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Exchange Rate Fluctuations and Trade Flows: Evidence from the European Union

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Abstract

This paper analyzes the effects of exchange rate volatility on bilateral trade flows. Through use of a gravity model and panel data from western Europe, exchange rate uncertainty is found to have a negative effect on international trade. The results seem to be robust with respect to the particular measures representing exchange rate uncertainty. Particular attention is reserved for problems of simultaneous causality. The negative correlation between trade and bilateral volatility remains significant after controlling for the simultaneity bias. However, a Hausman test rejects the hypothesis of the absence of simultaneous causality.

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Contents

SUMMARY

This paper analyzes the effects of exchange rate volatility on bilateral trade flows. Evidence from panel data from the European Union shows that an increase in exchange rate volatility depresses international trade. The results seem to be robust with respect to the particular measures representing exchange rate uncertainty. However, the absolute size of this effect appears to be very small.

Particular attention is reserved for the problems of simultaneous causality that usually arise in this kind of study. If central banks make an effort to stabilize the exchange rate vis-à-vis their main commercial partners, a negative correlation between volatility and trade will emerge from the data, but it should not be construed to mean that trade flows react negatively to exchange rate instability. In the paper this problem is addressed by using instrumental variables and taking directly into account the central bank's behavior. If the relative size of each country's commercial partners does not change much over time, the central banks' stabilizing effort can be treated as a country-specific fixed effect and eliminated by using a fixed-effect model. The negative correlation between trade and bilateral volatility remains significant after controlling for the simultaneity bias. However, a Hausman test rejects the hypothesis of the absence of simultaneous causality.

The role played by the European exchange rate mechanism (ERM) in promoting intre-EU trade is investigated. The ERM is found to have a not-significant, and sometimes negative, effect on trade. This result can be attributed to the lack of credibility of the official parities for most of the currencies and years in the sample. Finally, some effort is made to address the magnitude of any "trade-diverting" effect of a partial monetary union, but no strong conclusion can be reached.

I. INTRODUCTION

One main argument against flexible exchange rates has been that exchange rate volatility could have negative effects on trade and investment. If exchange rate movements are not fully anticipated an increase in exchange rate volatility, which increases risk, will lead risk-averse agents to reduce their import/export activity and to reallocate production toward domestic markets. In this paper we provide some estimates of the importance of these effects in the European Union.

The trade issue has played an important role in the debate on the European Monetary System (EMS) and the European Monetary Union (EMU). The EMS was established with the intent of controlling exchange rate volatility and avoiding large misalignments among European currencies. One of the stated purposes was to reduce exchange rate uncertainty to promote intra-EU trade and investments. The discussion on the transition to EMU, and in particular the idea of a "two speed" European Union, where "virtuous" countries would switch to EURO from the beginning and other countries would join later, involves similar issues. One major concern is that a partial monetary union would have negative effects on the trade flows of the countries joining the single currency at a second stage. The idea is that, as is the case for custom unions, a partial monetary union could divert trade away from non member countries. However, there is not strong or unambiguous empirical evidence to support these views. A quite extensive literature has tested the effects of exchange rate regimes on trade, but the results are not always significant and they change across studies.[2] Moreover most papers use only cross-sectional or time series data instead of a panel, and just a few use bilateral data.

The analysis in this paper includes only Western European countries, allowing us to gather both trade and financial data across time as well as across countries, instead of using cross-sections only. This enables us to deal in a new manner with some of the problems met in the previous literature. There are other reasons to limit the scope of this study to Europe. The theoretical foundations of the gravity model assume identical and homothetic preferences across countries and rely heavily on the concept of intra-industry trade.[3] European countries are relatively homogeneous in terms of technology, factors endowments and per capita income, thus the model seems particularly appropriate for this case. Moreover, as Bayoumi

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[2]For example, Bahmani et al. (1993), Bailey et al. (1986), and Hooper and Kohlhagen (1978), find no evidence of a negative effect of volatility on trade. Frankel and Wei (1993) and Kenen and Rodrik (1986) find conflicting results. While Kim and Lee (1996), Stockman (1995), Chodwhury (1993), and Pereè and Steinherr (1989) find significant evidence of a negative relation. For a discussion see IMF (1984), or European Commission (1990). Th existence of conflicting evidence is consistent with Gagnon (1993) who suggests that the likely impact of volatility on trade should be small.

[3]See Helpman (1987).

and Eichengreen (1995) notice, the relationship between trade and other economic characteristics might be different for industrial and developing countries. Thus by restricting the sample to Western European countries we minimize problems due to country-specific factors. Finally, the actual perspective of a single currency regime for the EU makes this set of countries the natural target for this kind of study.

In what follows we test the effects of exchange rate volatility on trade using different measures and techniques. Particular attention is dedicated to the simultaneous causality problem that may arise in this kind of studies. If central banks make an effort to stabilize the exchange rate with their main trade partners, a negative correlation between exchange rate volatility and trade would appear from the data, but this should not be construed to mean that trade reacts negatively to exchange rate instability. The use of panel data allows us to deal with this problem in a way that explicitly takes into account the behaviour of the central banks. If the central bank stabilizing strategy does not change over the period considered, it can be treated as a country-pair specific effect and it can be eliminated by using a fixed effect model.

The empirical evidence in this paper supports the view that exchange rate uncertainty depresses international trade. However, according to our results the negative effect of exchange rate volatility on trade is very small. The results are robust with respect to the particular measures chosen to represent uncertainty. They also show that the negative correlation between exchange rate volatility and bilateral trade remains significant when we control for simultaneous causality. However, we reject the hypothesis of the absence of a simultaneity bias.

Section II describes the general gravity model. Section III discusses the problems related to the choice of a measure of exchange rate uncertainty and the simultaneous causality issue. Section IV, V, and VI report the empirical results. Section VII concludes.

II. Gravity Models

The gravity model has been widely used in empirical work in international economics.[4] The microeconomic foundations of this model are based on the theory of trade under imperfect competition, and more specifically on intra-industry trade theory.[5] In a gravity model the volume of trade between two countries increases with the product of their GDPs and decreases with their geographical distance. The idea is that countries with a larger economy tend to trade more in absolute terms, while distance represents a proxy for transportation

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[4]See, for example, Bayoumi and Eichengreen (1995), Frankel (1992), Krugman (1991).

[5]Helpman (1987) uses a Dixit/Stiglitz imperfect competition model to obtain the relation between gross trade and GDPs. Bergstrand (1989) generalizes this model to include Heckscher-Ohlin trade.

costs and it should depress bilateral trade. In general a per capita income variable is included to represent specialization, richer countries tend to be more specialized, and thus they tend to have a larger volume of international trade for any given GDP level. Models often include a number of dummy variables to control for different factors that might affect transaction costs. For example, a common border, language, or membership in a custom union are suppose to decrease transaction costs and to promote bilateral trade. In this paper we include a proxy to represent exchange rate uncertainty. In the actual estimation this variable will take different forms: the standard deviation of the first differences of the logarithmic exchange rate, the sum of the squares of the forward errors, and the percentage difference between the maximum and the minimum of the nominal spot rate. The pooled OLS regression is

$$\log(TRADE_{ijt})=\gamma_t+\beta_1\log(GDP_{it}GDP_{jt})+\beta_2\log(DIST_{ij})+\beta_3\log(pop_{it}pop_{jt})$$
$$+\beta_4 BORD_{ij}+\beta_5 EU_{ijt}+\beta_6 LANG_{ij}+\beta_7 v_{ijt}+\varepsilon_{ijt} \tag{1}$$

where "TRADE" is the gross bilateral trade (Export + Import) between countries i and j at time t. "EU" represents membership in the European Union (1 when both countries j and i are in the union at time t, 0 otherwise), and "BORDER" and "LANG" represent respectively a common border and language. The variable v represents the proxy for uncertainty about the bilateral exchange rate between country i and j at time t. Notice that we have to allow the intercept to change over time. Indeed following the model in Helpman (1987) any change in world aggregate GDP will be captured by the intercept.[6] In doing so we are implicitly

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[6]Assume two differentiated products X and Y, and homothetic preferences identical in every country, then, in the completely specialized case, import of country k from country j will be

$$IMP_{kj}=s_k(p_x X_j+p_y Y_j)$$

where s_k is country k's share in world spending (and it's share of world income in the absence of trade imbalances) and X_j and Y_j are the outputs of goods X and Y produced in country j (we omit the time index here). The symmetric is true for the import of country j from country k. Thus the total gross trade is

$$T_{kj}=s_k(p_x X_j+p_y Y_j)+s_j(p_x X_k+p_y Y_k)=s_k GDP_j+s_j GDP_k$$

rewriting we get

(continued...)

imposing a restriction on the "third country" coefficient. In other words, we are assuming, for example, that the trade between Germany and Italy reacts in the same way to a change in U.S. or France incomes.

A major advantage of using panel data is the ability to control for possibly unobservable country-pair individual effects. Such omitted effects, if correlated with the included regressors, would bias the OLS estimation. We consider a standard model where we assume that the latent individual effect is a time-invariant random variable. That regression reads

$$\log(TRADE_{ijt})=\gamma_t+\alpha_{ij}+\beta_1\log(GDP_{it}GDP_{jt})+\beta_2\log(DIST_{ij})+\beta_3\log(pop_{it}pop_{jt}) \tag{1}$$
$$+\beta_4 BORD_{ij}+\beta_5 EU_{ijt}+\beta_6 LANG_{ij}+\beta_7 v_{ijt}+\varepsilon_{ijt}$$

where α_{ij} stands for the individual effect. The use of panel data allows us to control for cultural, economical, and institutional country-pair specific factors that are constant over time, and are not explicitly represented in the model. Notice that in the fixed effects specification any time-invariant country-pair specific effect will be capture by the dummy α_{ij}.

III. Exchange Rate Volatility Measures

If PPP held, domestic and foreign trade would not systematically involve a different degree of uncertainty. However, exchange rates experience significant and persistent deviations from PPP,[7] adding an exchange risk component to import/export activities. Then an increase in exchange rate uncertainty may lead risk averse firms to reduce their foreign activity reallocating production toward their own domestic markets.[8] With regard to this, the relevant type of exchange rate risk will depend on the model of exporting/importing firm that we have in mind. On the one hand, exporting firms may sign short term export contracts in foreign currency. Then, assuming that costs in the firm own currency are known at t-1, the only uncertainty arises from the nominal exchange rate: the firm does not know its revenue in

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[6](...continued)

$$T_{kj}=s_k s_j GDP_{world}+s_j s_k GDP_{world}=2GDP_j\frac{GDP_k}{GDP_{world}}$$

thus, when we take logs, any change in the world GDP will be captured by the constant.

[7]See Froot and Rogoff (1995).

[8]This result holds under certain conditions, see DeGrauwe (1988).

domestic currency at t-1.[9] In this situation forward exchange rate markets represent an effective way to hedge against uncertainty. Short term contracts are available for all the major currencies and they are relatively cheap.[10] On the other hand, firms might have some sort of long term commitment to the export activity. This kind of firms have to sustain sunk costs to enter particular foreign markets and are interested in the relationship between their costs and the price which they can charge on those markets. In this case what matters is the real exchange rate, firms are interested in the evolution of their revenues relatively to their costs.[11] To hedge against this kind of uncertainty is much more difficult. Forward markets are not complete in terms of maturity, and the future exchange needs might not be known precisely at the moment of the decision. Hence, real exchange rate uncertainty may play an important role in determining firms import/export choices.[12]

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[9]The expected utility from profit at time t-1 for the exporting firm will be $E_{t-1}U(\Pi_t)=E_{t-1}U((q_t|t-1)(p_t^*|t-1)e_t-(C_t|t-1))$

where the price in foreign currency is fixed at time t-1, and where, assuming production occurs between t-1 and t, quantity produced and costs are known at time t-1. In this context Viaene and de Vries (1992) show that the effect of exchange rate volatility with well developed forward markets is ambiguous.

[10]Nonetheless, studies show that only a small, but increasing, part of international trade is actually hedged on forward markets. See Dornbusch and Frankel (1988), Commission of the European Communities (1990), Frankel (1995).

[11]Assuming that costs are a function of domestic prices, for these firms future expected profits are a function of domestic prices, foreign prices and the exchange rate, thus real profits are a function of the real exchange rate

$$E_o U(\Sigma_t \Pi_t (1+r)^{-t}) = E_o U(\Sigma_t (p_t^* e_t - C_t(p_t))(1+r)^{-t})$$

and:

$$E_o U(\Sigma_t \frac{\Pi_t}{p_t}(1+r)^{-t}) = E_o U(\Sigma_t \frac{(p_t^* e_t - C_t(p_t))}{p_t}(1+r)^{-t})$$

[12]These considerations suggest that the next step in this kind of studies should look at more disaggregated data. It seems important to be able to discriminate the effects of exchange rate volatility across industries characterized by different import/export structures.

The first problem we have in estimating the effects of exchange rate uncertainty on trade is to choose an appropriate variable to represent instability.[13] The literature has used a number of measures of exchange rate volatility and variability as a proxy for risk. Some papers used the standard deviation of the percentage change of the exchange rate or the standard deviation of the first differences of the logarithmic exchange rate.[14] This measure has the property of being zero in the presence of an exchange rate that follows a constant trend and it gives a larger weight to extreme observations (consistently with the standard representation of risk averse firms).[15] Others consider the average absolute difference between the previous period forward rate and the current spot to be the best indicator of exchange rate risk. The advantage of this measure is that, under a target zones regime, or pegged but adjustable exchange rates, it would pick up the effect of the presence of a "peso problem" or the lack of credibility of the official parity. Another possibility is to use the percentage difference between the maximum and the minimum of the nominal spot rate over the t years preceding the observation, plus a measure of exchange rate misalignment. This index stresses the importance of medium run uncertainty. The idea is that large changes in the past generate expected volatility.[16] It is worth to notice that the measures proposed as proxies for risk are backward looking, the assumption is that firms use past volatility to predict present risk. Then, even if we could restrict our choice to a particular measure, we would still have many options: daily, weekly or monthly changes? Which temporal window? Etc. . Consequently we tested the model in this paper using different variables: the standard deviation of the first difference of the logarithmic exchange rate, the sum of the squares of the forward errors, and the percentage difference between the maximum and the minimum of the nominal spot rate.[17] Moreover we used different temporal windows, and both real and nominal exchange rate.

A problem of simultaneous causality may arise using some of these measures. Central banks could systematically try to stabilize the bilateral exchange rate with their most important

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[13]For a discussion of exchange rate volatility measures see Brodsky (1984), Kenen and Rodrik (1986) and Lanyi and Suss (1982).

[14]See Brodsky (1984), Kenen and Rodrick (1986) and Frankel and Wei (1993).

[15]The underlying assumption is that a constant trend would be perfectly anticipated and it would not affect uncertainty. An alternative variable some authors used is the standard deviation of the level of the nominal exchange rate. This measure relies on the underlying assumption that the exchange rate moves around a constant level. In the presence of a trend this index would probably overestimate exchange rate uncertainty. For similar measures see Akhtar and Hilton (1984), Bailey et al. (1986), and Hooper and Kohlhagen (1978).

[16]See Peree and Steinherr (1989).

[17]All these variables are constructed using end of the period exchange rate monthly data from the IFS.

trade partners. In this case we would not be able to treat exchange rate volatility as an exogenous variable. Exchange rate volatility and trade would be negatively correlated, but the direction of causality would be uncertain, and OLS would provide a biased estimation. In other words, with an OLS regression it would not be possible to distinguish between the effects of investors' risk aversion and the effects of central bank policies. Instrumental variable estimators represent a solution to this problem. Frankel and Wei (1993) use the standard deviation of the relative money supply as instrument for the exchange rate volatility. Their justification is that relative money supplies and bilateral exchange rates are highly correlated, but monetary policies are less affected by trade considerations than exchange rate policies. Unfortunately, this solution presents the problem that for many European countries exchange rate stability has been an important determinant of the monetary policy.[18] However, the forward error is not a target of central banks' policies and reflects in some way exchange rate uncertainty. The sum of the squares of the forward errors (defined as the difference between the log of the three months forward rate and the log of the spot rate three months later, using "end of the month" data) is correlated with the standard deviation of the spot rate and thus it represents an instrument for exchange rate volatility.

The availability of panel data allows us to try a different approach to solve the simultaneous causality problem. The idea behind the simultaneity bias is that central banks try to stabilize the bilateral exchange rate against the main trade partners of their countries. If that is the case, the exchange rate volatility becomes a function of the share of the bilateral trade of the two countries over their total trade

$$v_{ijt}=\lambda_{ijt}-\beta(\frac{T_{ijt}}{T_{i.t}})-\gamma(\frac{T_{ijt}}{T_{.jt}})+\eta_{ijt}$$

where the terms β and γ represent the stabilization effort functions of the two central banks. In this context, if the bilateral trade shares were constant over time, we could write

$$v_{ijt}=\lambda_{ijt}+\theta_{ij}+\eta_{ijt}$$

In that case we would be able to treat the central bank factor as country-pair fixed effect. Then the central bank effect would be captured by the country pair dummy, and the fixed effects specification of regression (2) would give unbiased estimates. We can imagine central banks following a more general and less accurate rule, in which the stabilization effort depends on the order of magnitude of the bilateral shares, and not on their exact value. In such a case we would not need the trade shares to be perfectly constant, but only more or less stable over time. In other words, we would need that countries maintained their relative importance as trade partners. This is actually the case for our sample: trade shares are not strictly constant over time, but for every country the relative size of its trade partners remains more or less the same over the period considered.

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[18]This is specially true for the countries participating in the ERM.

IV. EMPIRICAL EVIDENCE

Our sample period covers 20 years from 1975 to 1994. The countries included are the actual 14 EU countries (with Belgium and Luxembourg taken as a whole)[19] and Switzerland, for a total of 2100 observations. The source for the trade data is the OECD database: bilateral data for both import and export flows are available. The GDP data are from the OECD as well. The original data were expressed in current prices and different currencies. In order to be used in a multi-period gravity model they had to be deflated and converted to a common currency.[20] There were two possible ways to proceed. We could first convert the data into a common currency and then use the deflator for that currency to express the data in constant prices, or, alternatively, we could first deflate the data with each country deflator and then convert them to a common currency. If PPP applied the two procedures would be equivalent. However, given PPP often fails, the second procedure seems superior. For similar reasons we chose to use only export data to compute the gross bilateral trade flows.[21] The available export (import) deflators are based on a basket that reflects a country's total export (import).[22] However, with our data the correct deflator should use baskets reflecting the bilateral flows between each pair of countries. It seems reasonable to assume that the bias introduced by using the "aggregate" deflator is smaller for export data than for import data. The idea is that, for each country, goods exported to different countries are more homogenous than goods imported from different countries. Distances are represented by air distances between capital cities.[23] I use different proxies to represent exchange rate uncertainty: the standard deviation of the first differences of the logarithm of the monthly average bilateral spot rate, the sum of the squares of the forward errors, and the percentage difference between the maximum and the minimum of the nominal spot rate. Exchange rate data are end of the month observations and the source is the IFS. Analogous measures are used for the real rate, that is constructed using CPI indexes from the IFS.[24] The dummy "EU" is included to control for the progressive

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[19]Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK.

[20]For the conversion we used PPP values from the OECD series, we also obtained very similar results converting all the data to U.S. dollars.

[21]Note that, at least in theory, country j's import from country k is equal to country k's export to country j, thus we could use import and/or export data to compute the bilateral gross trade.

[22]These are IFS data.

[23]Exceptions are Frankfurt for Germany and Milan for Italy, the source is *Alitalia*.

[24]There is no monthly price index for Ireland. The monthly real exchange rate is constructed

(continued...)

enlargement of the union: this variable has value one for country pairs and years for which both countries are EU members. An additional dummy "Language" represents country pairs with a common language.

Table one describes the results of regression (1) using various measures to represent exchange rate uncertainty. We allowed the intercept to change over time and controlled for heteroscedasticity and autocorrelation (FGLS). All coefficients have the expected sign and are significant at the 1 percent level. Moreover the results seem to be robust. Most coefficients are similar for the different regressions, suggesting that the four measures of exchange rate uncertainty are in some way equivalent (the regression using the sum of the squares of the forward errors as exchange rate volatility measure is on a sub sample of countries that does not include Portugal). It is worth to notice the relative importance of a having a common language in determining trade flows. Even after controlling for GDPs, populations, membership in the EU and a border in common, countries speaking the same language trade between each other 24 percent more. The exchange rate volatility coefficient is small, but not irrelevant. From the nominal exchange rate standard deviation coefficient, a total elimination of exchange rate volatility in 1994 would have determined a 12 percent increase in trade,[25] a 13 percent increase using the real exchange rate measure, and a 10 percent increase using the forward error. It is interesting to notice that the results for nominal exchange rate volatility are very close to the results for real volatility. This outcome is not particularly surprising given in our sample there is a strong correlation between nominal and real exchange rate volatility (see figure 1). The results of table 1 are statistically significant and seemingly do not depend on the variable chosen to represent exchange rate uncertainty. Nonetheless, the validity of these results could be questioned for the presence of simultaneity bias in regression (1) when using the standard deviation of the exchange rate change. Central banks are likely to try to stabilize the exchange rate vis à vis their main trade partners. In this case, even if exchange rate uncertainty did not have a negative effect on trade flows, we would get a negative correlation between exchange rate volatility and trade at a bilateral level. To solve this problem we can use the forward error as an instrument for exchange rate volatility: in particular the sum of the squares of the three month logarithmic forward error as an instrument for the standard deviation of the first differences of the logarithmic spot rate. This variable is not controlled by central banks and it is positively correlated with our measure of exchange rate volatility. Notice that the forward exchange rate was not available for Portugal, thus the regression with instrumental variables uses only a sub-sample of 14

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[24](...continued)
using the quarterly price index and assuming that the inflation rate is constant within the quarter.

[25]The average standard deviation of the monthly nominal exchange rate change in 1994 was about 0.55 percent.

countries (1820 observations).[26] Also here we allowed the constant to change over time and corrected for heteroscedasticity and autocorrelation.

Table 1. Regression (1): Pooled FGLS 1/

variable	std.dev. nominal	std.dev. real	forward error	range
GDP	0.93 (0.026)	0.88 (0.026)	0.98 (0.039)	0.93 (0.028)
Population	-0.19 (0.029)	-0.16 (0.029)	-0.26 (0.041)	-0.19 (0.031)
Distance	-0.34 (0.030)	-0.34 (0.029)	-0.20 (0.032)	-0.23 (0.030)
Common Border	0.25 (0.020)	0.25 (0.020)	0.31 (0.021)	0.29 (0.021)
Common Language	0.24 (0.025)	0.24 (0.025)	0.25 (0.026)	0.24 (0.026)
EU	0.23 (0.015)	0.23 (0.014)	0.34 (0.016)	0.29 (0.015)
Ex.Rate Volatility	-20.41 (1.281)	-22.56 (1.321)	-0.72 (0.081)	-0.87 (0.105)

1/ All coefficients are significant at the 1% level. Sources: OECD, IFS.

Table 2 describes the results of the regression using instrumental variables (two stages generalized least squares) and the results of FGLS on the same countries (without Portugal). All coefficients still have the right sign, they are significant at the 1 percent level, and their size does not change respect to the results of table 1. For the instrumental variable estimation the results are more or less the same, suggesting that the negative correlation between exchange rate volatility and trade is not determined solely by the simultaneous causality bias. In other words, the negative correlation between exchange rate variability and trade does not depend, or at least does not depend entirely, on central banks policies.

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[26]For all the other countries it was possible to construct a forward rate using short term interest rates, the source was the IFS.

Table 2. Regression (1): Instrumental Variables 1/

variable	nominal FGLS	nominal IV	real FGLS	real IV
GDP	1.05 (0.035)	0.99 (0.039)	0.99 (0.035)	0.92 (0.041)
Population	-0.32 (0.037)	-0.26 (0.041)	-0.28 (0.037)	-0.22 (0.043)
Distance	-0.33 (0.032)	-0.35 (0.038)	-0.32 (0.032)	-0.35 (0.038)
Common Border	0.27 (0.020)	0.26 (0.022)	0.27 (0.020)	0.27 (0.022)
Common Language	0.24 (0.025)	0.24 (0.026)	0.25 (0.025)	0.25 (0.026)
EU	0.27 (0.016)	0.25 (0.020)	0.27 (0.016)	0.26 (0.019)
Ex.Rate Volatility	-21.29 (1.349)	-22.13 (2.447)	-22.24 (1.384)	-23.00 (2.574)

1/ All coefficients are significant at the 1 percent level. Reduced sample 1820 obs. Sources: OECD, IFS.

It is possible to test the null hypothesis of absence of simultaneous causality using a Hausman specification test. If the hypothesis is verified FGLS are unbiased and consistent, but they are biased in the presence of simultaneous causality, while the IV estimator is unbiased and consistent under both the null and the alternative hypothesis. From the results of the Hausman test we can reject at the 10 percent level the hypothesis that the FGLS estimator is unbiased. This result is thus consistent with the presence of a simultaneity bias. Nevertheless, the results obtained with the instrumental variable estimation are still valid and confirm the existence of a negative relation between bilateral exchange rate volatility and trade flows.

The existence of unobserved country-pair specific effects may bias the results of regression (1). Then, to further test the robustness of these findings we can use the simple model proposed in the previous section. In the fixed effect model any individual effect will be captured by the country-pair dummy. Then, to the extent that the trade shares are stable over time, the fixed effect estimator will also take care of the simultaneity bias.[27] The "central bank effect" has to be constant over time in order to captured by the country-pair specific

[27]Trade shares are very stable in our sample. The only big change is in Spain/Portugal share.

dummies. We considered both fixed and random effects estimations. The random effects model has the obvious advantage of allowing the estimation of the coefficients of time-invariant variables. However, if individual effects are not drawn from the same distribution, the random effect estimates are not consistent. Table 3 reports the results of regression (2).

Table 3. Regression (2): Random and Fixed Effects Estimations 1/

variable	std. dev. nominal		std. dev. real		forward errors	
	RE	FE	RE	FE	RE	FE
GDP	1.27* (0.062)	1.69* (0.098)	1.25* (0.062)	1.63* (0.098)	1.19* (0.075)	1.41* (0.105)
Population	-0.50* (0.068)	-0.66* (0.132)	-0.48* (0.068)	-0.67* (0.132)	-0.42* (0.079)	-0.49* (0.138)
Distance	-0.07 (0.094)	- -	-0.08 (0.094)	- -	-0.16 (0.106)	- -
Border	0.36* (0.073)	- -	0.36* (0.072)	- -	0.35* (0.081)	- -
Language	0.19** (0.093)	- -	0.19** (0.093)	- -	0.18*** (0.102)	- -
EU	0.15* (0.009)	0.13* (0.010)	0.15* (0.010)	0.14* (0.010)	0.14* (0.011)	0.13* (0.012)
Ex.Rate Volatility	-3.21* (0.616)	-2.84* (0.608)	-4.68* (1.384)	-4.15* (0.645)	-0.27* (0.034)	-0.25* (0.034)

1/ (*) significant at the 1 percent level, (**) significant at the 5 percent level, (***) significant at the 10 percent level. Sources: OECD, IFS.

In this case the sample is complete set of 15 countries for the first four columns and the subset without Portugal for the regression with the forward errors. These results seem to confirm our previous findings. The GDP and population coefficients have the right sign and are still positive at the 1 percent level with all three measures of exchange rate volatility. The "EU" dummy coefficient is positive and statistically significant at the 1 percent level.

We tested the unbiasedness of the random effects estimator and rejected it at the 5 percent level. Hence, the random effects coefficients could be biased, and we should rely solely on the fixed effects estimator. However, our interest relies mainly with the exchange rate volatility coefficient that it is very similar for fixed and random effects estimations. The exchange rate volatility coefficient is still negative. It is significant at the 1 percent level for all the three different measures and for both fixed and random effects estimations. However, according to these estimates the size of the effect of volatility on trade is very small. A total elimination of exchange rate volatility in 1994 would have increased trade only by 3 or 4 percent. Nevertheless, these results are consistent with the idea that a negative correlation between exchange rate volatility and trade exists and that at least a part of it is not spurious correlation cause by central bank stabilization policies. They also suggest that country specific effects play an important role, advicing against the use of pooled OLS estimations.

In order to test the efficacy of this method in eliminating simultaneous causality, we performed again a Hausman test. Also in this case the instrumental variable was represented by the forward error measure. In this case we could not reject the hypothesis of unbiasedness of the OLS fixed effects estimator. The result of the test is then consistent with the assumption that the central banks factor is stable over time and is eliminated using the fixed effect model.

As noted before there is no "right" measure to represent the exchange rate volatility. For this reason we decided to further test the robustness of the previous results using a different time window for our measures. Table 4 reports the results of regression (1) using a two year window to compute the various exchange rate volatility variables. The results are consistent with the previous ones, confirming a negative effect of volatility on trade. Notice that we used instrumental variables estimation given the rejection of FGLS unbiasedness from the Hausman test on the previous results. All coefficients have the expected sign and are significant at the 1 percent level.

The evidence in this section shows a negative correlation between exchange rate volatility and trade flows. With the results presented here we can reject the hypothesis that the behavior of the central banks has no role in determining the negative correlation between volatility and trade. However, the results of estimations that are robust to simultaneous causality bias support the hypothesis that firms, reacting negatively to volatility on foreign currencies markets, determine a decrease in the volume of international trade when the exchange rate becomes more volatile.

V. The ERM Effect

Most observers viewed the 1992/93 crisis of the EMS (more precisely of the Exchange Rate Mechanism) as a stop in the process of economic integration of the European countries. The EMS purpose was to reduce exchange rate volatility among member currencies to promote trade and economic convergence and the ERM was actually successful in reducing both nominal and real exchange rate volatility (this is specially true for the period 1987-1992).[28] Thus following the results from the previous section, the ERM should have had a positive effect on the bilateral trade among EU member countries. Moreover we should be concerned for the future negative consequences of the 1992 crisis. If the end of the ERM meant a

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[28]See, for example, figure 2. While for a detailed analysis see De Grauwe and Verfaille (1987).

Table 4. Regression (1): FGLS Two-Year Window 1/

variable	nominal IV	real IV	forward error
GDP	1.02 (0.038)	0.95 (0.040)	0.94 (0.040)
Population	-0.29 (0.040)	-0.24 (0.041)	-0.23 (0.042)
Distance	-0.36 (0.037)	-0.35 (0.036)	-0.22 (0.032)
Common Border	0.24 (0.022)	0.25 (0.022)	0.29 (0.021)
Common Language	0.25 (0.026)	0.25 (0.026)	0.24 (0.026)
EU	0.25 (0.019)	0.26 (0.019)	0.34 (0.016)
Ex.Rate Volatility	-13.01 (1.311)	-13.12 (1.324)	-0.46 (0.046)

1/ All coefficients significant at the 1 percent level. Sources: OECD, IFS.

diminished exchange rate stability, we should expect a reduction in intra-EU trade. In this section we used the framework presented above to try to estimate the effects of the ERM on trade. We constructed a dummy equal to 1 for pairs with both countries members of the ERM and 0 otherwise.[29] The resulting equation is

$$\log(TRADE_{ijt}) = \gamma_t + \alpha_{ij} + \beta_1 \log(GDP_{it} GDP_{jt}) + \beta_2 \log(DIST_{ij}) + \beta_3 \log(pop_{it} pop_{jt}) + \beta_4 BORD_{ij} + \beta_5 EU_{ijt} + \beta_6 LANG_{ij} + \beta_7 ERM_{ijt} + \varepsilon_{ijt} \tag{3a}$$

In this way the ERM dummy captures the stabilizing role that the Exchange Rate Mechanism had on the currencies of member countries. On the other hand, we might be interested in the

[29]This approach has the advantage of avoiding the simultaneous causality problem. The decision to enter the ERM concerns more a country's general policy than simply its trade policy.

effect that the ERM had per se, and not only through the reduction of exchange rate volatility. Then the equation becomes

$$\log(TRADE_{ijt}) = \gamma_t + \alpha_{ij} + \beta_1 \log(GDP_{it} GDP_{jt}) + \beta_2 \log(DIST_{ij}) + \beta_3 \log(pop_{it} pop_{jt}) + \beta_4 BORD_{ij} + \beta_5 EU_{ijt} + \beta_6 LANG_{ij} + \beta_7 ERM_{ijt} + \beta_8 v_{ijt} + \varepsilon_{ijt} \tag{3b}$$

A negative sign on the "ERM" dummy coefficient would mean that the mechanism's role in reducing uncertainty went beyond the induced reduction in volatility.

The results of both regressions are presented in table 5. All the usual coefficients keep having the right sign and are still significant. The ERM coefficient has the wrong sign. For the fixed effects model it is significant at the 5 percent level, when controlling for exchange rate volatility, and at the 10 percent level when alone. For the random effects estimation it is significant at the 5 percent level in the regression with the real volatility measure, and with the forward errors measure. It is not significant in the regression with nominal volatility and when alone. On the one hand, this result seems surprising and it conflicts strikingly with the findings in the previous section. Indeed ERM membership should decrease uncertainty and thus increase trade. On the other hand, a large literature addressed the issue of the credibility of the ERM and rejected the full credibility hypothesis for most cases.[30] From that point of view, the result in this section can be reconciled with those in the rest of this paper. If, for most of the periods and the countries, the exchange rate target zones were not credible, we should not expect a significant effect of the ERM dummy on trade flows. At the same time a non credible ERM would generate expectations of relatively large realignments, to which agents may react in a particularly negative way.[31] In other words, agents may find a system of discrete changes, that are typically large over a short period, more harmful than similar, but more gradual changes under a system of flexible rates.

An alternative, but not very appealing, explanation is provided by political economy. Brada and Mendez (1988) suggest that countries with fixed exchange rate regimes are more likely to use trade restrictions to defend their trade balance. They find some evidence that countries with fixed rates trade less than countries with floating rates. However, in our context this

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[30]See Giovannini (1990), Svensson (1991), Frankel and Phillips (1992).

[31]A way to address this issue might be to control for the credibility of the bilateral target zones and construct a "credible ERM" dummy. First, we would have to define a measure of credibility. Then we could construct a variable taking value 1 when the commitment to the bilateral parity is credible, and 0 otherwise. The quoted literature relies on test based on forward rates (or interest rates differentials) first proposed in Svensson (1991). The basic idea is that if the forward rate is outside the band, the target zone cannot be fully credible.

effect seems very unlikely because most countries in the sample (all countries in the ERM) are EU members.

Table 5. Regressions (3a) and (3b): The ERM Effect 1/

variable	std. dev. nominal		std. dev. real		forward errors		ERM only	
	RE	FE	RE	FE	RE	FE	RE	FE
GDP	1.27* (0.062)	1.71* (0.099)	1.24* (0.061)	1.66* (0.099)	1.19* (0.075)	1.44* (0.106)	1.33* (0.066)	1.72* (0.099)
Population	-0.50* (0.067)	-0.66* (0.132)	-0.47* (0.067)	-0.67* (0.132)	-0.43* (0.078)	-0.50* (0.138)	-0.55* (0.072)	-0.64* (0.133)
Distance	-0.08 (0.093)	- -	-0.09 (0.092)	- -	-0.16 (0.105)	- -	-0.03 (0.107)	- -
Border	0.36* (0.071)	- -	0.35* (0.071)	- -	0.35* (0.079)	- -	0.37* (0.084)	- -
Language	0.19** (0.091)	- -	0.19** (0.090)	- -	0.18*** (0.100)	- -	0.19*** (0.107)	- -
EU	0.15* (0.010)	0.14* (0.010)	0.15* (0.010)	0.14* (0.010)	0.15* (0.012)	0.14* (0.012)	0.15* (0.010)	0.14* (0.010)
Ex.Rate Volatility	-3.31* (0.620)	-2.96* (0.610)	-4.88* (0.657)	-4.36* (0.649)	-0.27* (0.034)	-0.26* (0.034)	- -	- -
ERM	-0.01 (0.010)	-0.02** (0.010)	-0.02** (0.010)	-0.02** (0.010)	-0.02** (0.010)	-0.02** (0.010)	-0.01 (0.10)	-0.02*** (0.10)

1/ (*) significant at the 1 percent level, (**) significant at the 5 percent level, (***) significant at the 10 percent level. Sources: OECD, IFS.

VI. Third Country Effect

The effects of bilateral exchange rate volatility on trade have been extensively tested in this paper. Bilateral trade is negatively affected by a volatile bilateral exchange rate. From this point of view a monetary union, eliminating altogether nominal variability, and largely reducing real variability, would facilitate intra-EU trade. However, one could argue that not only the absolute volatility of the exchange rate, but also the relative volatility should be used in this analysis. Consider a country i trading with countries j and k. Assume that exchange rate variability increases for country i against the currencies of both j and k. If the increase is larger for country k, the relative risk of trading with country j decreases. This effect could imply a reallocation of trade for country i from country k to country j. In other words, changes in the bilateral exchange rate volatility might have not only trade creation, but also trade diversion effects: a monetary union could increase trade among its member countries and, at the same time, divert trade from the countries left out.

The third country effect issue is particularly relevant for European countries. In the debate on the transition to EMU a two stage process has been proposed: "virtuous" countries would join from the beginning, while other countries would join later. Moreover, it seems that EMU will actually start with 11 countries only. The obvious concern is about the effects of a partial monetary union on the countries that are excluded or choose to stay out of EMU. Here we are not interested in estimating the net welfare effects, but only in estimating the importance of the "third country" effect. We then include a variable representing the exchange rate volatility of the two currencies with respect to all the others. Consider the following regression:

$$\log(TRADE_{ijt})=\gamma_t+\alpha_{ij}+\beta_1\log(GDP_{it}GDP_{jt})+\beta_2\log(DIST_{ij})+\beta_3\log(pop_{it}pop_{jt}) \\ +\beta_4 BORDER_{ij}+\beta_5 EU_{ijt}+\beta_6 LANG_{ij}+\beta_7 v_{ijt}+\beta_8 m_{ijt}+\varepsilon_{ijt} \tag{4}$$

where

$$m_{ijt}=\sum_{i\neq j} v_{ijt} w_{ijt}+\sum_{j\neq i} v_{ijt} w_{ijt}$$

with weights w_{ijt} represented by relative GDPs. The trade shares of country i and j could represent a more appropriate system of weights. However, these weights would introduce a bias because trade shares are also a function of exchange rate volatility.[32] If the trade diversion hypothesis is valid we should obtain a negative sign for β_8.

Table 6 reports the results for regression (4) with real and nominal exchange rate volatility. Most coefficients have more or less the same values as in regression (1). However, for both cases there is probably a multicollinearity problem. The correlation between the bilateral exchange rate volatility and the volatility with the rest of the countries in the sample is above 0.9. Then it is not possible to determine the contribution of the two variables separately. Indeed the "third country" volatility coefficient is not significant and has the wrong sign. From this result a two speed monetary union with some countries switching first at EURO and others following later should not be opposed, at least not on the basis of trade considerations. However, the evident multicollinearity problem suggests that more empirical evidence should be collected before reaching any conclusion.

[32] An alternative measure is the standard deviation of changes in the effective real exchange rate. See Lanyi and Suss (1982) for a discussion on these measures.

VII. CONCLUSIONS

In this paper we tested the relationship between exchange rate uncertainty and trade with data from Western European countries. In the analysis we used different variables as proxies for uncertainty, and all gave consistent results. We found evidence of a small but significant negative effect of bilateral volatility on trade.

The problem of a possible simultaneity bias was addressed in two different ways, and both instrumental variables and fixed effects over time gave results consistent with the hypothesis of a negative effect of exchange rate uncertainty on trade. Nevertheless, a Hausman specification test rejected the hypothesis that no simultaneity bias exists. The issue of the "third country" effect was analysed. We found significant evidence of a negative effect of "third country" exchange rate volatility on bilateral trade. Thus from this point of view a partial monetary union, the so called "two speed Europe" should not be obstructed. Nonetheless, technical problems recommend caution with the interpretation of this result.

Further research in this area should look at more disaggregated data. It is more difficult to find financial instruments to hedge against exchange rate risk when the time horizon becomes longer. Then EMU might have a different impact across industries. In sectors where the export activity requires large investments, trade should prove more sensitive to exchange rate volatility than in sectors characterized by "short term" export.[33] For the same reasons exchange rate stability might result more important for FDIs than for trade flows.[34]

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[33]Stokman (1995) uses disaggregated, but not bilateral, data to estimate the effects of exchange rate volatility on the intra-EU export of 5 European countries.

[34]See Campa and Goldberg (1995), or Goldberg and Kolstad (1995) for some evidence on the relationship between exchange rate volatility and FDIs.

Table 6. Regressions (4): The "Third Country" Effect 1/

variable	std. dev. nominal		std. dev. real	
	RE	FE	RE	FE
GDP	1.27* (0.062)	1.69* (0.099)	1.25* (0.062)	1.64* (0.098)
Population	-0.50* (0.068)	-0.66* (0.132)	-0.48* (0.068)	-0.67* (0.132)
Distance	-0.07 (0.095)	- -	-0.08 (0.095)	- -
Border	0.36* (0.073)	- -	0.36* (0.073)	- -
Language	0.19** (0.094)	- -	0.19** (0.094)	- -
EU	0.15* (0.010)	0.14* (0.010)	0.15* (0.010)	0.13* (0.010)
Ex.Rate Volatility	-3.22* (0.617)	-2.85* (0.609)	-4.70* (0.651)	-4.17* (0.646)
"Third Country" Volatility	-0.24 (0.451)	-0.13 (0.444)	-0.37 (0.468)	-0.27 (0.462)

1/ (*) significant at the 1 percent level, (**) significant at the 5 percent level, (***) significant at the 10 percent level. Sources: OECD, IFS.

FIGURES

Figure 1. Real and Nominal Exchange Rate Volatility (as from Standard Deviation of ER Change)

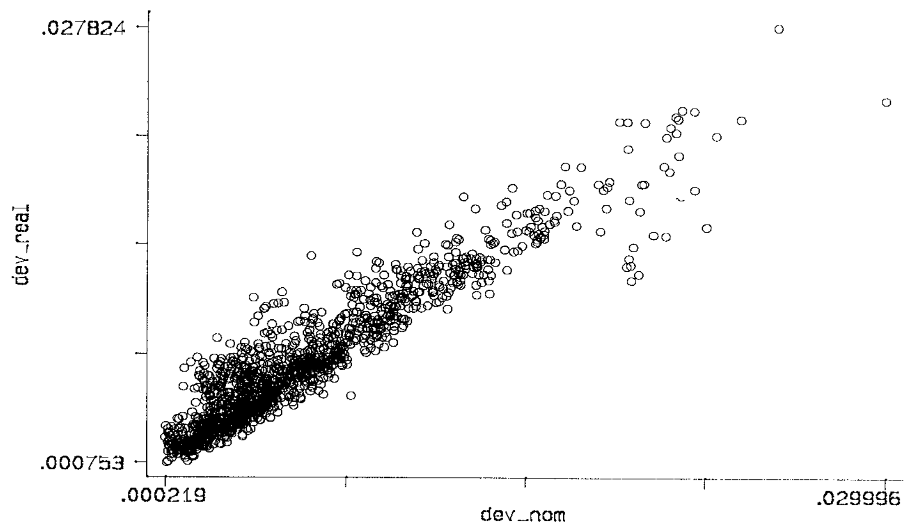
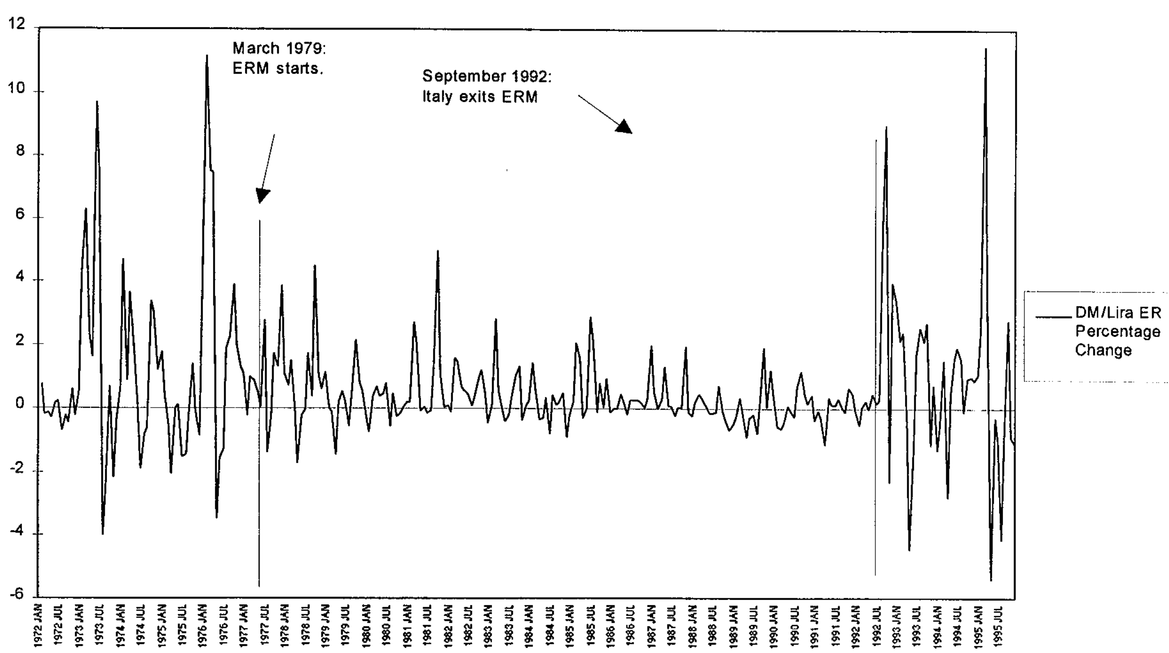


Figure 2. Lira/DM Exchange Rate Volatility with and without ERM.



APPENDIX I: EU - EMS CHRONOLOGY

- 1951 Apr. European Coal and Steel Community - Treaty of Paris
- 1957 Mar. European Economic Community - Treaty of Rome (6 countries)
- 1971 Aug. End of the Bretton Wood System
- 1972 Mar. Introduction of the Snake (Belgium, France, Germany, Italy, Netherlands)
- 1972 May Denmark, UK and Norway join the Snake.
- 1972 Jun. Denmark and UK exit the snake.
- 1972 Oct. Denmark rejoins the Snake.
- 1973 Jan. Denmark, Ireland and UK become members of EEC
- 1973 Feb. Italy exits the Snake.
- 1974 Jan. France exits the Snake.
- 1975 Jul. France rejoins the Snake.
- 1976 Mar. France exits the Snake.
- 1979 Mar. EMS starts (Belgium, Denmark, France, Germany, Ireland and Netherlands with 2.25 percent margins, Italy with 6 percent).
- 1981 Jan. Greece joins EEC.
- 1986 Jan. Portugal and Spain join EEC.
- 1989 Jun. Spain joins the EMS with 6 percent margins.
- 1990 Jan. The margin for the Italian Lira is narrowed to 2.25 percent
- 1990 Oct. Unification of Germany. UK joins the ERM with 6 percent margins.
- 1992 Feb. Maastricht Treaty on European Union.
- 1992 Apr. Portugal joins ERM whit 6 percent margins.
- 1992 Sep. Italy and UK suspend participation in the ERM.
- 1993 Jan. Single European Market.
- 1993 Aug. ERM margins widened to 15 percent.
- 1995 Jan. Austria, Finland and Sweden join the EU.

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