Chapter 5

Geography, Trade and Currency Union

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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 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.

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5.1 Introduction

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.

5.2 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 alters not only its plant and animal life and the yield of its land and waters, but its required insulation, 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 the various 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. Accordingly, any reduction in the bilateral trade of a country with another means an equal increase in its trade with third countries or at home. Without knowing the sign and the size of the associated change in trade with third countries, nothing can be said about the change in domestic trade. Notwithstanding, changes in bilateral trade are sometimes merely aggregated to obtain effects on total foreign trade in applications of gravity equations (e.g., Frankel and Romer (1999), and Frankel and Rose (2000)). In general, repercussions on third countries are frequently neglected.

These last remarks echo a recent complaint of Anderson and van Wincoop (2001) 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 that 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 third 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. In that case, distance should have declined in influence over the last couple of centuries. If, instead, the effects of distance refer mostly to substitution between alternative trade partners, there is no difficulty of interpretation. With the fall in transportation barriers over time, relative distances could simply count much more now in deciding *how far* goods will travel abroad than they did earlier.

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. In addition, the first three relationships – all of them except those concerning former colonial relations – also breed trade with outsiders and therefore increase foreign trade in the aggregate. Similar tests by other researchers covering the same study period – 1970 to 1995 – 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 privileged political relationships except those associated with past colonialism promote foreign trade between the principals and the rest.

If this be puzzling, it is perhaps less so in regard to currency union than free trade agreement and political association. Consider free trade. 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, since the euro started circulating as a currency in 2002, and therefore bank drafts could be written conveniently in euros in commodity trade, British and Swedish households have been able to store euros instead of 12 monies in commodity trade with euro members. The households have also been able to benefit from fewer units of account in this trade. Thus, they can now 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 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 arrangement promotes 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 between countries with unusually low trade barriers between one another. If that were so, the impact of currency union in Rose's tests might largely reflect other factors besides a common currency. In fact, Rose's data permits testing this hypothesis. My 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 suspected 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. As a consequence, therefore, 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 (2001)), or at least does so in the case of currency unions between countries that already traded a lot with one another beforehand (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

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

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.

A more recent paper still by Glick and Rose (2002) offers 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 of the impact of currency union for 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 between the two stems from the fact that the lower estimate properly concerns the impact of currency union as such, whereas the higher one, in line with Rose's earlier results, does not do so 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.

5.3 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:

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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. They do so by introducing separate fixed effects for all individual country pairs. But in this case, all the geographical variables disappear from the analysis, since those variables do not vary by country pair. Effectively, Pakko and Wall drop the gravity model altogether.

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

one concerning distance, the other language. Whereas Rose locates countries at their geographical center (in conformity 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 for calculating the bilateral distances between trading partners. This method produces identical results to those found in the atlases and related web sites.[4] In the case of language, I kept Rose's series but made 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 the UK-France distance and London-Frankfurt the UK-West Germany one). But those changes turn out to be trivial over the entire 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 this might alter if we examined language in detail).[5]

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 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

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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.

5 Nitsch (2001) does find some significant changes in estimates resulting from a more extensive modification of Rose's data than mine. Yet, for the moment, it is not possible to tell how much Nitsch's finding depends on a failure to pool the data for different years. As regards language, my modifications and Nitsch's are almost identical.

common border; whether one or both or neither of them are landlocked; and whether they share a common language. This particular choice of variables is now common. The data covers approximately 98 percent of all world trade, and is recorded every five years from 1970 through 1995. Dummies are included for the individual years but are not reported. The table also shows robust standard errors. Since the observations for identical country pairs (one to six) are likely to be highly correlated, those standard errors are further corrected for clustering by country pair. 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 column hinge on the exact data in Frankel and Rose (2000) and those in the second column follow my modifications. The two sets are indistinguishable.

5.4 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. Proceeding from homogeneous goods, Deardorff (1998) showed how to derive the equation from the factor proportions model. Proceeding similarly, Eaton and Kortum (1997) obtained the equation from random technological differences between countries. Nonetheless, efforts to introduce factor proportions directly into the equation have had little success thus far (see Frankel (1997), p. 134), and though Eaton and Kortum did get good results with technological knowledge, they did so only with respect to manufacturing in 19 OECD countries.

Yet geography alone could carry information about comparative advantage, and therefore could carry information about both factor proportions (Deardorff) and international differences in production functions (Eaton and Kortum). As mentioned above, so far as the comparative advantage of different countries is related to differences in climate and seasons,

differences in latitude North-South should capture the variable. 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, whereas the differences North-South would also pertain to the opposition of the seasons in the two hemispheres, and any factors of environment that are associated with the separate features of the Northern and Southern hemispheres (as, for example, the higher ratio of land to water 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 dominant.[7] Indeed, the Difference in Absolute Latitudes becomes insignificant. For this reason, I will keep strictly the North-South Difference in the subsequent discussion. However, the correlation between the two measures of latitudinal distance (in logs) is high: 0.73. Therefore, the North-South Difference should perhaps be viewed as largely standing for both.

5.5 The effects of distance

Does the impact of distance on bilateral trade reflect switching between closer and more distant partners, or does distance affect aggregate foreign trade, or both? One simple

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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 that has frequently appeared in the discussion is distance from the Tropics. See, for example, Sachs and Warner (1997) and Rodriguez and Rodrik (2000). This next variable is supposed to reflect the low trade of countries near the Equator resulting from a poverty of endowment. (For a radically different interpretation of this variable, though, see Hall and Jones (1999).) Based on the same notation as in the

way to get at this question is to introduce some measure of relative distance between countries, or to consider the distance between countries relative to the average distance between country pairs and all of the other countries in the world. To be specific, let the straight-line average of the (great-circle) distances of a country from all the other 185 in the sample be termed remoteness.[8] 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. This relative distance variable is clearly intimately related to the concept by the same name that Deardorff (1998) introduced into the gravity model (compare Bergstrand (1998)). The variable is also 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 on 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 that includes both relative distance and the product of remoteness in logs. (Evidently, this is equivalent to including 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 country pairs but always damage aggregate foreign trade, the coefficient of relative

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preceding note, the distance from the Tropics is $|\text{lat1}| + |\text{lat2}|$. The variable is always insignificant in my tests.

8 The most remote country in my data set is New Zealand; the least is Austria. Note that this use of the term "remoteness" differs from the literature. Remoteness is generally not conceived as a pure geographic variable at all, but as a reflection of the opposite pull of third countries on the trade of a country with a specific trade partner. In this last usage (where output weights enter for alternative trade partners), the "remoteness" of Australia in its trade with New Zealand, for example, is greater than its "remoteness" in its trade with the US.

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 the impact of remoteness should be close to nil. Of course, even in this last instance, 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. However, distance could bear both a substitution and a scale effect on foreign trade. Therefore, relative distance and remoteness could both enter simultaneously 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 simply replaces bilateral distance (d_{ij}) as the measure of distance, the significance of distance falls, but remains very high. 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 last 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 together, relative distance completely dominates remoteness, with a Student *t* about 15 times higher. In addition, the impact of North-South Difference returns to a positive value, and this positive value is the same as before in column 1. To all evidence, therefore, distance exerts mostly a substitution effect

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See Helliwell (1998). I find my use of the term more intuitive. Note that in more recent work, Helliwell has

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 around one-third of one percent (0.36, or 0.18 times 2 since R_iR_j relates to distance squared) rather than over one percent (1.26, if we judge from column 1).

The rest of the impact of distance concerns the cross-country composition of trade. The 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. While falls in transportation costs might have been expected to reduce the impact of remoteness (as indeed they seem to have),[9] they could well have increased the impact of distance on bilateral trade in deciding whether to ship near or far.[10]

5.6 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 adopt the principle that a political union always implies a free trade area, and therefore score country pairs as belonging to a Free Trade Area only if they are 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

started using ALT (for "alternative trading partners") instead of "remoteness." See Helliwell and Verdier (2001).

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

10 Of course, if transportation costs should ever become tiny, further reductions in these costs would not continue to raise the influence of relative distance on bilateral trade.

ones in the preceding section), the estimate of the basic gravity equation is the one 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. But this political variable is the one that possesses the least number of observations. There are only 47 cases of Political Union entering in the tests (because of no missing complementary data), while there are 284 such 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 one. This last dummy does double duty for the 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

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. Both dummies would comprise cases of trade between an ex-colonized and an outsider, and the main differences between the two would concern instances of an Ex-Colonial Relationship or an Ex-Common Colonizer, and therefore would be reflected in these other two variables.

12 Though he refers instead to a variable that he terms "openness," which combines FTA and FTA/Outsider (but when used together with FTA, essentially denotes FTA/Outsider).

increase trade with outsiders. As indicated before, I largely exhibit the generality of the finding. Instead of merely testing for third-country effects of different political variables one at a time, I test for all of them together, and show that monetary union, Political Union, and free trade agreements all promote trade with outsiders. Furthermore, in all three cases, the trade creation among the members of the political associations themselves is much higher than that with outsiders, but both effects are well marked. It may be noted as well that in the tests concerning influences on third parties, the number of observations relating to third-party effects is a multiple of the one relating to the associated effects on the principals themselves (by an order of four). Also, the new dummy variables do not detract from anything in the rest of the equation.

5.7 Currency union

The final part of the discussion focuses on the hottest topic in connection with the political variables: the impact of Currency Union. This last political variable has a coefficient of around 1.5 with a Student *t* of 8 in columns 1 and 2. Taken at face value, the 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 economic 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. It is extremely 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 to neither 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 between pairs 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 pairs composed on an 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 pairs belonging to a Combined Currency Union appear under no other political rubric. The four relevant dummies pertaining to trade with outsiders in columns 3 and 4 have been redefined accordingly as well (except that there has

been no effort to construct separate dummies concerning the effects of Strict Currency Union and Combined Currency Union on outsiders, and Currency Union/Outsider has been retained as such).[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 that is not reflected elsewhere in the equation). But this is not the case. The difference between the two coefficients is only about 0.3. Instead, 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 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

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[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 cases of such a shared past are proportionately just as significant for Strict Currency Union and Combined Currency Union alike. In addition, the coefficient of Ex-Common Colonizer is only 0.5.

[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 the 47 relevant ones in columns 1 and 2.

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 not only belong to the same nation or a FTA, but also share a common earlier colonizer (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. 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. Interestingly enough, though, the result is confirmed by more recent work by Rose together with Glick. My effort rests on a data set containing at most six observations per individual trading pair, and therefore relates essentially to the cross-

[16] I abstract in this reasoning from the possibility of joint effects of common currency, a free trade agreement or

sectional evidence. By contrast, Glick and Rose (2002) 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. As they possess many more observations per individual country pair, Glick and Rose are able to employ panel data econometrics to estimate a separate coefficient for the impact 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 relates strictly to the impact of entry into, or exit from, currency union for individual country pairs, whereas their "between" estimate, with close bearing on all of Rose's previous work, concerns cross-sections or different pairs. Their former estimate does not mix up effects of currency union with those of close trade and political ties, while their latter one continues to do so.

Glick and Rose's "within" estimate is 0.74 and their "between" estimate 1.57. Effectively, therefore, their "within" estimate matches exactly 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 as regards 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 in the instance of countries that 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

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a political union, and a shared colonial past that differ from the sum of the three separate effects.

distance and 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. However, I believe this to be even truer for Glick and Rose.

Once we take the position that all of 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, these estimates generally 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.[17]

5.8 Conclusion

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[17] What about the result of introducing country fixed-effects into the estimates? It is important to note that, in this case, all of the variables that are defined by country and that are time-invariant drop out. This includes remoteness, land area, and landlocked. In addition, since population (also defined by country) sticks to a trend, it can hardly be expected to enter significantly. However, all of the other variables – notably those whose values depend on the country's trade partner – should be unaffected. The results for the test corresponding to the one in Table 3, column 2 (and thus prior to any distinction between Strict and Combined currency union) follows. I omit the 185 fixed effects (25 of which drop out because of insufficient observations).

Bilateral Trade = –.7 Relative Distance +1.06 Real GDP +.54 Border +.5 Common Language
(.015) (.038) (.13) (.06)
+.19 North-South +1.05 Currency Union +1.3 Political Union +.6 FTA +1.63 Ex-Colonial
(.02) (.22) (.41) (.14) (.13)
+.7 Ex-Common-Colonizer +.086 Currency Union/Outsider +.17 Political Union/Outsider
(.09) (.077) (.11)
+.144 FTA/Outsider –.048 Ex-Colony/Colonizer/Outsider
(.058) (.038)
R^2 = .73 Number of observations = 31010 Number of clusters = 7963

As can be seen, the results are highly confirmatory. The only doubts of any note that arise concern the positive third-country effects of Currency Union and Political Union. Compare the discussion of Pakko and Wall (2001) in note 2.

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 is it possible to say that distance merely reflects 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 that allows for

complementary effects on bilateral trade with third countries. There is no problem in theory. But in practical application, such specification will 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 (2001) have simply excluded 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 31,010.
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)	−.65 (.02)
Log product of Remoteness	−.11 (.07)	−.18 (.07)	−.19 (.07)	−.18 (.07)
Log product of Real GDP	1.40 (.01)	1.35 (.02)	1.36 (.02)	1.36 (.02)
Log product of Population	−.43 (.02)	−.37 (.02)	−.37 (.02)	−.37 (.02)
Log product of Land Area	−.17 (.01)	−.18 (.01)	−.18 (.01)	−.18 (.01)
Common Land Border (0,1)	.75 (.12)	.80 (.13)	.80 (.13)	.79 (.13)
Number of Landlocked in pair (0, 1, 2)	−.31 (.04)	−.29 (.04)	−.30 (.04)	−.30 (.04)
Common Language (0,1)	.49 (.06)	.49 (.06)	.48 (.06)	.48 (.06)
Log North-South Difference	.26 (.02)	.25 (.02)	.25 (.02)	.25 (.02)
Currency Union (0,1)	1.45 (.18)	1.59 (.19)		
Strict Currency Union (0,1)			1.89 (.24)	2.10 (.49)
Combined Currency Union (0,1)			2.18 (.22)	2.43 (.18)
Political Union (0,1)	1.01 (.42)	1.35 (.43)	.98 (.64)	.98 (.64)
Free Trade Area (0,1)	1.03 (.10)	1.16 (.11)	1.24 (.11)	1.24 (.11)
Ex-Colonial Relationship (0,1)	1.95 (.13)	1.52 (.14)	1.57 (.14)	1.57 (.14)
Ex-Common-Colonizer (0,1)	.50 (.08)	.56 (.09)	.55 (.09)	.57 (.09)
Currency Union/Outsider (0,1)		.30 (.04)	.34 (.04)	.34 (.04)
Political Union/Outsider (0,1)		.25 (.05)	.29 (.06)	.29 (.06)
FTA/Outsider (0,1)		.29 (.05)	.29 (.05)	.29 (.05)
Ex-Colony/Colonizer/ Outsider (0,1)		.03 (.04)	.04 (.04)	.04 (.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 31,010.
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.