Disaggregated trade and disaggregated currency unions: a ranking of common currency effects - appendix

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1 Estimation Methodologies

1.1 Controlling for the MRTs

To obtain consistent estimates of the regressors of interest, the estimating equation should contain controls for the multilateral resistance terms. In general, these controls are country-specific fixed effects where each country has potentially 2 different indicator variables: one for the country's role as an exporter and one for the country's role as an importer. Taking seriously the role that these variables play in controlling for changes in multilateral resistance requires that the fixed effects vary dynamically for a panel of data. However, this requirement can complicate the estimation, especially non-linear estimation, for datasets tracking trade over numerous years. As Head and Mayer (2014) say, "the estimation might run into computational feasibility issues due to the very large number of resulting dummies to be estimated," (p. 152). In some instances, the number of dummies is so large that it impedes estimation.

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Is there a way to reduce the number of dummy variables necessary? This section demonstrates that an alternative approach for controlling the multilateral resistance terms leads to nearly-identical estimates for most variables of interest. In particular, this section shows that if importer and exporter fixed effects vary not yearly but less frequently, the coefficients and standard errors for most variables of interest are largely unaffected. Hence, researchers can obtain consistent estimates for coefficients from the gravity equation but with a fraction of the dummy variables required to control for the multilateral resistance terms. As a result, the computation time required to estimate parameters falls.

To demonstrate this claim, this section uses OLS to estimate the gravity equation on subsets of the data. This section uses OLS rather than non-linear estimation methods, owing to the speed and convenience of the former. As the controlling or not controlling for the multilateral resistance terms is a problem distinct from the objective function used to obtain parameter estimates (e.g., OLS vs. PPML), there is no reason to believe that the results would differ for PPML. For each type of trade (agriculture versus manufacturing), this section divides the available data into blocks of no more than 10 years.[1] For each block, this section reports estimation results from the gravity equation where the exporter and importer fixed effects are interacted not with the year dummy but with a `year_block` dummy. This `year_block` dummy groups years into a block of decreasing length. For example, the first length is 10 years: i.e., one fixed effect each for the country as an importer and as an exporter. The next length is 9 years: one fixed effect for each country's role (exporter and importer) for the first 9 years, followed by a different fixed effect for the remaining year. The next length is 8 years: one fixed effect for each country's role (exporter and importer) for the first 8 years, followed by a different fixed effect for the remaining 2 years. Once the length falls to 4 years, there are 3 fixed effects for each of the country's roles (exporter and importer), dividing the time span into two groups of

[1]The choice of 10 years is dictated by Stata's limit of no more than 11,000 independent variables for a regression.

Table 1: Estimated coefficients under differing frequencies of MRT for Agriculture trade (estimated with OLS)

	1980s				1990s				2000s			
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
Countries share a common currency	0.314	(0.177)	0.316	(0.18)	-0.102	(0.549)	-0.046	(0.79)	-0.183	(0.165)	-0.198	(0.14)
ln Y_{it}^k	0.128†	(0.078)	1.564	(0.597)	0.458**	(0.0)	-9.506**	(0.003)	0.351**	(0.0)	-0.102	
ln $Y_{world,t}^k$	0.388**	(0.0)	-1.053	(0.564)	-0.620**	(0.0)	-7.421	(0.193)	0.772**	(0.0)	2.518	
ln Distance	-1.193**	(0.0)	-1.206**	(0.0)	-1.181**	(0.0)	-1.209**	(0.0)	-1.301**	(0.0)	-1.306**	(0.0)
Pair belongs to a Regional trade Accord	0.397**	(0.002)	0.378**	(0.004)	0.252**	(0.0)	0.246**	(0.0)	0.390**	(0.0)	0.391**	(0.0)
Colonizer-colonized relationship	1.415**	(0.0)	1.407**	(0.0)	1.457**	(0.0)	1.459**	(0.0)	1.475**	(0.0)	1.485**	(0.0)
Country pair transitioning from colonialism	0.072	(0.761)	0.089	(0.738)	0.326	(0.264)	0.292	(0.344)	0.803†	(0.086)	0.785†	(0.095)
Countries were colonies of same country	0.297**	(0.002)	0.294**	(0.002)	0.322**	(0.0)	0.320**	(0.0)	0.450**	(0.0)	0.455**	(0.0)
Countries are contiguous	0.529**	(0.0)	0.513**	(0.001)	1.052**	(0.0)	1.051**	(0.0)	1.257**	(0.0)	1.257**	(0.0)
Shared common or official language	0.456**	(0.0)	0.465**	(0.0)	0.332**	(0.0)	0.346**	(0.0)	0.404**	(0.0)	0.410**	(0.0)
Number of dummy variables per decade	1		10		1		10		1		10	
Number of observations	36513				71289				58894			
Number of country pairs	6921				13944				14392			

Table 2: Estimated coefficients under differing frequencies of MRT for Manufacturing trade (estimated with OLS)

	1980s				1990s				2000s			
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
Countries share a common currency	1.955**	(0.0)	1.937**	(0.0)	1.176**	(0.0)	1.204**	(0.0)	0.160	(0.151)	0.159	(0.159)
ln Y_{it}^k	0.499**	(0.0)	16.837	(0.676)	0.491**	(0.0)	0.286	(0.763)	0.333**	(0.0)	0.016	(0.0)
ln $Y_{world,t}^k$	0.775**	(0.0)	-18.527	(0.695)	1.902**	(0.0)	-1.032	(0.684)	1.173**	(0.0)	-0.719	(0.0)
ln Distance	-1.700**	(0.0)	-1.709**	(0.0)	-1.625**	(0.0)	-1.639**	(0.0)	-1.719**	(0.0)	-1.721**	(0.0)
Pair belongs to a Regional trade Accord	-0.129	(0.353)	-0.160	(0.264)	0.326**	(0.0)	0.291**	(0.0)	0.540**	(0.0)	0.539**	(0.0)
Colonizer-colonized relationship	1.118**	(0.0)	1.104**	(0.0)	1.343**	(0.0)	1.344**	(0.0)	1.261**	(0.0)	1.258**	(0.0)
Country pair transitioning from colonialism	-0.044	(0.86)	-0.148	(0.579)	0.315	(0.113)	0.249	(0.226)	0.486†	(0.051)	0.497*	(0.047)
Countries were colonies of same country	0.436**	(0.0)	0.440**	(0.0)	0.676**	(0.0)	0.678**	(0.0)	0.728**	(0.0)	0.728**	(0.0)
Countries are contiguous	0.195	(0.191)	0.178	(0.242)	0.696**	(0.0)	0.692**	(0.0)	0.784**	(0.0)	0.782**	(0.0)
Shared common or official language	0.567**	(0.0)	0.583**	(0.0)	0.552**	(0.0)	0.554**	(0.0)	0.571**	(0.0)	0.571**	(0.0)
Number of dummy variables per decade	1		10		1		10		1		10	
Number of observations	44815				107917				98961			
Number of country pairs	8094				19363				21394			

four years and one group of two years. The most refined specification is interacting the importer effect and the exporter effect with a dummy for year.

The results are in tables 1 and 2. For issues of space, only the broadest (1 fixed effect per decade per role) and the narrowest (1 fixed effect per year per role) results are included. Other results are available upon request. Overall, most coefficients and standard errors change little as the number of fixed effects changes, as evidenced from the correlations in table 3, summarizing the results in tables 1 and 2.[2] The correlations in table 3 do not carry any statistical meaning but serve merely to show whether an array of numbers is "similar" to another array of numbers.

Table 3: Correlation between effects of trade when year_block = 1 and when year_block = 10 (based on tables 1 and 2)

	1980s	1990s	2000s
Agriculture (including Y_{it}^k and $Y_{world,t}^k$)	0.65	0.51	0.84
Manufacturing (including Y_{it}^k and $Y_{world,t}^k$)	0.03	0.51	0.75
Agriculture (excluding Y_{it}^k and $Y_{world,t}^k$)	0.99	0.99	0.99
Manufacturing (excluding Y_{it}^k and $Y_{world,t}^k$)	0.99	0.99	0.99

The only exceptions are the coefficients for the value of production at the country and world level. It is not immediately clear why estimates for these variables should respond differently than do other estimates. Output certainly fluctuates over time in a way distinct from the fluctuations of the bilateral resistance terms (e.g., changes in membership for multilateral regional trade accords). Changing the frequency with which the dynamic multilateral resistance changes may have some unexpected influence on the coefficients of output. Additionally, this paper follows the practice of Anderson

[2]Note that when comparing regression results across decades but within trade type and the value of `year_block` implies, in some cases, noticeably different effects (e.g., the estimate coefficient for contiguity). Though explaining why the effects may change over time is an interesting and important question, it is beyond the scope of this paper.

and Yotov (2010a) by using the importer's fixed effect to control simultaneously for the importer's expenditure as well as the multilateral resistance term, a practice that may contribute to the changing coefficients on Y_{it}. However, the coefficient for regional trade agreements is largely constant as the `year_block` dummy changes, even though membership in trade agreements does change over time. Nonetheless, if one excludes the coefficients for output, one can see that whether one follows a strict practice of changing the fixed effects every year or a looser practice of changing the fixed effects less frequently, the estimated coefficients for the variables of interest change little.

1.2 Serial Correlation

A concern with panels, particularly those that span decades, is the possibility for serial correlation of errors to bias coefficient and standard error estimates. Taking first differences of the data and estimating a model on those differences is a straight-forward way to remove the serial correlation, provided that the model is linear (e.g., pooled OLS). First differencing is not an available option for a non-linear model such as PPML. To understand why, note that the estimating equation for PPML is of the form $y_{it} = \exp(x'_{it}\beta) + \upsilon_{it}$ and suppose that $\upsilon_{it} = \upsilon_{it-1} + \epsilon_{it}$ where ϵ_{it} is a mean zero, identically and independently distributed disturbance term. First differencing the estimating equation for such a series of data would imply estimating a vector of coefficients from the following estimating equation in order to eliminate the serial correlation in the error term: $\Delta y_{it} = \exp(x'_{it}\beta) - \exp\left(x'_{it-1}\beta\right) + \epsilon_{it}$. That is to say, this estimation procedure requires estimating β from a difference of exponentials, not an exponential of differences. Estimating β from such a regression would eliminate any contamination from the serial correlation of errors, but is a far more difficult task than doing so in a pooled OLS framework.

To address concerns about serial correlation in the data, this paper will appeal to the

fixed-T, large-N asymptotics identified by Wooldridge (2002). If the cross-sectional size is large relative to the number of years covered by the data, then a pooled OLS estimator "is fully robust to arbitrary heteroskedasticity - conditional or unconditional - and arbitrary serial correlation across time (again, conditional or unconditional)," (pp 175-176). If the cross-sectional size is large relative to the number of years covered by the data, then a pooled Poisson estimation with a robust, sandwich-form variance covariance matrix will yield consistent coefficient estimates and standard errors "robust to the presence of serial correlation in the score and arbitrary conditional variances," without assuming that the data truly follow a Poisson distribution. (p. 670). In this paper, the number of years or T ranges from 32 to 36. The size of the cross-section, N, is the number of country pairs and ranges from 12,820 to 24,954. The values of N and T arguably satisfy the condition of fixed-T and large-N. All standard errors come from a fully-robust, sandwich form, variance-covariance matrix.

2 Other bilateral resistance terms

Focusing on the PPML estimates over the OLS estimates, the estimated coefficients of bilateral resistance are larger in magnitude for manufacturing trade than for agricultural trade. The exceptions to this pattern are distance (as mentioned earlier); the colonizer-colonized variable (for a pair of countries, one country was a former colonizer of the other country); the transitional colony variable (a country pair where one country has gained independence from a colonial empire while the other country has not); and the generic common currency variable for homogeneous integration. These variables are significant for agriculture while all, except the transitional colonialism variable, are insignificant for manufacturing. Overall, manufacturing trade and agricultural trade appear to have very different determinants. Table 4 shows that for a fixed regression model, the correlation between coefficients across trade types suggests a weakly positive association (agricultural:

0.497) or a nearly non-existent association (manufacturing: 0.263). Hence, the results bear out the message of Anderson and Yotov (2010a), Anderson and Yotov (2010b), and Anderson and Yotov (2012). Trade costs and country-pair features that mitigate those trade costs differ substantially across the types of goods traded.

Table 4: Correlation between all coefficients in columns 3 & 4 of tables 14 and 15

	Ag PPML	Manuf OLS	Manuf PPML
Ag OLS	0.831	0.497	
Ag PPML			0.263
Manuf OLS			0.703

Larger estimates of bilateral resistances for manufacturing trade than for agricultural trade may not be expected for three reasons. First, agricultural products tend to be homogeneous across producers. Hence, the gravity equation, often motivated through the supposition of a CES objective function conveying a "love-of-variety"-like motivation, may be less appropriate for agricultural goods than for manufacturing goods. A consequence of the homogeneity in product characteristics is a greater emphasis on price for customers when selecting a producer rather than other considerations (e.g., a common language).

Second, a large share of agricultural products may rely more heavily on natural endowments which tend to be country-specific in ways distinct from a comparable share of manufactured goods.[3] As endowments of natural resources tend to be country-specific, the flow of trade within a given country pair may depend more heavily on particular aspects of one of those countries (through natural endowments) than on a characteristic of the pair itself.[4] Consequently, the greater importance of country-specific factors

[3]I thank a referee for pointing out this distinction.

[4]Heerman et al. (2015) propose a model that recognizes the ability of changes in a single exporter's trade costs to alter the ratio of the market shares of two other exporters in some other market, a phenomenon labeled as a violation of the "independence of irrelevant exporters," (IIE) an international trade counterpart to the independence of irrelevant alternatives property commonly used in the discrete

means controls for the MRTs will absorb these effects in the gravity equation, leaving less explanatory power (and smaller bilateral resistance coefficients) for agricultural trade.

A third reason, that also explains the larger effect of a common currency for agricultural trade than for manufacturing trade, arises from the greater emphasis on price for agricultural than for manufacturing trade. A worldwide currency such as the U.S. dollar is generally the currency used for pricing and then purchasing agricultural goods (see Pick and Carter (1994)). If neither importer nor exporter use the currency in which the agricultural goods are priced, exchange rate uncertainty can affect both buyer and seller (in contrast to affecting the seller for producer-currency pricing or the buyer for local-currency pricing). As the trade-enhancing effects of a common currency are traditionally believed to arise from the elimination of exchange rate uncertainty, the removal of uncertainty from both ends of the transaction should increase trade to a larger extent than does removing uncertainty from just one end of the transaction (see Anderson and van Wincoop (2004)).

Table 5: Correlation between non-currency union coefficients

	Ag PPML	Manuf OLS	Manuf PPML
Ag OLS	0.902	0.504	
Ag PPML			-0.483
Manuf OLS			0.307

3 Individual manufacturing industries

The results in the previous section indicate distinct differences between the determinants of agricultural trade and the determinants of manufacturing trade. The results also show

choice literature. The violation of IIE owing to the importance of natural resources in a single country is a point that Heerman et al. (2015) justify by citing Eaton and Kortum (2002) and their caution against using their Ricardian model in a context where natural resources are critical for determining trade.

that there exists a common ranking of currency unions, independent of regression model, by the magnitude of their effect on trade.

Hence, this section will explore the robustness of this ranking within manufacturing trade by examining four industries: textiles, machinery, chemicals, and food, tobacco, and beverages. These are industries for which the value of production can be computed

Table 6: Estimated coefficients for chemical trade

	(1) OLS		(2) PPML		(3) OLS		(4) PPML	
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
East Caribbean Currency Union					1.428*	(0.043)	4.845**	(0.0)
West African Economic & Monetary Union					1.802**	(0.0)	2.174*	(0.018)
Central African Economic & Monetary Union					3.333**	(0.0)	3.233**	(0.0)
Australia zone					2.000**	(0.0)	2.493**	(0.0)
Dollarized zone					-0.111	(0.669)	-0.841**	(0.0)
Euro zone					0.178	(0.107)	-0.045	(0.628)
Krone zone (Denmark)					4.328**	(0.0)	5.574**	(0.0)
India-Bhutan					-0.068	(0.807)	2.522**	(0.0)
Singapore-Brunei					2.611**	(0.0)	1.802**	(0.002)
Countries share a common currency	0.517**	(0.0)	-0.118	(0.211)				
ln Y_{it}^k	0.318**	(0.0)	0.199**	(0.008)	0.315**	(0.0)	0.534**	(0.0)
ln $Y_{world,t}^k$	1.732**	(0.0)	1.207	(0.998)	1.747**	(0.0)	1.394**	(0.0)
ln Distance	-1.744**	(0.0)	-0.968**	(0.0)	-1.757**	(0.0)	-0.958**	(0.0)
Pair belongs to a Regional trade Accord	0.353**	(0.0)	0.240**	(0.003)	0.338**	(0.0)	0.238**	(0.004)
Colonizer-colonized relationship	1.077**	(0.0)	-0.344*	(0.044)	1.079**	(0.0)	-0.049	(0.794)
Country pair transitioning from colonialism	0.605*	(0.034)	-0.061	(0.787)	0.632*	(0.03)	-0.035	(0.871)
Countries were colonies of same country	0.592**	(0.0)	0.279*	(0.036)	0.591**	(0.0)	0.259*	(0.045)
Countries are contiguous	0.743**	(0.0)	0.147*	(0.045)	0.751**	(0.0)	0.158*	(0.045)
Shared common or official language	0.579**	(0.0)	0.311**	(0.008)	0.565**	(0.0)	0.297*	(0.011)
Number of observations	107355		149502		107355		149502	
Number of country pairs	12820		16984		12820		16984	

Table 7: Estimated coefficients for food, beverage, & tobacco trade

	(1) OLS		(2) PPML		(3) OLS		(4) PPML	
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
East Caribbean Currency Union					1.942*	(0.025)	2.818**	(0.001)
West African Economic & Monetary Union					0.534†	(0.057)	0.031	(0.94)
Central African Economic & Monetary Union					2.182**	(0.0)	1.387**	(0.008)
Australia zone					2.269**	(0.0)	1.426**	(0.001)
Dollarized zone					0.491†	(0.064)	0.508**	(0.004)
Euro zone					0.289*	(0.012)	0.182*	(0.042)
Krone zone (Denmark)					3.520**	(0.002)	2.352**	(0.003)
India-Bhutan					2.205**	(0.0)	3.071**	(0.0)
Singapore-Brunei					2.747**	(0.0)	2.737**	(0.0)
Countries share a common currency	0.488**	(0.0)	0.169†	(0.053)				
ln Y_{it}^k	0.199**	(0.0)	0.340**	(0.0)	0.197**	(0.0)	0.328**	(0.0)
ln $Y_{world,t}^k$	1.474**	(0.0)	0.831**	(0.0)	1.480**	(0.0)	0.796	(0.755)
ln Distance	-1.558**	(0.0)	-0.863**	(0.0)	-1.562**	(0.0)	-0.833**	(0.0)
Pair belongs to a Regional trade Accord	0.193**	(0.0)	0.466**	(0.0)	0.191**	(0.0)	0.508**	(0.0)
Colonizer-colonized relationship	1.336**	(0.0)	0.326*	(0.025)	1.328**	(0.0)	0.671**	(0.0)
Country pair transitioning from colonialism	0.229	(0.37)	-0.542*	(0.013)	0.248	(0.34)	-0.406†	(0.061)
Countries were colonies of same country	0.610**	(0.0)	0.468**	(0.0)	0.617**	(0.0)	0.594**	(0.0)
Countries are contiguous	0.933**	(0.0)	0.510**	(0.0)	0.934**	(0.0)	0.537**	(0.0)
Shared common or official language	0.562**	(0.0)	0.404**	(0.0)	0.557**	(0.0)	0.399**	(0.0)
Number of observations	107786		155409		107786		155409	
Number of country pairs	13729		17817		13729		17817	

Table 8: Estimated coefficients for machinery trade

	(1) OLS		(2) PPML		(3) OLS		(4) PPML	
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
West African Economic & Monetary Union					2.005**	(0.0)	2.662**	(0.0)
Central African Economic & Monetary Union					3.528**	(0.0)	3.759**	(0.0)
Australia zone					2.546**	(0.0)	2.933**	(0.0)
Dollarized zone					-0.844**	(0.003)	-1.971**	(0.0)
Euro zone					-0.344**	(0.002)	-0.108	(0.143)
Krone zone (Denmark)					3.556**	(0.0)	5.133**	(0.0)
India-Bhutan					1.672**	(0.0)	3.357**	(0.0)
Singapore-Brunei					1.312**	(0.0)	1.239**	(0.0)
Countries share a common currency	0.165	(0.205)	-0.155*	(0.038)				
ln Y_{it}^k	0.381**	(0.0)	0.766**	(0.0)	0.381**	(0.0)	0.771**	(0.0)
ln $Y_{world,t}^k$	1.302**	(0.0)	0.466**	(0.002)	1.312**	(0.0)	0.464**	(0.002)
ln Distance	-1.563**	(0.0)	-0.639**	(0.0)	-1.578**	(0.0)	-0.651**	(0.0)
Pair belongs to a Regional trade Accord	0.349**	(0.0)	0.730**	(0.0)	0.340**	(0.0)	0.716**	(0.0)
Colonizer-colonized relationship	1.073**	(0.0)	0.053	(0.714)	1.079**	(0.0)	0.091	(0.575)
Country pair transitioning from colonialism	-0.132	(0.704)	0.115	(0.786)	-0.120	(0.733)	0.078	(0.857)
Countries were colonies of same country	0.652**	(0.0)	0.220	(0.115)	0.641**	(0.0)	0.221	(0.118)
Countries are contiguous	0.732**	(0.0)	0.478**	(0.0)	0.718**	(0.0)	0.462**	(0.0)
Shared common or official language	0.683**	(0.0)	0.227**	(0.001)	0.670**	(0.0)	0.226**	(0.001)
Number of observations	119268		151572		119268		151572	
Number of country pairs	14050		17045		14050		17045	

Table 9: Estimated coefficients for textile trade

	(1) OLS		(2) PPML		(3) OLS		(4) PPML	
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
East Caribbean Currency Union					0.209	(0.727)	-0.588	(0.476)
West African Economic & Monetary Union					1.171**	(0.0)	1.453**	(0.007)
Central African Economic & Monetary Union					2.534**	(0.002)	2.216**	(0.002)
Australia zone					2.084**	(0.0)	2.122**	(0.001)
Dollarized zone					0.308	(0.363)	0.364	(0.652)
Euro zone					-0.481**	(0.0)	-0.147†	(0.059)
Krone zone (Denmark)					4.199**	(0.0)	4.773**	(0.0)
India-Bhutan					-2.125**	(0.0)	-0.019	(0.975)
Singapore-Brunei					3.100**	(0.0)	3.150**	(0.0)
Countries share a common currency	0.002	(0.988)	-0.140†	(0.076)				
ln Y_{it}^k	0.403**	(0.0)	0.715**	(0.0)	0.400**	(0.0)	0.735**	(0.0)
ln $Y_{world,t}^k$	1.913**	(0.0)	0.809	(0.0)	1.928**	(0.0)	0.762	(0.0)
ln Distance	-1.524**	(0.0)	-0.891**	(0.0)	-1.533**	(0.0)	-0.954**	(0.0)
Pair belongs to a Regional trade Accord	0.582**	(0.0)	0.627**	(0.0)	0.581**	(0.0)	0.542**	(0.0)
Colonizer-colonized relationship	1.263**	(0.0)	0.283	(0.247)	1.247**	(0.0)	0.358	(0.192)
Country pair transitioning from colonialism	0.513†	(0.094)	-0.820**	(0.005)	0.534†	(0.085)	-0.803**	(0.006)
Countries were colonies of same country	0.540**	(0.0)	-0.053	(0.711)	0.535**	(0.0)	-0.068	(0.635)
Countries are contiguous	0.721**	(0.0)	0.357**	(0.001)	0.748**	(0.0)	0.326**	(0.002)
Shared common or official language	0.693**	(0.0)	0.431**	(0.0)	0.680**	(0.0)	0.429**	(0.0)
Number of observations	112134		155076		112134		155076	
Number of country pairs	14261		17717		14261		17717	

over time and across countries using data from the World Bank's *World Development Indicators*. The years covered range from 1991 to 2006. Although these industries all belong to the manufacturing sector, textiles and food, beverage, and tobacco rely on inputs more closely linked with agricultural production than do the machinery and chemicals industries. This subsection and its results closely resemble those in Anderson and Yotov (2010b), but pays particular attention to the importance of currency union effects. Owing to difficulties in obtaining convergence for the PPML estimates, the MRTs are time-invariant fixed effects where each country has up to two fixed effects for the two roles it might play (importer and exporter). There is a separate, year fixed effect.

Table 10: Correlation between currency union coefficients across estimation procedures (OLS versus PPML)

Chemicals	Food, beverage, & tobacco	Machinery	Textiles
0.773	0.884	0.871	0.912

Food, beverage, and tobacco and textiles have currency union effects that tend to be the most robust regardless of estimation technique (see table 10). The correlation between the OLS and PPML results for food et al is 0.884 while the correlation for textiles is 0.912. The correlation for machinery, however, is also quite high: 0.871. Chemicals has a weaker correlation, 0.773. Note that except for chemicals, these correlations are roughly equal to or larger the correlation between the PPML and OLS currency union coefficients for agricultural and manufacturing trade (compare table 10 with table **??**). Hence, disaggregating trade can lead to a reliable ranking, independent of estimating method, of the effects of individual currency unions.

How do the results of individual industries compare with the estimates for agricultural trade and manufacturing trade overall? Consider the PPML results as the previous section established the greater plausibility of PPML over OLS. Overall and unsurprisingly, the coefficients of individual manufacturing industries are more closely correlated with

Table 11: Correlation for all coefficients between Agriculture, Manufacturing, and individual industries

	Chemicals	Food, beverage, & tobacco	Machinery	Textiles
Agriculture	0.42	0.492	0.498	0.563
Manufacturing	0.956	0.849	0.96	0.632

the coefficients from manufacturing trade (see table 11). Textiles is an exception as it appears to be nearly equally and weakly related to both agricultural trade overall and manufacturing trade overall.

Table 12: Correlation for currency union coefficients between Agriculture, Manufacturing, and individual industries

	Chemicals	Food, beverage, & tobacco	Machinery	Textiles
Agriculture	0.291	0.308	0.373	0.448
Manufacturing	0.94	0.762	0.952	0.473

The closeness between manufacturing and individual manufacturing industries continues when examining just the coefficients of the currency unions (see table 12). Looking at individual unions and industries, the UEMOA, CEMAC, Kroner zone, and India-Bhutan generally have larger and more significant coefficients in chemicals and manufacturing than in the agricultural-related industries. The coefficients for manufacturing are negative or insignificant for the dollar and euro zones, respectively, but are positive and significant for food et al.

Table 13: Correlation for non-currency union coefficients between Agriculture, Manufacturing, and individual industries

	Chemicals	Food, beverage, & tobacco	Machinery	Textiles
Agriculture	0.585	0.926	0.731	0.876
Manufacturing	0.832	0.901	0.911	0.958

The correlation between other covariates for individual industries and the larger cat-

egories of trade offers a slightly different story (see table 13). The correlation between manufacturing trade and each of the individual industries is high. However, the correlations between agricultural trade and each of food et al and textiles are also high. As both of these manufacturing industries rely on agricultural inputs to a large extent, the high correlation may not be too surprising. However, the correlation of 0.731 between machinery and agriculture is less easily explained. Food et al appears to be the industry best-explained by the gravity model in the sense that the coefficients of the regressors are generally larger and more significant than are the regressors for the other industries. Colonial-era variables tend to be the most important for food et al than for the other industries. The regional trade agreement indicator has a large coefficient for machinery and textiles, though the estimate for food et al coefficient is also sizable.

Table 14: Estimated coefficients for agricultural trade

	(1) OLS		(2) PPML		(3) OLS		(4) PPML	
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
East Caribbean Currency Union					-0.516	(0.245)	-0.308	(0.76)
West African Economic & Monetary Union					0.097	(0.771)	1.096*	(0.022)
Central African Economic & Monetary Union					-1.341**	(0.009)	-0.814	(0.248)
Rand zone					0.137	(0.87)	1.967*	(0.043)
Australia zone					-0.385	(0.607)	-0.460	(0.283)
Dollarized zone					0.466	(0.161)	0.588**	(0.008)
Euro zone					0.347**	(0.008)	0.238**	(0.002)
Krone zone (Denmark)					2.986**	(0.0)	3.447**	(0.0)
India-Bhutan					0.858	(0.595)	2.153**	(0.007)
Countries share a common currency	-0.035	(0.78)	0.275**	(0.002)				
ln Y_{it}^k	0.406**	(0.0)	0.402**	(0.0)	0.407**	(0.0)	0.506**	(0.0)
ln $Y_{world,t}^k$	0.311**	(0.0)	0.624**	(0.0)	0.312**	(0.0)	0.398**	(0.0)
ln Distance	-1.225**	(0.0)	-0.921**	(0.0)	-1.225**	(0.0)	-0.944**	(0.0)
Pair belongs to a Regional trade Accord	0.363**	(0.0)	0.472**	(0.0)	0.356**	(0.0)	0.439**	(0.0)
Colonizer-colonized relationship	1.480**	(0.0)	0.566**	(0.0)	1.472**	(0.0)	0.803**	(0.0)
Countries are colonies of the same country	3.187**	(0.0)	2.093**	(0.001)	3.253**	(0.0)	2.141**	(0.0)
Country pair transitioning from colonialism	0.400†	(0.077)	-0.764*	(0.043)	0.425†	(0.063)	-0.738†	(0.051)
Countries were colonies of same country	0.357**	(0.0)	0.279**	(0.009)	0.367**	(0.0)	0.280*	(0.01)
Countries are contiguous	1.012**	(0.0)	0.498**	(0.0)	1.031**	(0.0)	0.511**	(0.0)
Shared common or official language	0.388**	(0.0)	-0.019	(0.841)	0.380**	(0.0)	-0.025	(0.783)
Number of observations	175365		288366		175365		288366	
Number of country pairs	17461		24954		17461		24954	

Table 15: Estimated coefficients for manufacturing trade

	(1) OLS		(2) PPML		(3) OLS		(4) PPML	
	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value	$\hat{\beta}_x$	p-value
East Caribbean Currency Union					2.321**	(0.0)	3.227**	(0.0)
West African Economic & Monetary Union					1.905**	(0.0)	2.016**	(0.0)
Central African Economic & Monetary Union					1.479**	(0.002)	1.829**	(0.0)
Rand zone					0.397	(0.317)	1.285**	(0.005)
Australia zone					1.898*	(0.032)	2.340**	(0.0)
Dollarized zone					0.055	(0.772)	-0.893**	(0.002)
Euro zone					-0.841**	(0.0)	-0.023	(0.703)
Krone zone (Denmark)					3.468**	(0.0)	4.373**	(0.0)
India-Bhutan					2.780†	(0.06)	3.156**	(0.0)
Countries share a common currency	0.753**	(0.0)	-0.055	(0.356)				
ln Y_{it}^k	0.376**	(0.0)	0.613**	(0.0)	0.436**	(0.0)	0.736**	(0.0)
ln $Y_{world,t}^k$	1.079**	(0.0)	1.098**	(0.0)	1.172**	(0.0)	0.736**	(0.0)
ln Distance	-1.671**	(0.0)	-0.738**	(0.0)	-1.677**	(0.0)	-0.751**	(0.0)
Pair belongs to a Regional trade Accord	0.414**	(0.0)	0.619**	(0.0)	0.427**	(0.0)	0.584**	(0.0)
Colonizer-colonized relationship	1.280**	(0.0)	0.151	(0.255)	1.291**	(0.0)	0.234	(0.121)
Countries are colonies of the same country	0.326	(0.438)	-3.633**	(0.0)	0.326	(0.412)	-3.619**	(0.0)
Country pair transitioning from colonialism	0.277	(0.112)	-0.431*	(0.04)	0.287	(0.1)	-0.397†	(0.062)
Countries were colonies of same country	0.653**	(0.0)	0.337**	(0.0)	0.645**	(0.0)	0.335**	(0.0)
Countries are contiguous	0.629**	(0.0)	0.450**	(0.0)	0.607**	(0.0)	0.454**	(0.0)
Shared common or official language	0.560**	(0.0)	0.275**	(0.0)	0.555**	(0.0)	0.270**	(0.0)
Number of observations	254871		268571		254871		268571	
Number of country pairs	23579		24954		23579		24954	

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