Exchange rate regimes and trade

by

Christopher Adam* and David Cobham**

*University of Oxford
** Heriot-Watt University

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Abstract

A 'new version' gravity model is used to estimate the effect of a full range of *de facto* exchange rate regimes, as classified by Reinhart and Rogoff (2004), on bilateral trade. The results indicate that, while participation in a common currency union is typically strongly 'pro-trade'– as first suggested by Rose (2000) – other exchange rate regimes which lower the exchange rate uncertainty and transactions costs associated with international trade between countries are significantly more pro-trade than the default regime of a 'double float'. They suggest that the direct and indirect trade-creating effects of these regimes on uncertainty and transactions costs tend to outweigh the trade-diverting substitution effects. In addition, there is evidence that membership of *different* currency unions by two countries has pro-trade effects, which can be understood in terms of a large indirect effect on transactions costs. Tariff-equivalent monetary barriers associated with each of the exchange rate regimes are also calculated.

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Contact information:

Christopher Adam, Department of Economics, Oxford University, Manor Road, Oxford OX1 3UQ, UK; email christopher.adam@economics.ox.ac.uk (corresponding author).

David Cobham, Department of Economics, Heriot-Watt University, Edinburgh EH14 4AS; email d.cobham@hw.ac.uk

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1 Introduction

Research on the macroeconomics of exchange rate regimes has tended to focus on issues of growth, inflation and stabilization (for example, Bailliu *et al*, 2003; Ghosh *et al*, 2003; and Husain *et al*, 2005). Much less attention has been paid to whether the choice of exchange rate regime matters for the volume of trade between countries. An exception is the recent line of research, ignited by a provocative paper by Andrew Rose in 2000, that has focussed on the contribution of currency unions in promoting trade. Rose's initial finding that membership of a currency union appears to have a very large positive effect on trade between countries – boosting trade by as much as 200 percent, *ceteris paribus,* according to his central point estimates – has provided a major stimulus to empirical and theoretical work on gravity models of trade. Most of this has been concerned with 'shrinking' the size of Rose's initial estimates of the currency union effect which many researchers found implausible. Rose himself has offered further empirical work in the area (notably Rose, 2001; Rose and van Wincoop, 2001; Glick and Rose, 2002), while the specific effect of currency union in Europe has been investigated by Barr, Breedon and Miles (2003) and Micco, Stein and Ordoñez (2003). Baldwin (2005) provides a useful critical survey of the empirical literature and a review of the theoretical developments.

Currency unions represent only one possible exchange rate regime, however. In this paper we address the more general question: to what extent do exchange rate regimes other than currency unions affect trade volumes? We present what we think are the first comprehensive estimates of the effect on trade between pairs of countries of a full menu of different exchange rate regimes.[1] Using a large panel dataset which combines the Reinhart and Rogoff (2003b) data on *de facto* exchange rate regimes with the data collected by Rose (2003)[2], we estimate a 'new version' gravity model in which we identify the effect on the trade between pairs of countries of a wide range of bilateral exchange rate regimes, from membership of the same or of different currency unions, through pegging to the same or different anchor currencies, to managed floats and full floats. We find that exchange rate regimes which reduce exchange rate risk and transactions costs, including currency unions, do indeed have positive effects on trade, but we also obtain results which suggest that currency union membership and other arrangements have significant effects on the trade of third party countries. Our results enable us to produce a trade-weighted tariff-equivalent estimate of the full monetary barrier which is comparable to that found by Rose and van Wincoop (2001), together with estimates of the tariff-equivalent barriers associated with other exchange rate regimes.

In section 2 we explain our basic methodology, which involves the estimation of what Anderson and van Wincoop (2004) call the 'new' version of the gravity model, together with a treatment of distance which draws on Mélitz (2003, 2005). In section 3 we set out the methodology and data used to supplement this model with a specification of the exchange rate regimes between country pairs. In section 4 we present estimates of the effects on trade of the full menu of regimes over the period from 1973 to 1998. Section 5 uses the results to calculate the tariff-equivalent effects of different exchange rate regimes. Section 6 concludes.

2 Basic methodology

The original work on currency unions in gravity models, such as Rose (2000) and Frankel and Rose (2002), used what Anderson and van Wincoop (2003, 2004) have called the 'empirical' or 'traditional' version of the gravity model. Because of concerns that the extremely high estimates of the currency union effect on trade flows emerging from this approach reflected fundamental misspecification errors in the estimated gravity equation, recent work in this area, including by Rose and van Wincoop (2001) and Mélitz (2003), has returned to the trade-theoretic framework for the gravity model originally proposed by Anderson (1979). The key insight of this 'theoretical' or 'new' approach is that bilateral trade between countries *i* and *j* depends heavily on the ratio of 'bilateral trade resistance' to 'multilateral trade resistance', that is on the ratio of the barriers to trade between countries *i* and *j* to the barriers which each of *i* and *j* face in their trade with *all* their trading partners (including domestic or internal trade). In other words trade between, say, France and Italy depends on how costly it is for each to trade with the other relative to the costs involved for each of them in trading with other countries. A reduction in the bilateral trade barrier between France and the UK would therefore reduce France's multilateral trade resistance and (given the size of its trade barrier with Italy) reduce French trade with Italy, as well increasing the trade between France and the UK. This innovation introduces an obviously sensible substitutability between trade with different partners which was missing from the traditional formulation, and in doing so provides a natural way of understanding how exchange rate regimes impact on trade patterns.

More precisely, in the simple case where each country specialises in the production of a single differentiated good, Anderson and van Wincoop (2003) derive the following trade equation

$$T_{ij} = \frac{y_i y_j}{y^W} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\sigma} \tag{1}$$

where T_{ij} is the flow of trade between country i and country j,[3] y_i and y_j are the respective GDPs, y^W is global GDP, t_{ij} is the bilateral trade resistance expressed as the trade cost factor which relates the prices paid by the consumer in one country to the price received by the producer in the other (and where equation (1) assumes symmetry in trade costs so that $t_{ij} = t_{ji}$), σ is the constant elasticity of substitution between all goods (assumed to be greater than one so that there is a negative effect from bilateral trade costs on trade flows), and P_i and P_j are the respective CES consumer price indices for each country. The latter terms show the extent to which trade costs raise prices of goods in general to consumers in one country above the price received by firms in that and all other countries, and are denoted 'multilateral trade resistance'.[4] They depend on all the trade cost factors for each country's trade with itself and all other countries, and take the form

$$P_j = \left[\sum_i (\beta_i p_i t_{ij})^{1-\sigma} \right]^{1/(1-\sigma)} \tag{2}$$

where p_i is the price received by exporters in country i and β_i is the distribution parameter in the utility function.[5] Anderson and van Wincoop (2004) derive comparable results for a model in which each country produces a product within each product class.

The trade cost factors can in turn be regarded as functions of a group of continuous variables (see Mélitz, 2003), notably some measure of distance, on the one hand, and population and land area (reflecting the ease of domestic rather than international trade) on the other; and a group of categorical variables covering, for example, whether two countries have a common border, the nature of their prior and existing colonial relations, and whether they have some particular trade arrangement or exchange rate regime between them.

Empirical estimation of this model has to take account of the fact that P_i and P_j are not observable. Anderson and van Wincoop (2003) directly solve for P_i and P_j in terms of the observable determinants of the trade barrier and then estimate (1) directly using non-linear estimation techniques. An alternative, adopted by Rose and van Wincoop (2001) and Mélitz (2003) and used in this paper, is to include country fixed effects in a standard regression as proxies for multilateral trade resistance. The country fixed effects capture the common element in each country's trade with every other country, which is precisely the notion of multilateral trade resistance.[6]

The issue of distance has been investigated in more detail by Mélitz (2003, 2005), who has argued that distance is better measured as the distance between each country's most populous city (as the centre of gravity for economic activity), rather than as the distance between the geographic centres of each country as in Rose's work. Across the sample as a whole this modification makes little difference, but there are obvious cases where it does. In Canada, for example, economic activity is concentrated close to the border with the US while the geographic centre is much further north, and in a number of Middle Eastern and African countries the geographic centre is determined by large areas of economically empty desert while economic activity is concentrated on the shores of a sea or a river. Mélitz (2003) also argued, in line with the Anderson-van Wincoop emphasis on bilateral versus multilateral trade resistance, that what matters is not absolute but relative distance, that is, the distance between two countries relative to the average distance between each of them and all their trading partners. An obvious example of the importance of this is New Zealand, which is, as Baldwin (2005) points out, a long way from Australia but an even longer way from other industrialised countries. However, as Mélitz (2005) makes clear, once country fixed effects are included, the average distance or remoteness of a country is subsumed in those fixed effects, and distance is in effect relative distance.

With the exception of Mélitz's distance measures and our own classification of exchange rate regimes (see below), we rely exclusively on data provided by Rose (2003).[7] These consist of annual data from 1948 to 1999 for 175 countries. In that paper Rose was concerned primarily with assessing the impact on trade between countries of membership of the WTO (GATT), the IMF and the OECD, but his previous finding on the role of currency union membership comes through strongly. In this paper we focus on the post-Bretton Woods era from 1973 to 1998, only. For much of the earlier part of Rose's sample, many developing countries – particularly those in Africa and the Caribbean -- were still colonies whose exchange rate regimes were imposed by their colonial masters. The currency unions and hard peg regimes that proliferated under such arrangements were also associated with relatively low tariff barriers as the result of systems of 'imperial preference'. In addition, the post-1973 period involved much more change over time in individual countries' exchange rate regimes than the Bretton Woods period. The pre-1973 period therefore provides a much less suitable field for testing the effect of exchange rate regimes on trade than the later years when former colonies had become free to choose their own regime and tariffs and where non-tariff barriers generally were much lower. We also exclude 1999 because, given the evidence from Micco, Ordoñez and Stein (2003) that the impact on trade of European monetary union is gradual, we want to exclude the incomplete effect of the first year of that development.[8]

Our full estimating equation, defined for country-pair-years, is:

$$\begin{aligned}\ln(X_{ij}^{t}) = {} & \alpha_0 + \alpha_1 \ln(D_{ij}) + \alpha_2 \ln(Y_i Y_j)_t + \alpha_3 \ln(Pop_i Pop_j)_t + \\ & \alpha_4 \ln(Area_i Area_j) + \alpha_5 Lang_{ij} + \alpha_6 ComBord_{ij} + \alpha_7 Landl_{ij} + \\ & \alpha_8 Island_{ij} + \alpha_9 ComCol_{ij} + \alpha_{10} Colony_{ij} + \alpha_{11} CurCol_{ijt} + \alpha_{12} ComNat_{ijt} + \\ & \alpha_{13} \mathrm{Re}gional_{ijt} + \alpha_{14} GSP_{ijt} + \sum\nolimits_h ER_{ijt}^{h} + \sum\nolimits_t \gamma_t T_t + \delta_i C_i + \delta_j C_j + \varepsilon_{ijt}\end{aligned} \tag{3}$$

where *i* and *j* denote the two trading partners

t denotes time

X is the average value of real bilateral trade (constant US dollars)

Y is real GDP (constant US dollars)

Pop is the population of the country

D is the great circle distance between most populous cities (standard miles)

Area is the area of the country (square kilometres)

Lang is a dummy with value 1 if the two countries have the same language, and 0 otherwise

ComBord is a dummy variable with value 1 if the two countries have a common border

Landl is the number of landlocked countries in the pair (0, 1 or 2)

Island is the number of countries in the pair which are islands (0, 1 or 2)

ComCol is a dummy with value 1 if i and *j* were ever colonies after 1945 with same coloniser, and 0 otherwise

Colony is a dummy with value 1 if *i* ever colonised *j* or vice versa

CurCol is a dummy with value 1 if *i* and *j* are colonies at time *t*

ComNat is a dummy with value 1 if *i* and *j* are part of the same nation at time *t*

Regional is a dummy with value 1 if *i* and *j* belong to the same regional trade agreement at time *t*

GSP is a dummy with value 1 if *i* extended a GSP concession to *j* at time *t* or vice versa

$\{ER^h_{ijt}\}$ is the set of dummy variables describing the exchange rate regime between *i* and *j* at time *t*, as set out in the next section

$\{T_t\}$ is a set of time fixed effects

$\{Ci\}$ is a set of country fixed effects.

In order to build up towards this full model we first consider the introduction of country fixed effects as proxies for multilateral trade resistance. Table 1 presents, in columns 1 and 2, the results of a basic regression of bilateral trade on log distance, log product of real GDP, log product of population, log product of area and time dummies, and with and without country fixed effects. It is clear that the fixed effects add significantly to the explanatory power of the equation: the pooling restriction on the country fixed effects is decisively rejected and the adjusted R-squared rises from 0.63 to 0.71. At the same time the coefficient estimate for log product of real GDP falls from 1.40 to 0.54 while that for log distance rises (absolutely) from -1.36 to -1.63. On the other hand, since the log product of land area is perfectly collinear with the country fixed effects, it does not enter the regression in column 2. In the light of this statistical evidence, as well as the previous theoretical argument, we include country fixed effects (and exclude land area) from now on.

[Table 1 near here]

In column 3 we introduce the standard set of controls used by Rose and others, i.e. those from *Lang* to *GSP* in the above list. It is clear that they also add to the explanatory power without greatly disturbing the other coefficients; the adjusted R-squared rises from 0.711 to 0.721. Those variables which correlate perfectly with the country fixed effects, namely, *Landl* and *Island* are dropped from these and subsequent regressions.

3 Adding exchange rate regimes

We now build on this baseline by controlling for the exchange rate arrangements between countries, drawing primarily on Reinhart and Rogoff's (2004) classification of *de facto* exchange rate regimes.[9] This is one of a number of classifications produced in recent years in attempts to discriminate between regimes on the basis of what countries actually do rather than what they say they do; it makes particular use of parallel market data as well as official exchange rate data.[10]

Reinhart and Rogoff classify most of the countries in our sample in terms of 15 different regimes,[11] and we have filled in the gaps ourselves for the others.[12] They classify countries on an individual basis, but for use in a gravity model the classification has to be by country pairs. We are interested in distinguishing between exchange rate regimes in terms of exchange rate uncertainty and transactions costs. For this purpose we first aggregate Reinhart and Rogoff's 15 categories into four: a currency union or currency board; a (hard) currency peg; a managed float; and a free float. This involves separating Reinhart and Rogoff's second category ("currency board arrangement or pre-announced peg") into hard pegs, such as the peg of sterling to the dollar between 1951 and 1971, and currency boards, such as those operated in many colonies, in Africa and elsewhere, prior to independence in the late 1950s or 1960s. In general the distinction is clearcut, but we had to make judgments about the transition from currency boards to hard pegs for a range of ex-colonies, and here we relied in part on information given in Page (1993). We were also able to allocate the very small number of cases of Reinhart and Rogoff's category 15 into one or other of our four categories. Table 2 shows the correspondence between Reinhart and Rogoff's 15 and our four categories.

[Table 2 near here]

Next, we define a vector of mutually exclusive 0-1 dummy variables so as to distinguish on a country pair basis between regimes such as (a) two countries use the same currency in a currency union and/or as the anchor for a currency board (dummy variable SAMECU = 1), in which case there is zero uncertainty and near-zero transactions costs involved in trade between them;[13] (b) two countries peg to the same currency (SAMEPEG = 1), in which case there is some uncertainty and definite transactions costs; (c) both countries' exchange rates float but are managed with reference to the same anchor currency (SAMEMANREF = 1), in which case there is more uncertainty and probably higher transactions costs (from wider spreads); (d) cases where one country has a pegged and another a managed currency (without a specific reference currency) (PEGMAN = 1); and so on. The matrix in Table 3 is a simple way of identifying the different possible regimes; in each of the cells in the first three rows there are two regimes to cover when countries refer (more or less strictly) to the same currency (in the north-west corner of the cell) and when they refer to different currencies (in the south-east corner). Table 4 gives the full specification, together with the distribution of observations across regimes. The default exchange rate regime is where both countries have a freely floating currency.

[Tables 3 and 4 near here]

As for our prior expectations for the various dummies, on the basis of the existing literature on the effect of currency unions within gravity models, we expect countries in the same currency union/currency board to have significantly higher trade than those in the default regime, so that SAMECU should be positive. We expect countries which peg to the same currency to have somewhat higher trade, *ceteris paribus*, since the exchange rate uncertainty is less than in the default regime but there are significant transactions costs, so that SAMEPEG should be positive but smaller than SAMECU. We expect countries which manage their currencies with reference to the same currency to have a smaller improvement in external trade, so that SAMEMANREF would be positive but smaller again.

For exchange rate regimes which cross categories or involve different anchors, pegs or reference currencies, however, it is necessary to be more precise. In particular, we can distinguish three different effects. First, the direct effect of any exchange rate regime between two countries which reduces uncertainty and transactions costs relative to the default regime will be to increase the trade between them. Second, there will be a substitution effect: a regime may affect the trade between two countries negatively by encouraging one country to substitute it by trade with a third country with which it has a 'closer' exchange rate regime. And third, there will be an indirect effect: a regime may affect trade positively via an indirect reduction in transactions costs, where a country which trades with more than one user of a single currency, or (to a lesser extent) more than one country pegging to a vehicle currency, can economise on working balances in the single or the vehicle currency.

For example, where one country is in a currency union/currency board with an anchor to which the other pegs, the common anchor/peg should reduce uncertainty (relative to the default regime) and insofar as it trades with other members of the union the pegging country should be able to economise on working balances, both of which effects would increase trade; on the other hand, the country in the currency union may substitute trade with its currency union partner(s) instead of trade with the same-peg country, which would reduce trade. Thus, with positive direct and indirect effects but a negative substitution effect, the sign of SAMECUPEG is not clear *a priori*. Similarly, where two countries peg to different currencies, the existence of pegs may enable both countries to economise on working balances in the vehicle currencies, but there may be substitution effects in favour of trade with same-peg countries. So, with a zero direct effect (because both anchor currencies are floating against each other), a positive indirect effect and a negative substitution effect, the sign of DIFFPEG is also not clear *a priori*.

4 Results

Table 5 presents the results of adding the full menu of exchange rate regimes to the model reported in the final column of Table 1. The coefficients on the control variables are all close to those in the final column of Table 1, and the adjusted R-squared is unchanged at 0.721. 11 out of the 20 exchange rate regime coefficients are significant. The highest (and most significant) coefficient is that for SAMECU, which at 0.79 is slightly lower than Rose and van Wincoop's (2001) corresponding currency union result (of 0.86). SAMECUPEG, SAMECUMAN and SAMEPEG all have significant coefficients, at 0.38, 0.24 and 0.08 respectively. DIFFCU is significant at 0.36, as are DIFFPEG, DIFFPEGMAN and DIFFMANREF, at 0.09, 0.11 and 0.10. On the other hand PEGMAN, PEGFLOAT and CUFLOAT are significantly negative, with values between -0.09and -0.13.[14]

[Table 5 near here]

Table 6 provides an alternative way of looking at these results. It sets out the coefficient estimates in a matrix corresponding in part to that of Table 3. The columns indicate successive exchange rate regimes for one country, while the rows indicate successive regimes for the second, distinguishing between where the second country has the same currency or anchor or reference currency as the first, in the top three rows, and where it has a different anchor or reference, in the last three rows. The NO/man row is repeated so that the table fans out in a symmetrical way from the default regime. Scanning the table along one row or one column enables the reader to see the effect of varying one country's regime while holding the other's constant. And scanning along the diagonal towards the CU/CU cell at the top right shows the effect of keeping both countries' regimes the same but varying them both.[15]

[Table 6 near here]

A number of clear patterns emerge from Table 6. First, from the CU column it is clear that SAMECU > SAMECUPEG > SAMECUMAN > 0 > CUFLOAT. In other words, except in the case where the other currency is floating there is no significant trade diversion from membership of a currency union, a result which has also been obtained in more general terms by other researchers, e.g. Micco et al. (2003). Hence, the direct and indirect effects significantly outweigh the substitution effect. Second, from rows 2 and 3 of the table it is clear that SAMECUPEG > SAMEPEG and SAMECUMAN > SAMEPEGMAN, while from the peg column SAMEPEG > SAMEPEGMAN. Third, the patterns for regimes where the currency/anchor/reference are different are generally less clear (but the significance and the magnitude of the estimates are typically smaller). However, membership of different currency unions has a strong positive effect on trade, with DIFFCU nearly half as large as SAMECU, while DIFFPEG, DIFFMANREF and DIFFPEGMAN are also significantly positive.

We have also carried out the same analysis for the period 1948-72, and for 1948-98 as a whole. The results (which are available from the authors on request) are broadly similar, with two main differences: the absolute size of the exchange rate regime coefficients is typically larger for 1948-72 than for 1973-98; and DIFFCU is insignificant in 1948-72. While there is obviously scope for more disaggregated work here, these differences seem to be explicable in terms of the reasons given above for focusing on the later period, and two further points are worth making. First, the reduction in the trade effects of exchange rate regimes in the later period tends to go against the endogeneity argument (that countries with more trade choose 'closer' exchange rate regimes). Second, while Micco et al. (2003) interpreted the relatively small currency union effect which they found for the EMU countries as indicating that this effect is smaller for developed countries than for the developing countries which are prominent in Rose's datasets, the present findings suggest that Micco et al. may also have been picking up a smaller effect because currency unions typically had a smaller impact in the later period.

In general our results suggest that there is a graduated effect by which greater exchange rate fixity and lower transactions costs encourage trade. The effect of currency unions on trade, on which the literature has concentrated, turns out to be the strongest, but other regimes which imply more uncertainty and larger transactions costs than in a currency union, but less than in the default regime of a double float, also promote trade. In addition, the possible trade-diverting effect of 'closer' exchange rate regimes – the second of the three effects identified above – seems to be outweighed by the two trade-promoting effects. This is surely the obvious explanation for the positive and significant results for the DIFFCU regime: the direct effect of this regime (relative to the default) must be negative or zero at best (since the unions are floating against each other), the substitution effect on trade must be negative, but the indirect effect on transactions cost must be positive and could be large, particularly in cases where the two unions are themselves large and the two countries trade widely with members of the other union.

5 The tariff equivalent of different currency barriers

The previous two sections have presented a wealth of empirical results. These can be conveniently summarized by expressing the estimated barrier to trade represented by each exchange rate arrangement in tariff equivalent terms, relative to the barrier-free case which is here represented by the same currency union category (SAMECU). From the log-linearised version of equation (1) the estimated coefficients on the exchange rate dummy variables correspond to $\hat{\beta}^h = (\sigma - 1)\ln \mu_{ij}^h$ where μ_{ij}^h is that part of the trade cost factor for trade between countries *i* and *j* associated with exchange rate regime *h* (see Anderson and van Wincoop (2004)). The tariff equivalent in percentage terms is then (μ_{ij}^h - 1)*100. Table 7 presents the calculations based on the estimated coefficients reported in Tables 5 (and 6), on the basis of two different estimates of the elasticity of substitution, first σ = 5, which is used by Rose and van Wincoop (2001), and second σ =

8, which seems to be the preferred estimate of Anderson and van Wincoop (2004). The results are arranged in the rank order of the coefficients..

[Table 7 near here]

The full barrier, given in the table by the default regime, is estimated at 21.9% for σ = 5 and 12.0% for σ = 8; the former can be compared with Rose and van Wincoop's 26%. These barriers are reduced by exchange rate regimes which restrict the volatility of the exchange rate between two countries and/or decrease the costs of international transactions. In the σ = 8 case, for example, the barrier is reduced to 10.8% where two countries peg to the same anchor, to 6.7% when they are each members of different currency unions, and 6.3% when one is using in a currency union/currency board the currency to which the other is pegged. Some regimes constitute an even bigger obstacle to trade than the 'full barrier' implied by the double float (because their coefficients are negative, in some cases significantly so), notably those in which at least one country floats or manages its currency without a specific reference. The trade-weighted average tariff equivalent across the full range of exchange rate arrangements is 21.0% for σ = 5 and 11.5% for σ = 8.

These disaggregated estimates allow us to place Rose's original estimate of the currency union effect and Rose and Wincoop's estimate of the monetary barrier in context. In both cases their estimates are derived from an exercise in which only the currency union exchange rate regime is identified, and the default includes all other regimes. Such estimates are often understood implicitly as applying to the adoption of a currency union from the starting point of any other exchange rate regime. But our work shows it is important to differentiate. For example, the move from EMS to EMU was a move from SAMEPEG to SAMECU for trade between the countries concerned, and on our overall results that move reduces the monetary barrier by 10.8% rather than the full 12.0% (for $\sigma = 8$). Similarly, for Denmark to move now from pegging to the euro (SAMECUPEG) to adopting the euro (SAMECU) would reduce the monetary barrier to its trade with the eurozone only by 6.3%.

6 Conclusions

In this paper we have integrated a full set of bilateral exchange rate regimes into an existing large dataset and used the 'new' version gravity model to estimate the size of the barriers to trade represented by different regimes. The basic results confirm the importance of currency unions in encouraging trade between countries, but they put Rose's original results in context in two particular respects. First, they indicate that some regimes other than currency unions are also significantly more pro-trade than flexible exchange rates: there is a graduated positive effect on trade as uncertainty and transactions costs are reduced. Moreover, the results suggest that in general the positive direct and indirect effects on trade of such reductions outweigh the trade-diverting substitution effect. Second, the result that DIFFCU is large and positive suggests that the indirect effect from being able to economise on working balances is particularly important. That in turn suggests that a substantial part of the 'Rose effect' comes from the indirect effect, which is even stronger for membership of the same currency union, and that may help to explain the size of the effect.

Notes

[1] A partial exception to the exclusive focus on currency unions is Fritz-Krockow and Jurzyk (2004) who investigate the trade-enhancing effects of fixed pegs as well as currency unions in a set of 24 Caribbean and Latin American countries.

[2] Together with many other researchers in this field, we are very grateful to Andrew Rose for making his datasets available for download from his website. We are also grateful to Jacques Mélitz for making available his data on distance.

[3] Anderson and van Wincoop (2003) define the left hand side variable as the exports from one country to the other, but as Mélitz (2003) points out there is nothing to distinguish between exports and imports.

[4] These price indices are crucially absent from the traditional version of the gravity equation, and the implied adjustments to them are essential for obtaining proper predictions of the effects of changes in exchange rate regimes.

[5] In the case of domestic trade it is assumed that the trade cost factor, e.g. t_{jj}, is equal to unity.

[6] See also Feenstra (2004, pp. 161-2): 'Since the fixed-effects method produces consistent estimates of the *average* border effect across countries, and is easy to implement, it might be considered to be the preferred estimator.'

[7] The main sources for the data are IMF and World Bank publications and the CIA's *World* Factbook. See Rose (2003) for further details.

[8] The dataset consists of actual trade flows and is therefore unbalanced: for example almost 8,000 pair-wise trade flows are recorded in 1997 but only 5,300 in 1973.

[9] In programming the dataset we draw on Reinhart and Rogoff's background material (2003a, Part I) which specifies the reference currencies, as well as on their basic classification codes.

[10] See Levy-Yeyati and Sturzenegger (2000) and Bailliu, Lafrance and Perrault (2003) for alternative classifications.

[11] Monthly data is provided in Reinhart and Rogoff (2003b).

[12] Countries not covered in Reinhart and Rogoff but included in the dataset are: Afghanistan, Angola, Aruba, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Bermuda, Bhutan, Brunei, Cambodia, Cape Verde, Comoros, Djibouti, Fiji, Kiribati, Maldives, Mozambique, Namibia, Oman, Papua New Guinea, Qatar, Rwanda, Samoa, Sao Tome, Seychelles, Sierra Leone, Solomon Islands, Somalia, Sudan, Syria, Tonga, Trinidad and Tobago, United Arab Emirates, Vanuatu, Vietnam, Yemen, Zimbabwe (before 1980). We used individual country webpages and world exchange rate arrangements tables from the IMF's website, supplemented by examination of basic exchange rate data and common knowledge.

[13] It should be noted that the SAMECU variable differs from Rose's strict currency union dummy insofar as (a) SAMECU is 1 but Rose's *custrict* is 0 where two countries each have (institutionally separate) currency unions or currency board arrangements with the same anchor currency, eg Argentina and Hong Kong in the 1990s, and (b) SAMECU is 0 and *custrict* is 1 in some post-independence years when, according to Reinhart and Rogoff and other sources, some of the colonial currency board arrangements became pegs rather than currency boards.

[14] It should be noted that the very large number of observations means that it is in some sense 'easy' for a variable to appear statistically significant in this exercise. What matters is the absolute size of the currency effects.

[15] In this paragraph we have focused on the point estimates, but, as can be inferred from Table 5, all the differences mentioned are statistically significant except for those between SAMECUPEG and SAMECUMAN and between SAMEPEG and SAMEPEGMAN

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Table 1: The baseline gravity model

Dependent Variable: Log bilateral trade (constant US dollars)

Pooled OLS Estimation. Sample: 1948-1998 [unbalanced panel]

	Basic Model with no country effects	**As Column 1 with country fixed effects**	**As Column 2 with standard controls**
	[1]	**[2]**	**[3]**
log product real GDP	1.40 [344.15]	0.54 [34.87]	0.54 [35.48]
log product population	-0.44 [90.48]	-0.43 [12.12]	-0.41 [11.64]
log product area	-0.11 [44.02]	-	-
log distance	-1.36 [203.52]	-1.63 [209.15]	-1.46 [164.32]
Common language	-	-	0.34 [20.33]
Common Border	-	-	0.48 [14.55]
Common colonizer post 1945	-	-	0.64 [24.48]
Current colony	-	-	0.36 [1.75]
Ever colony			1.25 [48.84]
Members of common nation	-	-	0.55 [1.90]
Regional Trade Arrangement	-	-	1.31 [33.34]
GSP	-	-	0.60 [37.30]
year dummies	Yes	Yes	Yes
country dummies	No	Yes	Yes
Adjusted R^2	0.627	0.711	0.721
F[Country effects=0] [2]	-	187.96 [0.000]	186.05 [0.000]
No. observations	164,654	164,654	164,654

Notes: [1] heteroscedastic robust t-statistics in parentheses.
[2] F-test against joint significance of country dummies.

Table 2: Classification of exchange rate regimes

R&R fine code	R&R description	New classification
1	No separate legal tender	Currency board or currency union
2	Currency board arrangement or	
2	Pre-announced peg	Currency peg
3	Pre-announced horizontal band that is narrower than or equal to +/-2%	
4	De facto peg	
5	Pre-announced crawling peg	Managed floating
6	Pre-announced crawling band that is narrower than or equal to +/-2%	
7	De facto crawling peg	
8	De fact crawling band that is narrower than or equal to +/-2%	
9	Pre-announced crawling band that is wider than or equal to +/-2%	
10	De facto crawling band that is narrower than or equal to +/-5%	
11	Moving band that is narrower than or equal to +/-2% (i.e. allows for both appreciation and depreciation over time)	
12	Managed floating	
13	Freely floating	Flexible exchange rate
14	Freely falling	
15	Dual market in which parallel market data is missing	[allocated elsewhere]

Sources: Reinhart and Rogoff (2004); text.

Table 3: Matrix of exchange rate regimes by country pair

	currency union or currency board	pegged exchange rate	managed exchange rate with specified reference currency	managed exchange rate with no specified reference currency	flexible exchange rate
currency union or currency board	SAMECU DIFFCU				
pegged exchange rate	SAMECUPEG DIFFCUPEG	SAMEPEG DIFFPEG			
managed rate with specified reference currency	SAMECUMAN DIFFCUMAN	SAMEPEGMAN DIFFPEGMAN	SAMEMANREF DIFFMANREF		
managed rate with no specified reference currency	CUMAN	PEGMAN	MANREFMAN	MANMAN	
flexible exchange rate	CUFLOAT	PEGFLOAT	MANREFFLOAT	MANFLOAT	– (default)

Table 4: Classification and distribution of exchange rate regimes by country pair

Description of exchange rate regime by country pair	**Dummy variable**	**Percent of Total**
both countries use the same currency in a currency union and/or as the anchor for a currency board	SAMECU	1.5
both countries are in currency unions or operate currency boards, but with different anchors	DIFFCU	0.7
one country is in a currency union/currency board with an anchor to which the other pegs	SAMECUPEG	1.2
one country is in currency union/currency board with one anchor while the other pegs to different anchor	DIFFCUPEG	2.0
both countries peg to the same currency	SAMEPEG	2.1
both countries peg but to different anchors	DIFFPEG	1.2
one currency is in currency union/board with anchor with reference to which the other is managed	SAMECUMAN	3.9
one currency is in currency union/board with anchor other than that with reference to which the other is managed	DIFFCUMAN	7.4
one country is pegged to the currency with reference to which the other's currency is managed	SAMEPEGMAN	6.8
one country is pegged to a currency other than that with reference to which the other's is managed	DIFFPEGMAN	5.1
both countries have managed floats with the same reference currency	SAMEMANREF	8.9
both countries have managed floats with specified but different reference currencies	DIFFMANREF	8.0
one country is in currency union/board, the other has a managed float with no specified reference currency	CUMAN	3.6
one country pegs, the other has a managed float with no specified reference currency	PEGMAN	3.0
both countries have managed floats, one with and one without a specified reference currency	MANREFMAN	11.0
both countries have managed floats, with unspecified reference currencies	MANMAN	1.9
one country is in a currency union/currency board, the other has a floating currency	CUFLOAT	4.1
one country pegs, the other has a floating currency	PEGFLOAT	4.6
one country is managing its currency with a specific reference, the other has a floating currency	MANREFFLOAT	12.3
one country is managing its currency without a specific reference, the other has a floating currency	MANFLOAT	3.7
both countries have a flexible exchange rate	[default regime]	7.1
Total Observations		164,654

Table 5: Exchange Rate Arrangements and Trade

Dependent Variable: Log bilateral trade (constant US dollars)

Estimation: Pooled OLS with country and time dummies

Sample	**1973-1998**	
	Coefficient	**t-statistic[2]**
Exchange Rate Arrangements [1]		
SAMECU	0.792	13.17
DIFFCU	0.363	3.84
SAMECUPEG	0.384	6.46
DIFFCUPEG	0.016	0.31
SAMEPEG	0.079	2.02
DIFFPEG	0.091	2.12
SAMECUMAN	0.235	5.77
DIFFCUMAN	0.054	1.47
SAMEPEGMAN	-0.026	-0.90
DIFFPEGMAN	0.107	3.85
SAMEMANREF	0.005	0.19
DIFFMANREF	0.095	3.75
CUMAN	0.068	1.69
PEGMAN	-0.086	-2.54
MANREFMAN	0.046	1.75
MANMAN	-0.006	-0.13
CUFLOAT	-0.119	-2.88
PEGFLOAT	-0.134	-4.51
MANREFFLOAT	-0.037	-1.53
MANFLOAT	-0.045	-1.33
Control Variables		
log distance	-1.445	-158.68
log product real GDP	0.537	35.08
log product population	-0.406	-11.29
Common language post 1945	0.312	18.75
Common border	0.485	14.90
Common colonizer	0.587	22.34
Current colony	0.356	1.85
Ever colony	1.185	45.59
Members of common nation	0.685	2.43
Regional Trade Arrangement	1.285	32.37
GSP	0.577	35.75
Adjusted R-square	0.7213	
F[country effects=0]	168.33	
	[0.000]	
No. obs	164,654	

Notes:
[1] See Table 4 for definition of exchange rate arrangements
[2] heteroscedastic robust t-statistics in parentheses.

Table 6: Exchange rate regime coefficients 1973-98

Country 2. Exchange Rate Arrangement.				Country 1 Exchange Rate Arrangement				
		row		flex	man	ref	peg	CU
	SAME	1	CU					0.79*
		2	peg				0.08*	0.38*
		3	ref			0.01	-0.03	0.24*
	NO	4	man		-0.01	0.05	-0.09*	0.07
		5	flex	0	-0.05	-0.04	-0.13*	-0.12*
		6	man		-0.01	0.05	-0.09*	0.07
	DIFF	7	ref			0.10*	0.11*	0.05
		8	peg				0.09*	0.016
		9	CU					0.36*

Key: SAME = both countries have same currency/anchor/reference; DIFF = each country has different currency/anchor/reference; NO = no anchor/reference; CU = currency union/currency board; peg = pegged exchange rate; ref = managed exchange rate with specific reference; man = managed with no specific reference; flex = flexible exchange rate.

Table 7: Tariff equivalent estimates of monetary barriers (%) [1]

	1973-98	
	σ=5	**σ=8**
SAMECU	0.00	0.00
SAMECUPEG	11.82	6.34
DIFFCU	12.41	6.66
SAMECUMAN	15.85	8.57
DIFFPEGMAN	19.19	10.44
DIFFMANREF	19.50	10.61
DIFFPEG	19.61	10.68
SAMEPEG	19.90	10.84
CUMAN	20.18	11.00
DIFFCUMAN	20.54	11.21
MANREFMAN	20.74	11.32
DIFFCUPEG	21.50	11.75
SAMEMANREF	21.77	11.91
default	**21.90**	**11.98**
MANMAN	22.04	12.06
SAMEPEGMAN	22.54	12.35
MANREFFLOAT	22.81	12.50
MANFLOAT	23.01	12.61
PEGMAN	24.02	13.20
CUFLOAT	24.83	13.66
PEGFLOAT	25.19	13.87
Weighted Average [2]	20.98	11.47

Notes:

[1] Tariff equivalent calculations based on estimated coefficients from Table 5

[2] Computed by weighting each tariff-equivalent by the share of trade sustained under each exchange rate regime.