	1.041**		.729/1.63	47	.017
	.002	.091	.071	.090				
83.1-86.12	-.001	-.157*	.366**	.629**		.800/1.87	48	.013
	.002	.067	.093	.092				
87.1-90.12	-.001	.029	.100	.81?**		.682/1.73	48	.013
	.002	.060	.089	.103				
79.1-90.12	-.000	-.070#	.147**	.888**		.731/1.72	143	.014
	.001	.040	.045	.053				
Iceland-Krona								
79.1-82.12	-.034**	.751	-.080	.277##		.007/2.23	47	.033
	.005	.183	.143	.181				
83.1-86.12	-.021**	.428#	-.060	.759*		.071/1.83	48	.042
	.006	.222	.309	.305				
87.1-90.12	.011**	.245*	-.077	.44??		.142/2.13	48	.021
	.003	.100	.148	.172				
79.1-90.12	-.021**	.392**	-.015	.514**		.054/1.90	143	.035
	.003	.097	.108	.126				

Notes: (1) All currencies are measured in terms of SDR (USD 0.42, DM 0.19, Yen 0.15, French Franc 0.12, Pound 0.12).
(2) **, (*), [#], (##), denotes "significant at the 99%, (95%), [90%], (85%) level."

Table 10: Exchange Rate Volatility and Bilateral Trade
(OLS Estimation)

1980		Volat	GNPs	GNP/cap	Dist	Adj	adj.R^2	S.E.E.
	Nominal Ex Rate	-.077**	.78**	.32**			.63	1.39
		.026	.02	.02				
		-.064**	.78**	.24**	-.69**	.39##	.71	1.25
		.023	.02	.02	.05	.22		
	Real Ex Rate	-.148**	.76**	.31**			.66	1.35
		.033	.02	.03				
		-.088**	.76**	.25**	-.67**	.60**	.74	1.19
		.030	.02	.03	.05	.23		
1985	Nominal Ex Rate	-.159**	.75**	.29**			.65	1.37
		.022	.02	.02				
		.009	.80**	.23**	-.77**	.74**	.73	1.19
		.021	.02	.02	.04	.19		
	Real Ex Rate	-.263**	.72**	.27**			.69	1.32
		.028	.02	.03				
		-.041##	.78**	.24**	-.76**	.60**	.76	1.15
		.028	.02	.02	.05	.22		
1990	Nominal Ex Rate	.016	.77**	.13**			.67	1.30
		.016	.02	.02				
		.066**	.80**	.07**	-.69**	.92**	.76	1.10
		.014	.02	.02	.04	.17		
	Real Ex Rate	-.133**	.79**	.17**			.75	1.16
		.026	.02	.02				
		-.079**	.81**	.09**	-.62**	.51**	.81	1.01
		.023	.02	.02	.04	.21		

Notes:

(1) Standard errors are below the coefficient estimates.

(2) **, *, # and ## denote "statistically significant" at the 99%, 95%, 90% and 85% levels, respectively.

Table 11: Exchange Rate Volatility and Bilateral Trade
(OLS Estimation)

	Volat	GNPs	GNP/cap	Dist	Adj	WH	EEC	EFTA	EAEC	APEC	adj.R²	S.E.E.
1980												
		.74**	.29**	-.56**	.72**	.52**	.23		.88**	1.51**	.71	..29
		.02	.02	.04	.18	.15	.18		.27	.17		
Nominal Ex Rate	-56.11**	.77**	.24**	-.74**	.24	.13	-.14	-.08	.96**	1.31**	.74	1.17
	7.45	.02	.02	.05	.21	.23	.18	.32	.36	.19		
Real Ex Rate	-15.26**	.74**	.27**	-.70**	.48*	.17	-.09	-.22	.90*	1.40**	.76	1.14
	5.25	.02	.02	.05	.22	.20	.18	.38	.37	.22		
1985												
		.76**	.25**	-.70**	.75**	.33**	.44*		.59*	1.28**	.74	1.17
		.02	.02	.04	.18	.16	.17		.26	.17		
Nominal Ex Rate	.23	.77**	.24**	-.72**	.61**	.26##	.45*	-.02	.79*	1.18**	.75	1.16
	.49	.02	.02	.04	.19	.17	.18	.31	.36	.19		
Real Ex Rate	.09	.77**	.25**	-.77**	.46*	-.05	.26##	-.19	.72*	1.13**	.78	1.12
	.53	.02	.02	.05	.22	.20	.17	.31	.36	.21		
1990												
		.75**	.09**	-.56**	.79**	.92**	.47**		.69*	1.36**	.77	1.07
		.02	.02	.04	.16	.14	.16		.24	.15		
Nominal Ex Rate	5.23**	.78**	.09**	-.66**	.53**	.67**	.41**	-.03	.68*	1.35**	.80	1.02
	.58	.02	.02	.04	.16	.14	.16	.28	.32	.17		
Real Ex Rate	-8.04#	.79**	.12**	-.61**	.35#	.53**	.29	-.09	.91**	1.12**	.83	.97
	4.39	.02	.02	.04	.20	.17	.17	.27	.27	.17		

Notes:

(1) The volatility variable is in level. All the other variables except the dummies are in logarithm. All the regressions have an intercept for which the estimate is not reported here.

(2) Standard errors are below the coefficient estimates.

(3) **, *, # and ## denote "statistically significant" at the 99%, 95%, 90% and 85% levels, respectively.

Table 12: Exchange Rate Volatility and Bilateral Trade
(Instrumental Variable Estimation)

		Volat	GNPs	GNP/cap	Dist	Adj	WH	EEC	EFTA	EAEC	APEC	adj.R²	S.E.E.
1980													
	Nominal	-.15E-04##	.73**	.27**	-.55**	.74**	.60**	.23	.07	.91**	1.48**	.71	..20
	Ex Rate	.07E-04	.02	.02	.04	.18	.15	.18	.32	.27	.17		
	Real	-.19E-04**	.73**	.27**	-.55**	.76**	.64**	.23	.07	.90**	1.48**	.71	1.20
	Ex Rate	.07E-04	.02	.02	.05	.18	.15	.18	.32	.27	.17		
1985													
	Nominal	.28E-05	.76**	.25**	-.70**	.75**	.32*	.45**	-.06	.58*	1.29**	.74	1.17
	Ex Rate	.73E-05	.02	.02	.04	.18	.16	.18	.32	.26	.17		
	Real	.41E-05	.76**	.25**	-.70**	.75**	.31*	.45**	-.06	.58*	1.29**	.74	1.17
	Ex Rate	.75E-05	.02	.02	.04	.18	.16	.17	.32	.26	.17		
1990													
	Nominal	.18E-04*	.76**	.11**	-.56**	.78**	.84**	.49**	-.07	.66**	1.38**	.77	1.07
	Ex Rate	.07E-04	.02	.02	.04	.16	.14	.16	.29	.24	.15		
	Real	.23E-04**	.76**	.11**	-.56**	.75**	.80**	.49**	-.07	.65**	1.38**	.78	1.06
	Ex Rate	.08E-04	.02	.02	.04	.16	.:4	.16	.29	.24	.15		

Notes:

(1) The volatility variable is in level. The volatility of the relative money supply is used as its instrument. All the other variables except the dummies are in logarithm. All the regressions have an intercept for which the estimate is not reported here.

(2) Standard errors are below the coefficient estimates.

(3) **, *, # and ## denote "statistically significant" at the 99%, 95%, 90% and 85% levels, respectively.

Table 13
Effect of Exchange Rate Volatility: Nominal Rates
(Total Trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.63** (0.02)	0.64** (0.02)	0.72** (0.02)	0.76** (0.02)	0.76** (0.02)	0.76** (0.02)
GNP per capita	0.27** (0.02)	0.36** (0.02)	0.27** (0.02)	0.27** (0.02)	0.25** (0.02)	0.12** (0.02)
Distance	-0.40** (0.04)	-0.51** (0.04)	-0.68** (0.05)	-0.62** (0.04)	-0.71** (0.04)	-0.60** (0.04)
Adjacency	0.78** (0.17)	0.69** (0.17)	0.53** (0.18)	0.64** (0.18)	0.73** (0.18)	0.68** (0.16)
WH2	0.05 (0.16)	0.01 (0.14)	0.26# (0.15)	0.44** (0.15)	0.34* (0.16)	0.71** (0.14)
EAEC2	1.59** (0.31)	1.60** (0.29)	0.87** (0.33)	0.81** (0.26)	0.60* (0.28)	0.67** (0.25)
APEC2	0.60** (0.22)	0.70** (0.17)	0.87** (0.23)	1.35** (0.18)	1.21** (0.19)	1.39** (0.17)
EE2	0.20 (0.16)	0.08 (0.21)	-0.10 (0.18)	0.01 (0.18)	0.45* (0.18)	0.51** (0.16)
NV	-3.81** (0.60)	-2.47** (0.09)	-1.49* (0.74)	-7.65** (0.08)	0.13 (0.34)	2.24** (0.27)
# observations	1115	1231	1401	1653	1589	1519
adj R^2	0.70	0.72	0.72	0.72	0.74	0.78
SEE	1.04	1.06	1.18	1.18	1.17	1.05

Notes:
(1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t= >2.576)
  * denotes significant at 5% level (t= >1.96)
  # denotes significant at 10% level (t= >1.645)
(3) All variables except the dummies are in logarithms

Table 14
Effect of Exchange Rate Volatility: Real Rates
(Total Trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.72**	0.65**	0.72**	0.74**	0.76**	0.76**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
GNP per capita	0.24**	0.36**	0.27**	0.26**	0.25**	0.12**
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Distance	-0.53**	-0.50**	-0.67**	-0.62**	-0.71**	-0.57**
	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)
Adjacency	0.59**	0.77**	0.58**	0.73**	0.73**	0.80**
	(0.18)	(0.16)	(0.18)	(0.18)	(0.18)	(0.16)
WH2	0.02	0.02	0.27#	0.42**	0.30#	0.74**
	(0.15)	(0.13)	(0.15)	(0.15)	(0.15)	(0.14)
EAEC2	0.99*	1.80**	0.85**	0.76**	0.60*	0.71**
	(0.50)	(0.32)	(0.32)	(0.26)	(0.27)	(0.25)
APEC2	0.44#	0.67**	0.90**	1.35**	1.16**	1.38**
	(0.26)	(0.21)	(0.22)	(0.18)	(0.18)	(0.17)
EE2	0.04	0.08	-0.06	0.02	0.40*	0.57**
	(0.17)	(0.16)	(0.18)	(0.18)	(0.17)	(0.16)
RV	-3.02**	-2.72**	-1.57*	-6.97**	0.12	3.19**
	(0.67)	(0.83)	(0.82)	(0.08)	(0.37)	(0.27)
# observations	773	1053	1316	1503	1500	1494
adj R^2	0.76	0.76	0.74	0.75	0.75	0.78
SEE	0.94	0.99	2.21	1.13	1.14	1.04

Notes:
- (1) Standard errors are in parentheses
- (2) ** denotes significant at 1% level (t=>2.576)
  - * denotes significant at 5% level (t=>1.96)
  - # denotes significant at 10% level (t=>1.645)
- (3) All variables except the dummies are in logarithms

Table 15
Effect of Real Exchange Rate Volatility:
Using Volatility of Relative Money Supply as Instrument
(Total Trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.82** (0.05)	0.66** (0.02)	0.72** (0.02)	0.74** (0.02)	0.78** (0.02)	0.77** (0.02)
GNP per capita	-0.07 (0.12)	0.33** (0.04)	0.25** (0.02)	0.26** (0.03)	0.21** (0.02)	0.11** (0.02)
Distance	-0.50** (0.12)	-0.51** (0.08)	-0.69** (0.05)	-0.67** (0.05)	-0.74** (0.05)	-0.61** (0.04)
Adjacency	1.09** (0.47)	0.69** (0.18)	0.51** (0.20)	0.62** (0.19)	0.66** (0.20)	0.70** (0.17)
WH2	1.10# (0.60)	0.16 (0.43)	0.42* (0.17)	0.49** (0.15)	0.33# (0.17)	0.55** (0.17)
EAEC2	1.28 (0.92)	1.71** (0.43)	0.90* (0.35)	0.79* (0.32)	0.70# (0.36)	0.52# (0.27)
APEC2	0.26 (0.46)	0.74** (0.23)	1.09** (0.24)	1.49** (0.20)	1.22** (0.21)	1.39** (0.17)
EE2	-0.17 (0.35)	0.00 (0.18)	-0.12 (0.24)	0.00 (0.22)	0.39# (0.20)	0.59** (0.16)
RV	-38.03* (0.28)	-4.54 (11.73)	-2.05 (1.54)	-0.28 (3.22)	0.18 (0.46)	3.89** (0.59)
# observations	393	921	1076	1187	1163	1319
adj R²	0.51	0.76	0.73	0.74	0.76	0.79
SEE	1.40	0.97	1.14	1.13	1.12	1.03

Notes:
(1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t= >2.576)
      * denotes significant at 5% level (t= >1.96)
      # denotes significant at 10% level (t= >1.645)
(3) All variables except the dummies are in logarithms

Appendix: List of Countries Used in the Gravity Equation

showing regional groupings, and main city

(The distance between countries was computed as the Great
Circle distance between the relevant pair of cities.)

Americas (WH, 13)

Canada	Ottawa
US	Chicago
Argentina	Buenos Aires
Brazil	Sao Paulo
Chile	Santiago
Colombia	Bogota
Ecuador	Quito
Mexico	Mexico City
Peru	Lima
Venezuela	Caracas
Bolivia	La Paz
Paraguay	Asuncion
Uruguay	Montevideo

European Community (EC, 11)

W.Germany	Bonn
France	Paris
Italy	Rome
UK	London
Belgium	Brussels
Denmark	Copenhagen
Netherlands	Amsterdam
Greece	Athens
Ireland	Dublin
Portugal	Lisbon
Spain	Madrid

European Free Trade Area (EFTA, 6)

Austria	Vienna
Finland	Helsinki
Norway	Oslo
Sweden	Stockholm
Switzerland	Geneva
Iceland	Reykjavik

East Asia (EAEG, 10)

Japan	Tokyo
Indonesia	Jakarta
Taiwan	Taipei
HongKong	HongKong
S.Korea	Seoul
Malaysia	Kuala Lumpur
Philippines	Manila
Singapore	Singapore
Thailand	Bangkok
China	Shanghai

Other countries (23)

S. Africa	Pretoria
Turkey	Ankara
Yugoslavia	Belgrade
Israel	Jerusalem
Algeria	Algiers
Libya	Tripoli
Nigeria	Lagos
Egypt	Cairo
Morocco	Casablanca
Tunisia	Tunis
Sudan	Khartoum
Ghana	Accra
Kenya	Nairobi
Ethiopia	Addis Ababa
Iran	Tehran
Kuwait	Kuwait
Saudi Arabia	Riyadh
India	New Delhi
Pakistan	Karachi
Hungary	Budapest
Poland	Warsaw
Australia	Sydney
New Zealand	Wellington

Note: APEC consists of East Asia, plus Australia, New Zealand,
Canada & the United States.

Table A1: Non-linear Least Square Estimation
(Including data points for which trade is zero)

	GNP	GNP/capita	Dist	Adjac	WH	EEC	EFTA	EAEC	APEC	adj.R²	S.E.E.	#Obs
1980	.56**	.23**	-.28**	.47**	.29**	.51**		.58**	.82**	.86	1347	1953
	.01	.02	.02	.03	.04	.05		.08	.03			
	.58**	.22**	-.31**	.45**	.26**	.43**	.09	.57**	.81**	.86	1360	1953
	.01	.02	.02	.03	.04	.05	.23	.08	.03			
1985	.65**	.18**	-.44**	.42**	-.21**	.40**		.13*	.95**	.93	1164	1953
	.01	.01	.02	.03	.04	.04		.06	.03			
	.67**	.18**	-.46**	.42**	-.23**	.38**	.23	.16*	.94**	.93	1301	1953
	.01	.01	.02	.03	.04	.04	.22	.06	.03			
1990	.59**	.14**	-.36**	.47**	.10**	.45**		.00	1.03**	.90	2373	1953
	.01	.01	.02	.03	.04	.04		.06	.03			
	.60**	.13**	-.38**	.48**	.08**	.41**	-.00	.01	1.00**	.90	2393	1953
	.01	.01	.02	.03	.04	.04	.22	.06	.03			

Notes:

(1) **, (*), [##] denotes "significantly different from zero at the 1%, (5%), [15%] level."

(2) All the regressions have an intercept whose estimates are not reported here. All variables are in levels.

Table A2: Non-linear Least Square Estimation
(excluding data points for which trade is zero)

	GNP	GNP/capita	Dist	Adjac	WH	EEC	EFTA	EAEC	APEC	adj.R²	S.E.E.	#Obs
1980	.56**	.23**	-.28**	.47**	.29**	.51**		.57**	.83**	.86	1439	1708
	.01	.02	.02	.04	.05	.05		.09	.04			
	.58**	.21**	-.31**	.45**	.25**	.43**	.09	.55**	.81**	.86	1453	1708
	.01	.02	.02	.04	.05	.05	.25	.09	.04			
1985	.65**	.18**	-.45**	.42**	-.23**	.38**		.10##	.95**	.93	1262	1647
	.01	.01	.02	.03	.04	.05		.07	.03			
	.65**	.18**	-.46**	.41**	-.24**	.36**	.20	.10##	.95**	.93	1266	1647
	.01	.01	.02	.03	.04	.05	.23	.07	.03			
1990	.59**	.13**	-.37**	.47**	.09*	.44**		-.02	1.04**	.90	2634	1573
	.01	.02	.02	.03	.04	.04		.06	.03			
	.60**	.12**	-.38**	.47**	.06##	.39**	-.02	-.03	1.02**	.90	2669	1573
	.01	.02	.02	.03	.04	.04	.23	.06	.03			

Notes:

(1) **, (*), [##] denotes "significantly different from zero at the 1%, (5%), [15%] level."

(2) All the regressions have an intercept whose estimates are not reported here. All variables are in levels.

Appendix: Sensitivity of Results to Overweighting Small Countries or to Excluding Zero-Trade Pairs

Table A3: Weighted Least Squares
(With the log of the product of the GNPs as the weights)

	GNP	GNP/capita	Dist	Adjac	WH	EEC	EFTA	EAEC	APEC	adj.R^2	S.E.E.	#Obs
1980	.75**	.29**	-.56**	.69*	.53**	.24		.89**	1.48**	.72	1.19	1708
	.02	.02	.04	.17	.15	.17		.26	.16			
	.74**	.29**	-.56**	.68**	.53**	.23	.07	.89**	1.48**	.72	1.20	1708
	.02	.02	.04	.18	.15	.17	.32	.26	.16			
1985	.77**	.25**	-.70**	.72**	.31*	.43**		.59*	1.26**	.74	1.16	1647
	.02	.02	.04	.18	.15	.17		.25	.16			
	.76**	.25**	-.70**	.72**	.31*	.44**	-.06	.59*	1.26**	.74	1.16	1647
	.02	.02	.04	.18	.15	.17	.32	.25	.16			
1990	.75**	.09**	-.56**	.76**	.90**	.47**		.69**	1.35**	.78	1.05	1573
	.02	.02	.04	.16	.14	.15		.23	.14			
	.74**	.10**	-.55**	.71**	.86**	.51**	-.04	.68**	1.33**	.79	1.03	1573
	.02	.02	.04	.15	.14	.14	.28	.22	.13			

Notes:

(1) **, (*), [##] denotes "significantly different from zero at the 1%, (5%), [15%] level."

(2) All the regressions have an intercept whose estimates are not reported here. All variables except the dummies are in logarithm.

Appendix Table 4: Variance of Relative Money Supply
as an Instrument for Exchange Rate Volatility (Variance)

		Const.	S.D. of Rel. Mny Spply	adj.R^2	S.E.E.
1980					
	Nominal Ex Rate	.00205** .00023	-.0306 .0522	-.0006	.0049
	Real Ex Rate	-.00104** .0003	1.361** .075	.268	.0063
1985					
	Nominal Ex Rate	.0017** .0004	.8150** .0817	.081	.0071
	Real Ex Rate	.0030** .0003	.1841** .0624	.008	.0049
1990					
	Nominal Ex Rate	-.0150** .0010	4.2505** .948	.642	.0278
	Real Ex Rate	.0027** .0004	.0935/// .0639	.0014	.0073

Notes:

(1) Standard errors are below the coefficient estimates.

(2) **, *, // and /// denote "statistically significant" at the 99%, 95%, 90% and 85% levels, respectively.

Notes

1. Frankel (1991) presented a back-of-the-envelope measure of intra-regional bias: the <u>ratio</u> of the intra-regional trade share to the share of world trade. Anderson and Norheim (1992) use similar calculations of "intensity of trade indexes."

2. The results of one extensive early project along these lines were reported in Tinbergen (1962, Appendix VI, pp.262-293) and Linneman (1967). Foundations for the gravity model are offered in papers surveyed by Deardorff (1984, pp.503-06) and Wang and Winters (1992).

3. The focus of these papers was on potential Eastern European trade patterns. The Winters papers report statistically significant within-region biases to the following groupings: EC, Latin America, ASEAN, former British colonies, GSP, and EC preferences under the Lome convention. Havrylyshyn and Pritchett (1991) report significant effects for the EC, LAFTA and CACM.

4. Eichnegreen and Wyplosz (1993, p.136-37).

5. The list of countries, and regional groupings, is given in an Appendix [e.g., Frankel (1993)].

6. The specification implies that trade between two equal-sized countries (say, of size .5) will be greater than trade between a large and small country (say, of size .9 and .1). This property of models with imperfect competition is not a property of the classical Heckscher-Ohlin theory of comparative advantage. Helpman (1987) and Helpman and Krugman (1985, section 1.5). We have also tried to capture classic Heckscher-Ohlin effects, first by including bilateral absolute differences in GNP/capita figures, and then by including some factor endowment variables with data (for a subset of 656 of our 1,953 pairs of countries) generously supplied by Gary Saxonhouse (1989). There is some support for these terms [not reported here]. The other coefficients are little affected.

7. The use of the multiplicative form itself changes the results, however. Linnemann (1966) and Wang and Winters (1992) addressed the problem of trade flows so small as to be recorded as zero in another way: by trying the tests with fractions (like .5) of the minimum recordable unit substituted for the zeros. Eichengreen and Irwin (1993), examining the interwar period, use a third approach: they run the dependent variable (trade) in levels rather than logs, and use TOBIT to truncate negative values. They find that exclusion of zero values does make a difference to two parameter estimates: the coefficients on income per capita, and adjacency.

8. Frankel, Stein, and Wei (1993).

9. Table 5 in Frankel (1993).

10.   This is the same result found by Hamilton and Winters (a significant coefficient of .7 on the EC and zero on EFTA). But it is the opposite of the conclusion one might draw from simple statistics on the magnitudes of intra-regional trade in the EC 12 and Western Europe as a whole, if one did not hold constant for proximity.   Grant, Papadakis and Richardson (1992, p.48).

11. Havrylyshyn and Pritchett (1991) found that three languages are significant in the gravity model -- Portuguese, Spanish and English, in decreasing order of magnitude.   In a study of poor countries, Foroutan and Pritchett (1992) found that French, Spanish and English are statistically significant.

12. Most of the burgeoning trade between Taiwan and China shows up in the statistics twice, because it is recorded as passing through Hong Kong.   An attempt to correct the data for the effect of the ban on direct trade results in the Chinese language term becoming no stronger than the other languages.   Frankel and Wei (1993).

13. Reported ibid.   The coefficients are .50, .54, and .32, in 1980, 1985 and 1990, respectively.

14. Of the EC 12, only Greece had not joined the Exchange Rate Mechanism by early 1992 (though Italy and the United Kingdom dropped out soon thereafter).

15. Only Singapore and Indonesia, and at times Malaysia and Thailand, appear to put significant weight on the yen, and the weight is usually less than .1, as against .9 to 1.0 on the dollar. [It is not a coincidence that many Asian/Pacific countries call their currencies "dollar."   Nor, given the economies of scale in the use of an international currency, is it surprising that the dollar is the choice of Asia, as the rest of the world.   On the three major candidates for international currencies, see Alogoskoufis and Portes (1992) and Frankel (1992).]

16. We have made the decision in this paper to focus on the mark rather than the ECU.   One reason for this decision is that the ECU appears to have suffered a major set-back as an international currency subsequent to the foreign exchange crisis of September 1992.   The ECU bond market, for example, largely dried up.

17.   Why do countries keep the weights secret?   It allows the governments to devalue their currencies secretly when they so desire.   But secret weights undermine the governments' ability to commit credibly to a low inflationary monetary policy.   (Lowell, 1992.)

18. The earlier tests on Asian currencies tried the Swiss franc and purchasing power over local goods as numeraires, in addition to the SDR [Frankel and Wei (1994) and Frankel (1993), respectively].

19. Table 7 in the NBER Working Paper 4335, or Table 6 in Frankel and Wei (1993).

20. The results in Table 8 in the NBER Working Paper 4335, or Table 7 in Frankel and Wei (1993), confirm those in Frankel (1993) and Frankel and Wei (1994).

21. Reported in NBER Working Paper 4335, Appendix tables 4-7.

22. For example, Hooper and Kohlhagen (1978), Kenen and Rodrik (1986), Akhtar and Hilton (1984), Cushman (1986) and Peree and Steinherr (1989). The literature is surveyed in Edison and Melvin (1990).

23. The regressions with the volatilities measured in log form are available in Table 13 of Frankel and Wei (1994). There the coefficient on real exchange rate volatility again loses significance in 1985, although remaining negative in sign.

24. Estimates based on a logarithmic specification for the standard deviation may be more appropriate for this question, what would happen to the level of trade if exchange rate variability among the EMS countries now returns to the level that prevailed in 1980. Of our various logarithmic estimates, the preferred one is the instrumental variables estimate for the effect of the log of real exchange rate variability in 1980: .01. This point estimate would imply that a doubling of exchange rate variability would reduce trade within Europe by a mere 0.7 per cent (= .01(ln 2)).

25. "First-stage" regressions of exchange rate variability against our measure of variability in relative money supply changes are usually significant statistically [reported in Appendix Table 4.]

26. For example, Gros (1987) or Caballero and Corbo (1989).

27. This figure does not even take into account the outcome of more recent measures toward greater integration associated with 1992.
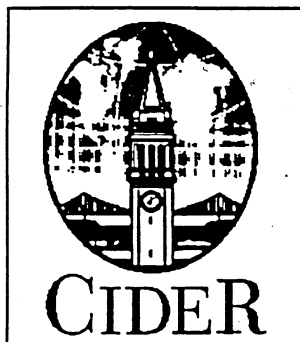
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