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GEOGRAPHY, TRADE AND CURRENCY UNION

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ABSTRACT

Geography, Trade and Currency Union*

This Paper reports on four basic results of tests of the standard gravity equation. First, geography can serve to reflect comparative advantage as well as transportation costs. Second, the effect of distance on bilateral trade is mostly a substitution effect between closer and more distant trade partners rather than a scale effect on total foreign trade. Third, special political relationships, such as free trade agreements, former colonial attachments and currency union, do not produce any trade diversion in the aggregate, but increase trade with outsiders as well as among the parties to the relationship. Fourth, Rose's surprisingly high estimate of the impact of currency union on trade stems partly from a selection bias, but even following a correction for this bias, the estimate remains high.

JEL Classification: F10 and F33
Keywords: bilateral trade, free trade area, geography, gravity, monetary union, trade creation and trade diversion

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The gravity model is now a workhorse in empirical study of trade and serves to deal with such varied questions as the importance of political borders (McCallum (1995)), free trade agreements (Frankel (1997)) and currency unions (Rose (2000)). The proper specification of the model has therefore become a matter of general concern. In this paper, I report on tests dealing with three questions about the model. The first one relates to the possibility that geography may serve to reflect comparative advantage, and not only transportation costs. The second concerns the distinction between substitution and scale effects in the model. To what extent does distance reduce trade with more distant countries in favor of trade with closer ones rather than damage foreign trade in general? Likewise, to what extent do special political relationships, such as free trade agreements and currency unions, increase trade within the group at the expense of trade with outsiders instead of increasing foreign trade in general? The third and last series of tests pertains to Rose's surprisingly high estimate of the impact of currency union on trade, which asserts that such union will more than quadruple trade among the members. A brief opening word may be said about the motivation for each of these separate tests and the results.

I. Motivation and results

Great-circle distances in gravity models serve to reflect transportation costs. But there are other measures of distance that could reflect comparative advantage instead. So far as comparative advantage depends on differences in climate and seasons, this factor could be reflected simply in differences in latitude between countries. The latitude of a country affects the length of its days, its sunlight, its temperatures and seasons, and will alter not only its plant and animal life and the potential yield of its land and waters, but its required insulation, storage, energy and equipment, and its optimal production techniques. Diamond's (1997) fascinating history of mankind strongly suggests that production opportunities can often be reproduced through selective planting, breeding, tooling and exertion at any given latitude on earth, but that similar efforts to do so become increasingly futile as we move North or South. If so, as long as we control for great-circle distances (and therefore transportation costs), greater distance along the North-South axis should increase, not diminish, trade. As I shall

show, that is exactly what happens. When great-circle distances are taken into account, the larger the absolute difference in latitudes between two countries North and South of the equator, the greater their bilateral trade. This effect of geography shows up consistently with *t* values of the order of ten without disturbing the rest of the gravity equations. Furthermore, the effect retains this order of significance in all of the extensions below.

As regards the substitution or scale effects of different influences on trade in the gravity model, some preliminary discussion is required. Attempts over the last twenty years to provide theoretical underpinnings for the model assume that aggregate output in each country (or region) is given, and the output must be sold either at home or abroad. Thus, any reduction in the bilateral trade of a country with another means an equal increase in its trade with third countries or at home. Should trade with third countries rise, domestic trade could stay constant or go up. If instead trade with third countries falls, the entire reduction in foreign trade must be in favor of domestic trade. Nevertheless, in some applications of gravity equations to bilateral trade, all or nearly all repercussions on third countries are neglected. Furthermore, even when this neglect (partial or total) occurs, changes in bilateral trade are sometimes aggregated to obtain effects on total foreign trade (e.g., Frankel and Romer (1999), and Frankel and Rose (2000)).

These last remarks echo a recent complaint of Anderson and van Wincoop (2000) about the failure to pay adequate attention to the constraints on aggregate trade in estimating gravity equations for bilateral trade. In order to deal with the problem, they propose a non-linear method of estimating these equations which incorporates “multilateral trade resistance,” or a term expressing the tariff-equivalent of all of the barriers to trade (both domestic and foreign), viewed as a whole. I propose instead – if only as a start – to introduce separate variables to reflect possible substitution or scale effects of bilateral trade on trade with third countries and to see whether these variables emerge as significant and which sign they bear. Of my relevant experiments, I will report only on those relating to distance and special political relationships.

As regards distance, my study uses relative distance to reflect possible substitution effects between different foreign countries, where relative distance refers to the absolute

distance between a trading pair divided by their average distance to other countries (to be defined more precisely below). When relative distance enters in the tests side by side with average distance to all the rest, relative distance emerges as the larger and statistically more significant of the two. Thus, most of the impact of distance in the usual gravity equations of bilateral trade must be attributed to substitution effects between alternative trade partners.

This last result may help to understand some previous evidence. Even though transportation costs have fallen greatly over the last two centuries, applications of gravity equations to the second half of the nineteenth century (Flandreau (1995)) and the interwar period (Eichengreen and Irwin (1995)) show lower effects of distance on trade than more recent applications over the last thirty years. If the effects of distance on bilateral trade refer mostly to aggregate trade, there is a puzzle. If, instead, they refer mostly to substitution between alternative trade partners, there is no difficulty of interpretation. With the fall in transportation barriers over time, relative distances simply count much more now in deciding *how far* goods will travel abroad than they did earlier (Anderson and van Wincoop (2000) say as much).

On the issue of the scale or substitution effects of political associations, the study considers all five political variables that Rose (2000) and Frankel and Rose (2000) introduce into gravity equations: namely, currency union, membership in a common country (as in the case of Greenland and Denmark or the Falklands and the UK), regional trade agreements, relations between former colony and colonizer, and relations between former colonies of the same colonizer. The results show that all five variables increase trade among the parties to the relationships. But every one of the relationships also breeds trade with outsiders, and therefore increases foreign trade in the aggregate. Of course, this last conclusion might be true for the study period but not all earlier times. However, so far as similar tests have been performed within the same study period – that of 1970-1995 – the results concur. Frankel experimented widely with the effect of free trade agreements on outsiders in studies with Stein and Wei (e.g., Frankel, Stein and Wei (1995, 1998), and Frankel and Wei (1998)), and in his pooled results (Frankel (1997)), reports the same promotion of trade with outsiders. In addition, Rose and Frankel-Rose find similar trade-creating effects for currency unions. I simply display the

generality of the finding: all five of the privileged political relationships induce the principals to trade more with everyone.

If this be puzzling, it is perhaps less so in regard to currency union than the other examples. Admittedly, a reduction in trade barriers between two countries without any similar lowering of barriers with the rest may be trade-diverting. Based on this logic, Frankel invokes special political hypotheses in order to explain his result that free trade agreements (FTAs) foster trade with outsiders. Drawing from the literature, he cites various possibilities: competitive liberalization; the possible build up of a political constituency in favor of liberalization through the revelation of export-competitiveness after countries enter into a FTA; and so forth (Frankel (1997), ch. 10). But a currency union can be viewed with a different eye. If some countries form a currency union, there are fewer currencies and fewer units of account in the world, and therefore lower trade barriers for everyone. Hence, currency union may not represent a discriminatory reduction of trade barriers at all. For example, once the euro circulates as a currency after 2002, and therefore bank drafts can be conveniently written in euros in commodity trade, British and Swedish households will be able to store euros instead of 12 monies in commodity trade with euro members, and they will benefit from fewer units of account in this trade. Thus, they will reap many of the same advantages of lower transaction costs, greater ease of calculation, and greater transparency of prices that the members of the EMU will get. Furthermore, in so far as EMU broadly interferes with political controls on capital movements and instructions to fund managers to hold home-currency assets, the result will be to raise capital-market integration worldwide. In theory, as Obstfeld and Rogoff (1996, 2000) demonstrate, this could mean more trade in goods in general.

As regards currency union, Rose has surprised everyone (including himself) with the size of the impact on trade that he found. He has also reported numerous tests of the robustness of his finding. The further experiments here concern the suspicion (occasionally voiced elsewhere)[1] that his sample of currency unions is biased, and the unions always occur

[1] See the comment by Marco Pagano in the Economic Panel discussion of Rose's paper (Rose (2000), p. 39), and Persson (200l).

between countries with unusually close trade ties with one another. If so, the impact of currency union in Rose's tests may largely reflect other factors besides a common currency. In fact, Rose's data permits testing this hypothesis. The tests exploit the presence of other political variables in the analysis (whose coefficients are therefore not to be considered "nuisance parameters," in opposition to Rose's designation). Interestingly, the tests confirm the bias, but the correction for it only moderates Rose's result without upsetting the outcome. More precisely, the correction cuts down the estimate of the impact of currency union on the log of trade by half. It follows, therefore, that currency union, as such, doubles instead of roughly quadrupling trade. On this basis, I conclude that the tests essentially support Rose's stand.

In more recent work with van Wincoop, Rose offers a different ground for reducing his earlier estimate of the influence of currency union on trade (Rose and van Wincoop (2000)), or at least does so in the case of new currency unions between countries that already trade a lot with one another (including the EMU). The argument is that, in these cases, currency union would not reduce the price of home goods nearly as much in trade within the union as it does for the existing currency unions in his sample, since bilateral trade with the partners would already be much higher as a percentage of total foreign trade in the first place. More generally, Rose and van Wincoop apply Anderson and van Wincoop's concept of multilateral trade resistance to lower Rose's estimate in the event of new currency unions between close trading partners. However, my argument is independent. According to it, Rose's coefficient of currency union mixes up effects of other political factors enhancing trade with the effects of a single currency.

In a more recent paper still, Glick and Rose (2001) offer evidence supporting both my criticism of Rose's earlier work and my reduction in his estimate of the impact of currency union on trade. In this joint study, the authors employ an enlarged data set, which contains many more time series observations for individual trading pairs. As a result, they are able to obtain an estimate the impact of currency union on individual trading pairs over time, or "within" as well as "between" estimates. Their "between" estimate of this impact is as high as Rose's earlier ones, while their "within" estimate drops to the lower level in my study. Glick

and Rose pose their lower "within" estimate as the right one, without commenting on the reason for their higher "between" one. I shall argue that the gap stems from the fact that the lower estimate properly concerns the impact of currency union as such, while the higher one, which conforms to the results in all of Rose's earlier work, does not but regards the combined impact of currency union and other influences on trade.[2]

The discussion will cover each of the tests in succession, and will end with a few brief general remarks.

II. The data and initial tests

All of the tests rest on the data in Frankel and Rose (2000), which is available on Rose's web site.[3] My indebtedness to Rose for making his data public, and for including detailed instructions on how to use it, is enormous. I made two initial changes in the data set: one concerning distance, the other language. Whereas Rose locates countries at their geographical center (in accordance with the CIA), I place them wherever their most populous city stands (as found on the CD-rom *encarta*). Subsequently, the arc-geometry formula for great-circle distances serves me to calculate the bilateral distances between trading partners. This method yields the identical results to those found in the atlases and related web sites.[4] In the case of language, I kept Rose's series but added a few obvious corrections (most of which he subsequently incorporated). The difference in our measures of great-circle distances could matter in studying parts of the world with complicated political geographies, including Western Europe and Southeast Asia. For example, Rose's measure places East Germany closer to the UK than West Germany and France still further from the UK than West Germany, whereas mine does the opposite (with London-Paris setting UK-France and London-Frankfurt UK-West Germany). But those changes turn out to be trivial over the entire

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[2] Pakko and Wall (2001) report no impact of currency union at all on trade (nor membership in a free trade area) in a more radical challenge to Rose's stand, which falls outside the framework of this paper. The authors use a general fixed-effects model. In this case, all the geographical variables disappear from the analysis, since these variables are time-invariant. Therefore, Pakko and Wall drop the gravity model altogether.

[3] http://www.haas.berkeley.edu/~arose/.

[4] For details, consult Bob Chamberlain, "What is the best way to calculate the distance between two points?" at http://www.census/gov/cgi-bin/geo//gisfaq?Q5.1.

world sample of observations of bilateral trade. (The correlation between our two measures of distance in the world sample of over 40,000 observations is .987.) Similarly, my changes in denoting common languages between countries have no impact on the estimates (though they could if we examined language in greater detail).[5]

To open the discussion of the tests, the first two columns of table 1 show the estimate of the basic gravity equation with Rose's data prior to my changes and following them. The dependent variable is bilateral trade and the first four independent variables in the columns are distance, the product of the country pairs' GDPs, the product of their populations, and the product of their land areas. These variables are in logs. The next three variables on the list are dummies showing whether the countries have a common border; whether one, both or neither of them are landlocked; and whether they share a common language. This particular choice of variables no longer needs discussion. The data covers approximately 98 percent of all world trade, and is recorded every five years from 1970 through 1995. Dummies are also included for the individual years but are not reported. Because some country pairs are recorded as many as six times, the robust standard errors are corrected for clustering. The regressions rest on 31,010 observations rather than all the 40,000-some in the sample on account of missing values for some of the variables (predominantly GDP). The results in the first two columns – where the first one rests on the exact data in Frankel and Rose (2000) – are indistinguishable.

III. The forces of geography

The relevant gravity equation is known to be broadly consistent with the model of monopolistic competition in trade (subject to Anderson and van Wincoop's reservations). But recent research shows that it can also be obtained from models with homogenous goods. Deardorff (1998) explained how to derive the equation from the factor proportions model. Eaton and Kortum (1997) obtained it from random technological differences between countries. Nonetheless, efforts to introduce factor proportions directly into the equation have

[5] Nitsch (2001) does find some significant changes in estimates resulting from a more extensive modification of Rose's data. But for the moment, it is not possible to tell how much Nitsch's finding depends on his failure to pool the data for different years. As regards individual years, there are very few observations for some of his variables. In the case of language, my modifications and Nitsch's are almost identical.

had little success thus far (see Frankel (1997), p. 134), and though Eaton and Kortum got good results with technological knowledge, they did so only for manufacturing in 19 OECD countries. Yet geography alone could carry information about comparative advantage, and therefore about both factor proportions and international differences in production functions (for any given state of knowledge). As mentioned above, so far as the comparative advantage of different countries is related to differences in climate and seasons, the variable should be reflected in differences in latitude North-South. Such differences, by themselves, though, would treat Argentina as distant from Greece, whereas the two countries are at comparable latitudes in the two hemispheres and have similar climates. As a result, I experimented with differences in *absolute* latitudes, as well as differences North-South.[6] The differences in absolute latitudes would then relate specifically to climate, while the differences North-South would also pertain to the opposition of the seasons in the two hemispheres, and any factors of climate and environment that may be associated with the different features of the Northern and Southern hemispheres. For example, the ratio of land to water is much higher in the North.

As shown in columns (3), (4), and (5) of the table, if used alone, either one of these two measures of latitudinal distance (respectively labeled North-South Difference and Difference in Absolute Latitudes) emerges as highly significant and with the expected positive sign. But when joined together, the North-South variable is the only significant one.[7] In fact, the Difference in Absolute Latitudes is statistically significant in some of my other experiments despite the presence of the North-South Difference. But its significance never

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[6] If we let lat1 and lat2 stand for the respective latitudes of country 1 and country 2 in a trading pair (with Northern latitudes positive and Southern ones negative), then the North-South Difference is $|lat1 - lat2|$ and the Difference in Latitudes is $||lat1| - |lat2||$.

[7] Another geographical variable which has been frequently mentioned and used in the discussion is distance from the Tropics. See, for example, Sachs and Warner (1997) and Rodriguez and Rodrik (2000). This variable is supposed to reflect the low trade of countries near the Equator resulting from the poverty of their endowment. (For a radically different interpretation and use of this variable, see Hall and Jones (1999).) Based on the same notation as in the preceding note, the distance from the Tropics is $|lat1| + |lat2|$. The variable is always insignificant in my tests.

approaches that of the North-South Difference. For this reason, I will keep strictly the North-South Difference in the subsequent discussion. But the correlation between the two measures of latitudinal distance (in logs) is 0.73, and therefore the North-South Difference should perhaps be viewed – at least partly – as standing for both.

IV. The effects of distance

Does the impact of distance on bilateral trade reflect switching between closer and more distant partners, or does it affect aggregate foreign trade, or both? One simple way to get at this question is to introduce some measure of relative distance between countries, or to consider their distance relative to their average distance from all of the other countries in the world. Let the straight-line average of the (great-circle) distances of a country from all the other 185 in the sample be termed remoteness. If we use d_{ij} to refer to the distance between countries i and j, and R_i and R_j to refer to their respective remoteness, the relative distance between countries i and j can be defined as d_{ij}^2/R_iR_j.[8] Remoteness is usually defined somewhat differently in the literature as a *weighted-average* distance of each country from the rest, with weights depending on real GDPs. In the present usage, the term depends on distance alone, with all other n−1 potential trading partners in the relationship receiving equal weights. This relative distance variable is entirely in the spirit of Anderson and van Wincoop's measure of "multilateral trade resistance," except that their term combines all of the barriers to trade in the gravity equation in a single term (political borders, differences in language, differences in currency – everything).

There is a relative distance for each observation in the database. If we take the average of these relative distances, the value cannot be far from 1 (it is actually 1.03). Therefore, if expressed in logs, the variable will be centered around zero, and will show negative values for relative distances below the mean, and positive values for relative distances above the mean. But the log of the product of remoteness R_iR_j will always be positive. Suppose then that we run a regression while including both relative distance and the product of remoteness in logs. (Evidently, this is simply to include distance since log (d_{ij}^2/R_iR_j) plus log R_iR_j equals log d_{ij}^2.) If the bilateral distances d_{ij} induce no substitution effects at all in trades with alternative

[8] The most remote country in my data set is New Zealand, the least is Austria.

country pairs but always damage aggregate foreign trade, the coefficient of relative distance should be insignificant and close to zero while that of remoteness should be significantly negative. Suppose instead that trading distances below the mean really raise trade at the expense of trading distances above the mean while they do not affect aggregate foreign trade. Then the relative distance variable should be significantly negative while remoteness should be around zero. Of course, even in case of this last result, we would hesitate to conclude that distance does not affect aggregate trade, since if that were the case, then when entered alone, absolute distance d_{ij} would be insignificant, which we know to be false. But distance could bear both a substitution and a scale effect on foreign trade and therefore relative distance and remoteness could both enter with significant negative signs.

The first column in table 2 repeats the earlier estimate in table 1 with the Difference North-South but without the Difference in Absolute Latitudes. The second column in table 2 next substitutes remoteness (R_iR_j) for absolute distance, and the third column includes both relative distance and remoteness together. The exact correlation between relative distance and remoteness in logs is low, only 0.23. From the second column, we see that if remoteness serves instead of bilateral distance, both the coefficient and the significance of distance fall, but both remain very high. (Note, however, that the elasticity of the influence of distance is still on the order of usual estimates in this case.) In addition, the coefficients and Student *t*s of border and language (especially border) notably rise, and the coefficient of North-South Difference turns negative. This is not surprising, since these three variables now largely reflect geographical proximity between trading pairs. But the third column is the fundamental one. When relative distance and remoteness are both present, relative distance completely dominates remoteness, with a Student *t* about 15 times higher. Moreover, relative distance is statistically about as significant as d_{ij} in the first column, even though its coefficient is around one-half the size of d_{ij}'s, whereas the coefficient of remoteness, though still significant, becomes a fraction of d_{ij}'s. Otherwise, the impact of North-South Difference returns to its usual positive position, and the estimate remains the same as in column 1. Thus, distance exerts mainly a substitution effect rather than a scale effect on foreign trade.

As mentioned before, this last result helps to interpret some earlier evidence. Previous authors have commented on the improbably high magnitudes of the effects of distance on aggregate trade in gravity equations (e.g., Grossman (1998)). But according to the last column of table 2, a percentage fall in distance only raises *aggregate* trade by one-fifth of one percent ($\exp(0.18) \approx 1.2$) rather than 3 percent (as might have been concluded from column 1 ($\exp(1.26) \approx 4$)). The rest of the impact of distance concerns the cross-country composition of trade. The same result also helps to understand why distance has risen, not fallen, as an influence on *bilateral* trade with the drop in costs of transportation over time. Falls in transportation costs should have reduced the impact of remoteness (as indeed they seem to have done);[9] but they could well have increased the responsiveness of bilateral trade to distance in deciding whether to ship near or far.[10]

V. The effects of political associations

The next series of tests concern the five political variables in Rose and Frankel's tests: Currency Union, Political Union, Free Trade Area (FTA), Ex-Colonial Relationship, and Ex-Common Colonizer. According to Rose's series, some countries (territories, or departments in certain cases) in a political union also belong to a "free trade area" (to use Rose's term (2000)) whereas others do not, depending on whether or not there exists a separate free trade agreement between them. Instead I adopted the principle that a political union always implies a free trade area, and therefore scored country pairs as belonging to a Free Trade Area only if they were not part of a Political Union. This will clarify the subsequent interpretation of the results, as we will see. Following this further change in the data (in addition to the earlier ones in the preceding section), the estimate of the basic gravity equation is as shown in the first column of table 3. As we know already from Frankel and Rose (2000), all five political variables appear with positive and significant signs. The least significant of these signs, with a Student *t* of 2.4, regards Political Union, the political variable possessing the least number of observations. There are only 47 cases of Political Union which enter in the tests (because of

[9] Boisso and Ferrantino (1997) show that exports travel longer distances since 1960.

[10] Of course, any rising influence of relative distance on bilateral trade will not persist forever if transportation costs should fall below a certain point and become negligible.

no missing complementary data), while there are 284 similar cases of Currency Union, 427 ones of Ex-Colonial Relationship, 764 ones of FTA, and 2630 ones of Ex-common Colonizer. These other four political variables all have Student *t*s over 6.

The next column admits effects on trade with outsiders. Specifically, the column adds dummy variables for country pairs consisting of one member of a political association and one non-member. Thus, the dummy Currency Union/Outsider concerns trade between one member of a currency union and one non-member, the dummy Political Union/Outsider between one member of a political union and one non-member, FTA/Outsider between one member of a free trade area and one non-member, and Ex-colonized/Colonizer/Outsider between one ex-colonized or ex-colonizer and a country which is neither. This last dummy also does double duty for effects of Ex-Colonial Relationship and Ex-Common-Colonizer on outsiders.[11] Identically constructed dummy variables have served in a similar way in other studies. Frankel (with and without co-authors) uses FTA/Outsider in order to test for substitution or scale effects of FTAs on outsiders,[12] and both Rose and Rose-Frankel use Currency Union/Outsider in such tests for currency unions. Furthermore, these earlier studies report the same results for the relevant dummies: that is, both FTAs and currency unions increase trade with outsiders. As indicated before, I simply exhibit the generality of the finding: all five of the political variables promote trade with outsiders. The trade creation among the members of the political associations themselves is always much higher than the trade creation with outsiders, but both effects are well marked. It may be noted as well that the dummies for trade with third parties multiply the number of relevant observations for the political variables by an order of four. Adding these dummy variables also does not detract from anything in the rest of the equation.

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[11] Any effort to introduce separate dummies for the impact of Ex-Colonial Relationship and Ex-Common-Colonizer on outsiders would only lead to confusion. Except for relations between a colonizer and an outsider, the main differences between the two dummies would concern instances of an Ex-Colonial Relationship or an Ex-Common Colonizer, and would be reflected in these other variables. Apart from those instances of deviations, the two dummies would coincide perfectly or almost, since they would comprise mainly the identical cases of trade between ex-colonized and outsider.

[12] Though he mainly uses a variable that he terms "openness," which combines FTA and FTA/Outsider (but when used together with FTA, essentially denotes FTA/Outsider).

VI. Currency union

The final part of the discussion focuses on the hottest topic connected to the political variables: the impact of Currency Union. This last variable has a coefficient of around 1.5 with a Student *t* of 8 in columns 1 and 2. Taken at face value, this coefficient would say that entering into a currency union increases trade between the members by a factor of 3.5 ($\exp(1.5) \approx 4.5$). But there is good reason to think that countries will only form a currency union if they already enjoy particularly close trade or political ties with one another. If so, much of the 1.5 coefficient of currency union may be attributable to features of the relationship having nothing to do with a common currency. The first two columns of table 3 are consistent with this interpretation, since the coefficient of Currency Union in these columns exceeds those for either Political Union or Free Trade Area, while it is very difficult to see how removing the frictions of separate currencies could possibly promote trade more than removing protective trade barriers or entering into political union (which I interpret to mean removing trade barriers as well). Thus, those first two columns can be said nearly to invite the hypothesis that currency unions share many of the attributes of Free Trade Area and Political Union in the tests, whatever the political engagements may be. At least this hypothesis merits testing. In fact, a test is possible.

It so happens that the 284 usable observations of bilateral trade between members of a currency union (because of no missing complementary data) divide into 108 cases of country pairs that are also members of a political union or a FTA and 176 country pairs that are not. Of the 176 observations of pairs in a currency union belonging neither to a political union nor a FTA, most concern Africans with a shared colonial past. If we remove these next African examples from the previous 176 in order to isolate currency unions with no other relevant political affiliation whatever, we are down to only 56 observations. Those 56 essentially fall into three groups: Liberia, the Turk Caicos Islands, Panama, the Bahamas, the British Virgin Islands, Bermuda, and the US, all of which use the US dollar; African countries in a franc zone but without past colonial ties to France; and a heterogeneous lot consisting of the Australia-Kiribati-Nauru ensemble, Bhutan and India, and Ireland and the UK prior to 1980. My proposed tests exploit these divisions in the sample.

Column 3 of table 3 distinguishes between the currency unions consisting of country pairs that are not members of a political union or a FTA, labeled Strict, and the rest, labeled Combined (in which there happen to be no cases of earlier colonized and colonizer). Column 4 interprets Strict Currency Unions even more narrowly as even excluding country pairs with a past common colonizer (thus leaving only 56 examples). In both columns 3 and 4, the variables Political Union, Free Trade Area, Ex-Colonial Relationship, and Ex-Common Colonizer are redefined so as to exclude the cases of Combined Currency Union. As a result, all observations of a Combined Currency Union appear under no other political rubric. The four related dummies pertaining to trade with outsiders in columns 3 and 4 have been redefined accordingly as well (except that Currency Union/Outsider has been retained as such, and no effort has been made to construct separate dummies concerning the effects of Strict Currency Union and Combined Currency Union on outsiders).[13]

The estimates in columns 3 and 4 confirm the hypothesis that currency unions imply exceptionally close trade ties, whether or not the countries in the relationship belong to a common country or have signed a free trade covenant. If Rose's interpretation of the coefficient of Currency Union is correct, the coefficient of Combined Currency Union in column 3 should be much higher than that of Strict Currency Union, since this coefficient should reflect the combined influence of currency union and either Political Union or FTA (a combined influence which is not reflected elsewhere in the equation). But this is not the case. The difference between the two coefficients is only about 0.3. But it would need to be around 1.2 to reflect the impact of Political Union or FTA (predominantly FTA) according to the rest of the equation, and the difference between 0.3 and 1.2 is statistically significant.[14] The same conclusion holds in column 4: the coefficient of Combined Currency Union is not nearly high

[13] The reason for avoiding the fabrication of two such dummies is similar to the one for failing to provide separate dummies for the impact of colonized/colonizer and common colonizer on outsiders (footnote 11): any such attempt would simply raise problems of interpretation.

[14] The presence of a shared colonial past does not affect this comparison, since there is a sizable proportion of instances of such a shared past under Strict Currency Union and Combined Currency Union alike, and the coefficient of Ex-Common Colonizer is only 0.5.

enough above that of Strict Currency Union to admit the supplementary effect of nationhood or free trade agreement.[15]

However, the estimates in columns 3 and 4 are also impossible to reconcile with the view that currency union does not raise trade at all. To see this, consider the coefficient 2.18 of Combined Currency Union in column 3. According to the rest of this column, the part of this coefficient reflecting nationhood or FTA should be around 1.2. Another 0.25 may be added to reflect the fact that nearly one-half of the observations of Combined Currency Union relate to country pairs that, besides belonging to the same nation or a FTA, share a common earlier colonizer as well (0.5 applied to one half of the observations yields 0.25). This gives a total of 1.45. Therefore, currency union must account for the difference of 0.73, or 2.18 minus 1.45, and this difference is statistically significant.[16] The 0.73 estimate is also coherent. It would mean that of the 1.87 coefficient of Strict Currency Union, 1.14 of it – a reasonable amount in light of the rest of the estimate – should be attributed to combined effects of lower trade barriers and past colonial relations rather than a common currency, as such.

In the case of column 4, similar reasoning requires a higher estimate than 0.73 for the impact of a common currency, as such, since the previous attribution of 1.45 to other factors applies only to about two-thirds of the observations of Combined Currency Union, and as regards the remaining third (relating strictly to country pairs with a shared colonial past), the right attribution is 0.5. This yields a weighted-average attribution to other factors of around 1.1. Consequently, currency union must account for 1.3 of the coefficient of 2.4 of Combined Currency Union. All in all, therefore, I come to an estimate of the impact of currency union on trade of about 0.7 to 1.3. The lower estimate, 0.7, is my preferred one, because of the paucity of instances of a Strict Currency Union in column 4, which makes that column more doubtful.

[15] The lower statistical significance of Political Union in columns 3 and 4 than 1 and 2 must be put down to the fact that there are only 29 cases of political union without currency union, and therefore only 29 relevant observations in columns 3 and 4 instead of 47 relevant observations, as in columns 1 and 2.

[16] Evidently, my reasoning abstracts from the possibility of joint effects of a common currency, a free trade agreement or a political union, and a shared colonial past. Otherwise, I could not attribute the 0.73 exclusively to a common currency.

But even so, the exponential of 0.7 is close to 2. Therefore, we are still talking about a doubling of trade, if no longer about a quadrupling or more.

This estimate of the downward adjustment of Rose's figure for the impact of currency union on trade is admittedly rough. Very recent work by Rose, together with Glick, sheds a great deal more light. My effort rests on a data set containing at most six observations per individual trading pair, and therefore relates essentially to the cross-sectional evidence. By contrast, Glick and Rose (2001) use annual series starting as early as 1948 and going up to 1997 in a study covering over 230 countries (IMF country codes) and harboring over 200,000 data points. Since they have many more observations per individual country pair, Glick and Rose are able to employ panel data econometrics to obtain a separate estimate for the effect of currency union on bilateral trade over time. More exactly, they are able to furnish a "within" as well as a "between" estimate for the impact of currency union. Their "within" estimate then relates strictly to the impact of entry into, or exit from, currency union for particular country pairs, whereas their "between" one, as in Rose's previous work, concerns cross-sections or different pairs. The former estimate cannot properly be said to mix up effects of currency union with those of close trade and political ties, while the latter can be supposed to continue to do so.

Glick and Rose's "within" estimate is 0.74 and their "between" estimate 1.57. Thus, their "within" estimate corresponds exactly to mine for the impact of a common currency on bilateral trade after the corrections, while their "between" one basically repeats Rose's own earlier estimates for the impact of currency union, alone or with Frankel, and my uncorrected estimates in columns 1 and 2 of Table 3. There could hardly be closer correspondence. Admittedly, Glick and Rose's "within" estimate is statistically superior to mine for the impact of currency union as such. But my effort clarifies the gap between their "within" and "between" estimates, which they leave unexplained.

The 0.7 estimate of the impact of currency union on trade might be lowered still more for countries which already trade intensely with each other by following Rose and van Wincoop in the systematic adoption of the concept of "multilateral trade resistance" in the tests. Of course, the scope for doing so is narrowed in my case since some aspects of

"multilateral trade resistance" are already present in the reasoning – specifically, respecting distance, and respecting countries belonging to any of the five relevant political associations. Still, since I do not control systematically for the adverse impact of political frontiers on foreign trade, there remains room for further application of Rose and van Wincoop's argument. I believe this holds all the more for Glick and Rose.

Once we take the position that all the estimates of the influence of currency union on bilateral trade prior to Glick and Rose's pertain to cases of low trade barriers, whether or not formal trade or political agreements exist to that effect, it becomes difficult to assign a separate empirical interpretation to the estimates of Currency Union/Outsider as distinct from those of Political Union/outsider, FTA/Outsider, and Ex-Colony/Colonizer/Outsider. Nonetheless, all of these estimates point to effects on (the log of) trade with outsiders of about one-third to one-sixth the size of those on (the log of) trade between the principals in the political relationships. Therefore, the best estimate of the impact of currency union, as such, on (the log of) trade with outsiders is one-third to one-sixth of 0.7. As mentioned earlier, theory offers little ground to dispute this effect on outsiders. But a systematic application of the concept of "multilateral trade resistance" could modify the estimate.

VII. Conclusion

Gravity equations yield remarkably good statistical fits. This study focuses broadly on the proper variables to include in these equations. Two of the results are satisfying from a general conceptual standpoint. The forces of geography can be marshaled to exhibit the impact of comparative advantage on trade in gravity equations. It is also rewarding to find some explicit evidence of substitution effects of distance on trade with different foreign partners. The rest of the results do not necessarily fit neatly into preconceived ideas. We have no fundamental cause to think that closer political associations between countries will open them up to trade with everyone, or at least such general reasons as we have are contestable. I have argued that those positive effects on trade with third countries can be most easily explained in the case of currency unions. But even as regards currency unions, the positive effects on trade with outsiders would not necessarily have been predicted beforehand. It may

also be satisfying to obtain estimates of the impact of currency union on trade which are far below Rose's, or which can be interpreted to be so. Still, those effects on trade are pretty high.

All the results of the study, whether satisfying or not, are complicating. No longer can distance be said merely to reflect costs and frictions in trade. Rather, distance in some dimension also reflects opportunities for trade. In addition, based on the traditional great-circle measures, distance in bilateral trade must be seen as combining both substitution effects between alternative foreign trade partners and scale effects on aggregate foreign trade (where those aggregate effects may be substitution effects between foreign and domestic trade). Fitting together and sorting out all of these effects of distance would be an undertaking. Finally, attempts to fit gravity equations into a neat theoretical groove have often treated political unions and free trade associations as trade-diverting. But such attempts, as well as any putative future attempts to treat currency union the same way, go contrary to the facts. The gravity model thus may need to be specified in a way which allows for complementary effects on bilateral trade with third countries. There is no problem in theory. But in practical application, such specification may complicate the programming of the constraints on total trade in bilateral trade relations, or the construction of "multilateral trade resistance." For example, Rose and van Wincoop (2000) still exclude all complementary effects on third countries.

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Table 1: The Basic Gravity Model and Geography

	Frankel-Rose	Same Following Data Changes	Effect North-South	Effect of Difference in Absolute Latitudes	Both Effects
Log Distance	–1.15 (.025)	–1.11 (.024)	–1.26 (.03)	–1.16 (.03)	–1.26 (.03)
Log product of Real GDP	1.40 (.01)	1.39 (.01)	1.37 (.01)	1.38 (.01)	1.37 (.01)
Log product of Population	–.47 (.02)	–.46 (.02)	–.42 (.02)	–.44 (.02)	–.42 (.02)
Log product of Land Area	–.16 (.01)	–.17 (.01)	–.18 (.01)	–.17 (.01)	–.18 (.01)
Common Land Border (0,1)	.62 (.13)	.70 (.13)	.84 (.12)	.82 (.12)	.84 (.12)
Number of Landlocked in pair (0, 1, 2)	–.39 (.04)	–.36 (.04)	–.41 (.04)	–.39 (.04)	–.41 (.04)
Common Language (0,1)	.87 (.06)	.91 (.06)	.92 (.06)	.94 (.06)	.92 (.06)
Log North-South Difference			.23 (.02)		.23 (.03)
Log Difference in Absolute Latitudes				.15 (.02)	.003 (.03)
R^2	.63	.63	.64	.64	.64
RMSE	2	2	1.99	1.99	1.99

Regressand is log of bilateral trade in real American dollars.
Number of Observations is 31,101 for the first column, 31,010 for the rest.
Year-specific fixed effects are not reported.
Robust standard errors recorded in parentheses.

Table 2: The Effect of Relative Distance

Log Distance	–1.26 (.03)		
Log Relative Distance			–.68 (.02)
Log product of Remoteness		–1.08 (.08)	–.18 (.07)
Log product of Real GDP	1.37 (.01)	1.38 (.02)	1.38 (.01)
Log product of Population	–.42 (.02)	–.49 (.02)	–.42 (.02)
Log product of Land Area	–.18 (.01)	–.18 (.01)	–.19 (.01)
Common Land Border (0,1)	.84 (.12)	2.44 (.13)	.73 (.13)
Number of Landlocked in pair (0, 1, 2)	–.41 (.04)	–.35 (.05)	–.36 (.04)
Common Language (0,1)	.92 (.06)	1.3 (.07)	.84 (.06)
Log North-South Difference	.23 (.02)	–.16 (.02)	.26 (.02)
R^2	.64	.58	.64
RMSE	1.99	2.14	1.98

Regressand is log of bilateral trade in real American dollars.
Number of Observations is 31,101 for the first column, 31,010 for the rest.
Year-specific fixed effects are not reported.
Robust standard errors recorded in parentheses.

Table 3: The Effects of Political Associations

			Revised Definitions of Political Variables[1]	Further Revised Definitions of Political Variables[2]
Log Relative Distance	–.64 (.02)	–.65 (.02)	–.65 (.02)	–.66 (.02)
Log product of Remoteness	–.11 (.07)	–.13 (.07)	–.14 (.075)	–.14 (.075)
Log product of Real GDP	1.40 (.01)	1.36 (.02)	1.37 (.02)	1.37 (.02)
Log product of Population	–.43 (.02)	–.38 (.02)	–.38 (.02)	–.38 (.02)
Log product of Land Area	–.17 (.01)	–.17 (.01)	–.18 (.01)	.18 (.01)
Common Land Border (0,1)	.75 (.12)	.81 (.13)	.80 (.13)	.79 (.13)
Number of Landlocked in pair (0, 1, 2)	–.31 (.04)	–.29 (.04)	–.29 (.04)	–.29 (.04)
Common Language (0,1)	.49 (.06)	.48 (.06)	.47 (.06)	.47 (.06)
Log North-South Difference	.26 (.02)	.25 (.02)	.25 (.02)	.25 (.02)
Currency Union (0,1)	1.45 (.18)	1.57 (.19)		
Strict Currency Union (0,1)			1.87 (.24)	2.07 (.49)
Combined Currency Union (0,1)			2.18 (.22)	2.40 (.18)
Political Union (0,1)	1.01 (.42)	1.33 (.43)	.95 (.64)	.95 (.64)
Free Trade Area (0,1)	1.03 (.10)	1.15 (.11)	1.24 (.11)	1.23 (.11)
Ex-Colonial Relationship (0,1)	1.95 (.13)	1.63 (.14)	1.69 (.15)	1.69 (.15)
Ex-Common-Colonizer (0,1)	.50 (.08)	.51 (.08)	.49 (.08)	.51 (.08)
Currency Union/Outsider (0,1)		.28 (.04)	.32 (.04)	.32 (.04)
Political Union/Outsider (0,1)		.22 (.05)	.24 (.06)	.25 (.06)
FTA/Outsider (0,1)		.28 (.05)	.28 (.05)	.29 (.05)
Ex-Colony/Colonizer/ Outsider (0,1)		.13 (.04)	.15 (.05)	.15 (.05)
R^2	.65	.65	.65	.65
RMSE	1.96	1.94	1.94	1.94

See notes next page

Regressand is log of bilateral trade in real American dollars.
Number of Observations is 31,101 for the first column, 31,010 for the rest.
Year-specific fixed effects are not reported.
Robust standard errors recorded in parentheses.

[1]All of the observations of joint membership in a Currency Union and a Political Union or a Free Trade Area are now classified under Combined Currency Union. These observations have also been removed from Political Union and Free Trade Area. The dummies political union/outsider and FTA/Outsider have been redefined accordingly.

[2]All of the observations of joint members of a Currency Union who had the same colonizer in the past have now been added to Combined Currency Union. (There are no similar cases of a previous colony and colonizer who are in a currency union.) These observations have been removed from Common Ex-Colonizer, and the dummy Ex-Colony/Colonizer/Outsider has been redefined accordingly.