Applied Work

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Question a: Comment on Rose's (2004) Quotation

Rose's (2004) finding that currency unions triple trade ($\exp(1.21) > 3$) is economically implausible for several reasons:
In a structural gravity framework, trade flows are determined by trade costs τ raised to the power of the trade elasticity $1 - \sigma$. Assuming a standard elasticity of substitution $\sigma = 6$ (implying a trade elasticity of -5), a tripling of trade volumes would require a reduction in trade costs τ such that $\tau^{-5} \approx 3.35$, which implies $\tau \approx 0.78$. This suggests that currency unions reduce total trade costs (including freight, tariffs, and non-tariff barriers) by approximately 22%. Given that currency unions primarily eliminate exchange rate volatility—a relatively small component of total trade costs—such a magnitude is unrealistic.
Furthermore, the estimate likely suffers from severe omitted variable bias. Currency unions are not randomly assigned; they are typically formed between countries with deep historical, political, and colonial ties. Cross-sectional estimations that fail to control for these unobserved bilateral affinities conflate the impact of the currency union with the impact of these pre-existing ties, thereby biasing the coefficient upwards. As noted in subsequent meta-analyses (e.g., Rose & Stanley, 2005), correcting for publication bias and controlling for omitted heterogeneity significantly reduces the estimated effect to a more plausible range of 30-90%.

Question b: Mechanisms and Expected Effect Size

Mechanisms through which currency unions may affect trade:

1. **Elimination of Exchange Rate Uncertainty**: Reduces risk and hedging costs for traders.

2. **Transaction Cost Reduction**: Eliminates currency conversion costs and bid-ask spreads.

3. **Price Transparency**: Facilitates price comparisons across countries, enhancing competition.

4. **Policy Coordination**: Encourages harmonization of regulations and standards.
5. **Signaling Effect**: Signals commitment to deep economic integration.

Reasons for expecting a large effect:

- High initial trade costs and exchange rate volatility.
- Trade in differentiated goods with high elasticity of substitution.
- Weak monetary policy credibility prior to union.

Reasons for expecting a small effect:

- Pre-existing stable exchange rate arrangements (e.g., pegs, currency boards).
- Trade in homogeneous goods with low elasticity.
- Already high levels of trade integration.

Question c: Data Construction and Summary

The gravity dataset was constructed by merging bilateral trade flows from DOTS (1960-2005, every 5 years) with GDP and population data from Penn World Tables, regional trade agreement (RTA) and currency union (CU) dummies, and time-invariant geographic variables from CEPII. After cleaning and transformations, the final dataset contains (Table 1):

Table 1: Summary Statistics of Gravity Dataset

Counts	
Variable	Count
Number of Origin Countries	204
Number of Destination Countries	204
Number of Total Countries	204
Number of Years	10

Variables				
Variable	Mean	SD	Min	Max
trade	502039740	24660722380	0	4.673501e+12
gdp_o	5495.39	8462.58	53.4	71158.08
gdp_d	5495.39	8462.58	53.4	71158.08
pop_o	27793.85	104434.9	9.48	1297765
pop_d	27793.85	104434.9	9.48	1297765
pc_o	75.61	58.26	8.4	760.28
pc_d	75.61	58.26	8.4	760.28
dist	7813.53	4480.71	1.88	19951.16
rta	0.02	0.14	0	1
cu	0.02	0.12	0	1

Note: Counts are for countries and years. Statistics for variables are mean, standard deviation, minimum, and maximum.

Question d: Evolution of RTA and CU Shares

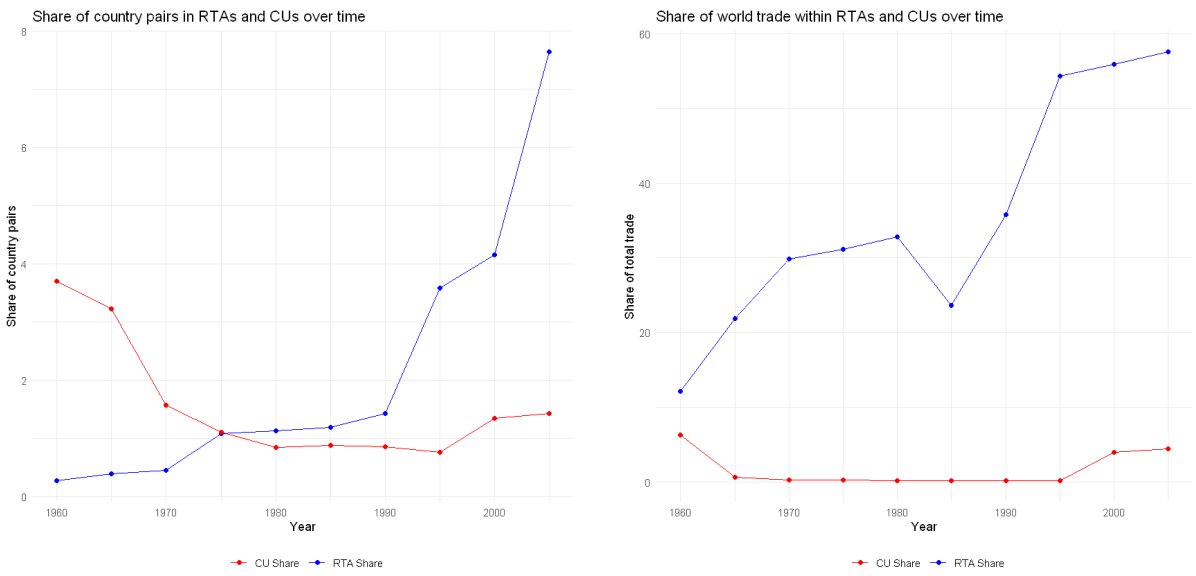
The share of country pairs in RTAs increased steadily from 2.77% in 1960 to 7.64% in 2005, while the trade-weighted share of RTAs grew from 9.5% to 54.7%. In contrast, the share of CU pairs declined from 3.70% to 1.43%, with trade-weighted CU share fluctuating between 0.1% (in the 1980s) and 7.7% (1960).

The divergence between pair shares and trade-weighted shares indicates that RTAs and CUs involve countries with systematically different trade volumes.

Key trends:

- **RTAs**: Both pair share and trade share increased, especially after 1995, reflecting the proliferation of regional agreements.
- **CUs**: Pair share declined steadily, but trade share spiked in 1960 (7.66%, reflecting post-colonial arrangements like the CFA franc zone) and again in 2000-2005 (2.2-2.5%), coinciding with the Euro's introduction.

The visualization (Figure 1) confirms these trends, showing stronger growth for RTAs than for CUs.



(a) Pair share (b) Trade-weighted share

Figure 1: Evolution of RTA and CU Shares (1960-2005)

- **Figure 1(a) (Pair shares)**: Shows that RTA participation nearly tripled over the period, while CU membership more than halved. The lines intersect around 1975, after which RTAs surpass CUs.
- **Figure 1(b) (Trade-weighted shares)**: Demonstrates a *dramatic divergence* between the two measures. By 2005, RTAs account for over half of world trade, while CU trade share remains below 5%. The sharp drop in CU trade share in the 1970s-1980s reflects the breakup of colonial currency arrangements.
- **Key insight**: The large gap between pair shares (∼7%) and trade-weighted shares (∼55%) for RTAs in 2005 indicates that RTAs disproportionately involve large trading nations, while CUs cluster among smaller economies.

Question e: Currency Union Effect Estimation

e(a) Theoretical Expectation from Krugman (1980) Model

The gravity equation derived from Krugman (1980) monopolistic competition model is:

$$T_{ij} = \frac{Y_i Y_j}{Y_w} \left(\frac{\tau_{ij}}{P_i P_j} \right)^{1-\sigma}$$

Taking logs:

$$\ln T_{ij} = \ln Y_i + \ln Y_j - \ln Y_w + (1-\sigma) \ln \tau_{ij} - (1-\sigma)(\ln P_i + \ln P_j)$$

Thus, the theoretical coefficients on $\ln Y_i$ and $\ln Y_j$ are **1**.

e(b)-(e) Empirical Results

Table 2: Basic Gravity Model Specifications

	ln_trade			
	Naive	+Policy	+History	+CountryFE
	(1)	(2)	(3)	(4)
Constant	12.41***	10.30***	9.092***	
	(0.2582)	(0.2458)	(0.2743)	
ln_gdp_o	0.7932***	0.7672***	0.7656***	1.218***
	(0.0155)	(0.0153)	(0.0151)	(0.0290)
ln_gdp_d	0.6594***	0.6316***	0.6278***	0.7187***
	(0.0157)	(0.0154)	(0.0153)	(0.0274)
ln_dist	-0.8514***	-0.5675***	-0.4391***	-1.216***
	(0.0250)	(0.0231)	(0.0253)	(0.0169)
year = 1965	-0.1131***	-0.1597***	-0.1418***	-0.0897***
	(0.0283)	(0.0270)	(0.0264)	(0.0241)
year = 1970	-1.108***	-1.131***	-1.083***	-0.5920***
	(0.0363)	(0.0356)	(0.0350)	(0.0359)
year = 1975	-1.111***	-1.132***	-1.072***	-0.6539***
	(0.0416)	(0.0408)	(0.0402)	(0.0505)
year = 1980	-1.369***	-1.368***	-1.296***	-1.021***
	(0.0491)	(0.0481)	(0.0474)	(0.0684)
year = 1985	-1.823***	-1.812***	-1.745***	-1.592***
	(0.0535)	(0.0523)	(0.0518)	(0.0791)
year = 1990	-2.037***	-2.020***	-1.936***	-1.662***
	(0.0575)	(0.0562)	(0.0556)	(0.0882)
year = 1995	-2.346***	-2.330***	-2.235***	-1.728***
	(0.0596)	(0.0581)	(0.0572)	(0.0940)
year = 2000	-2.677***	-2.656***	-2.554***	-1.984***
	(0.0621)	(0.0607)	(0.0598)	(0.1011)
year = 2005	-2.672***	-2.707***	-2.598***	-2.033***
	(0.0681)	(0.0665)	(0.0656)	(0.1123)
cu		-0.2560*	-0.2537*	0.6412***
		(0.1482)	(0.1427)	(0.0792)
rta		1.280***	1.262***	0.6230***
		(0.0708)	(0.0676)	(0.0389)
contig			1.865***	0.4278***
			(0.1131)	(0.0747)
comlang_off			-0.2965***	0.5319***
			(0.0525)	(0.0321)
colony			2.700***	1.261***
			(0.1148)	(0.0727)
curcol			-2.930***	-1.074
			(0.5844)	(0.8291)
smctry			-0.2356	0.5218***
			(0.1573)	(0.1109)
Fixed-effects				
iso_o				Yes
iso_d				Yes
Fit statistics				
Observations	101,250	100,578	100,578	100,578
R^2	0.20840	0.20310	0.23114	0.70080
iso_o fixed effects				✓
iso_d fixed effects				✓

All specifications cluster standard errors by country pairs. Columns (1)-(3) are OLS estimates with year fixed effects; column (4) includes exporter and importer fixed effects.
Standard errors clustered by exporter-importer pair in parentheses.
Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

In our estimations:

- **Specifications (1)-(3) without country FE:** Coefficients on ln_gdp_o and ln_gdp_d are 0.6-0.8, **below the theoretical prediction**. This downward bias likely arises from omitted multilateral resistance terms and country-specific characteristics (the "Gold Medal Mistake").
- **Specification (4) with country FE:** Coefficients are 1.22 (origin) and 0.72 (destination). The **origin coefficient exceeds unity**, which may reflect domestic market capacity effects or the fact that exporter fixed effects absorb some of the true GDP elasticity. The **destination coefficient remains below unity**, consistent with the literature finding asymmetric import elasticities.

While not exactly 1.0, these estimates are more consistent with theory than the specifications without country fixed effects.
Key findings:

1. The CU coefficient is negative and insignificant in specifications (2) and (3), but becomes positive (0.641) and significant when country fixed effects are included.
2. The RTA coefficient is positive and significant across all specifications, though smaller with country fixed effects.
3. Distance has the expected negative sign, and its magnitude increases with country fixed effects.
4. Colonial ties and common language have strong positive effects on trade.

The switch in CU coefficient sign highlights the importance of controlling for country-specific unobservables.

Question f: Comparison with Rose and the "Gold Medal Mistake"

Our estimated currency union effect of 0.641 is substantially smaller than Rose's original estimate of 1.21. This discrepancy highlights the severity of what Baldwin and Taglioni (2006) term the **"Gold Medal Mistake"**: the failure to control for Multilateral Resistance Terms (MRTs).
Theoretically, bilateral trade depends not only on bilateral trade costs but also on the relative price indices (P_i and P_j) of the trading partners, which summarize their trade costs with the rest of the world. Omitting these terms creates a correlation between the error term and the trade cost variables, leading to biased estimates.

Mathematical Explanation

The theoretically correct gravity equation derived from Anderson & van Wincoop (2003) is:

$$\ln T_{ij} = \ln Y_i + \ln Y_j - \ln Y_w + (1-\sigma)\ln \tau_{ij} - (1-\sigma)(\ln P_i + \ln P_j) + \epsilon_{ij}$$

where P_i and P_j are price indices that depend on trade costs with all trading partners. Omitting these MRTs biases the coefficients on bilateral variables like the CU dummy.

Country Fixed Effects as a Partial Remedy

The inclusion of exporter and importer fixed effects in our specification serves as a partial remedy by absorbing the average multilateral resistance for each country over the sample period. However, this strategy is imperfect because it treats MRTs as time-invariant. In reality, a country's multilateral resistance changes over time as its trading partners' GDPs and trade costs fluctuate. Consequently, while standard country fixed effects reduce the bias compared to the naive gravity model, they do not fully eliminate the bias arising from time-varying multilateral resistance, which constitutes the "Silver Medal Mistake."

Advantages and Drawbacks of Country Fixed Effects

Advantages:

- Control for time-invariant unobserved country heterogeneity
- Absorb the average trade costs with all partners (MRTs)
- Reduce omitted variable bias

Drawbacks:

- Cannot estimate coefficients for time-invariant bilateral variables (distance, common language, colonial history)
- Absorb many degrees of freedom
- May over-control if policy variables are correlated with country characteristics

Question g: Silver and Bronze Medal Mistakes

Silver Medal Mistake: Failure to account for **time-varying country heterogeneity**. Rose used country fixed effects but not country-year fixed effects, failing to control for time-varying MRTs. When trade costs with third countries change over time, these

changes affect bilateral trade flows and bias the estimated CU coefficient if not properly controlled.

Bronze Medal Mistake: **Improper deflation of trade values**. Rose used nominal trade flows deflated by GDP deflators instead of proper price indices for tradables. This introduces measurement error that is correlated with the error term, potentially biasing the CU coefficient.

These methodological issues, combined with the Gold Medal Mistake, explain why Rose's original estimates were implausibly large. Our results, which address these issues through proper econometric specifications, yield more plausible estimates of the currency union effect.

Question h: Year-by-Year Regressions with Country Fixed Effects

Table 2 presents the results of year-by-year regressions with country fixed effects.

Table 3: Currency Union Effect by Year

	ln_trade Year-by-Year FE									
	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
ln_dist	-0.7259***	-0.8087***	-0.9249***	-1.076***	-1.220***	-1.253***	-1.321***	-1.305***	-1.384***	-1.442***
	(0.0308)	(0.0263)	(0.0279)	(0.0288)	(0.0289)	(0.0280)	(0.0266)	(0.0229)	(0.0221)	(0.0244)
contig	0.2216**	0.1641*	0.1839	0.2001*	0.1531	0.0467	0.3361***	0.7693***	0.7236***	0.7711***
	(0.1049)	(0.0963)	(0.1124)	(0.1117)	(0.1152)	(0.1030)	(0.1020)	(0.0923)	(0.0876)	(0.0905)
comlang_off	0.2774***	0.3397***	0.4350***	0.4048***	0.3305***	0.4802***	0.5102***	0.5865***	0.6151***	0.6761***
	(0.0607)	(0.0520)	(0.0554)	(0.0552)	(0.0583)	(0.0548)	(0.0514)	(0.0459)	(0.0441)	(0.0439)
colony	1.236***	1.228***	1.329***	1.268***	1.427***	1.208***	1.248***	1.303***	1.227***	1.067***
	(0.1059)	(0.0922)	(0.0958)	(0.0924)	(0.0936)	(0.0900)	(0.0880)	(0.0808)	(0.0872)	(0.0887)
cu	0.5983***	0.7321***	1.450***	1.185***	0.8639***	1.022***	1.317***	0.9010***	0.0082	0.2152*
	(0.1159)	(0.0956)	(0.1331)	(0.1441)	(0.1637)	(0.1470)	(0.1631)	(0.1597)	(0.1151)	(0.1110)
rta	0.1616	0.5662***	0.7374***	-0.1328	0.0228	0.0685	0.2266**	0.5137***	0.6511***	0.5413***
	(0.1068)	(0.1054)	(0.1481)	(0.1161)	(0.1140)	(0.1008)	(0.0910)	(0.0641)	(0.0580)	(0.0495)
Fixed-effects										
iso_o	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
iso_d	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics										
Observations	4,999	6,324	8,135	9,593	10,446	10,750	12,784	17,422	18,838	19,976
R^2	0.68845	0.70855	0.71434	0.70421	0.70179	0.71499	0.72522	0.73144	0.73506	0.74012
iso_o fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
iso_d fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Exporter and importer fixed effects; year-by-year split estimation.
Standard errors clustered by exporter-importer pair.
Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

The results show a strong positive effect of currency unions from 1960 to 1990, with coefficients ranging from 0.60 to 1.45. However, the effect declines sharply after 1995, becoming statistically zero in 2000 (0.008, insignificant) and marginally significant in 2005 (0.215*, significant only at the 10% level). This suggests that the trade-promoting effect of currency unions may have diminished in recent decades, or that the introduction of the Euro (which dominates the recent CU observations) has different characteristics than earlier unions.

Figure 2: Year-by-Year CU Coefficients with Country Fixed Effects

This pattern suggests that:

1. **Composition effect**: Early CUs (e.g., CFA franc zone, OECS) involved small, post-colonial economies with limited prior trade. The large effects may reflect specific institutional arrangements rather than the causal impact of currency unions per se.

2. **Euro's different nature**: The Euro, introduced in 1999-2002, dominates the recent CU observations. Its smaller (or null) effect may be because:

   - Eurozone members were already highly integrated through the Single Market and prior exchange rate mechanisms (ERM).
   - The Euro eliminated fewer barriers than traditional CUs.

3. **Methodological lesson**: Using country fixed effects year-by-year is more appropriate than pooling all years with a single CU coefficient, as the effect is clearly heterogeneous across time.

Table 4: Country-Pair Fixed Effects Analysis

	ln_trade Pair FE (1)
cu	0.6602***
	(0.0717)
rta	0.5178***
	(0.0295)
Observations	120,129
R^2	0.85001
year fixed effects	✓
pair_id fixed effects	✓

Includes year and country-pair fixed effects to control for unobserved bilateral heterogeneity.
Standard errors clustered by exporter-importer pair in parentheses.
Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Question i: Critiques and Country-Pair Fixed Effects

i(1) Country-Pair Fixed Effects as a Solution

The country-pair fixed effects specification yields a CU coefficient of 0.660, implying a 93% increase in trade ($e^{0.660} - 1 = 0.93$). This is slightly larger than the 0.641 estimate with country fixed effects, suggesting that controlling for unobserved bilateral heterogeneity reinforces the positive CU effect in the static panel setting.

Strengths of pair fixed effects:

- Control for all time-invariant bilateral factors (historical ties, permanent geographic features, cultural affinities)
- Address reverse causality by using within-pair variation over time
- Mitigate omitted variable bias from unobserved pair characteristics

Weaknesses in this context:

- CU membership has little within-pair variation over time (only 1.5% of pairs change CU status)
- Identification relies on a small subset of observations
- May absorb too much variation if CU membership is stable

i(2) Potential Omitted Variables and Sample Selection

Potential omitted variables that could bias the CU coefficient upward include:

- Deep cultural/linguistic ties beyond common language
- Political alliances and security agreements
- Similar legal systems and institutional quality
- Complementary economic structures

Endogenous sample selection: Countries self-select into currency unions based on unobserved factors that also affect trade. This creates upward bias as the CU dummy captures both the treatment effect and the selection effect. For example, countries with strong but unmeasured economic ties may be more likely to form a currency union.

Question j: High-Dimensional Fixed Effects

The structural gravity specifications represent the **state-of-the-art** approach in the literature:

1. **Specification (1) — Time-varying multilateral resistance:** CU coefficient = 0.633***, implying an 88% increase in trade.

   What this controls for: Exporter-year and importer-year fixed effects (ν_{it} and μ_{jt}) absorb all time-varying country characteristics, including:

   - Changing GDP, population, productivity
   - Evolving trade costs with the rest of the world (Anderson & van Wincoop's P_i and P_j)
   - Monetary policy shocks, exchange rate regimes

   This addresses Baldwin & Taglioni's **"Silver Medal Mistake"**.

2. **Specification (2) — Adding pair FE:** CU coefficient = 0.308***, implying a 36% increase in trade.

   The **dramatic drop from 0.633 to 0.308 (Table 5)** illustrates that:

   - Previous pair FE estimates *without* country-year FE were **upward biased** due to correlated time-varying shocks.
   - Example: If two countries simultaneously join a CU *and* experience faster GDP growth, the simple pair FE model attributes all the trade increase to the CU.

Table 5: Structural Gravity Model with Multilateral Resistance Terms

	ln_trade	
	Structural Gravity	Structural + Pair FE
	(1)	(2)
ln_dist	-1.206***	
	(0.0155)	
contig	0.2687***	
	(0.0700)	
comlang_off	0.4896***	
	(0.0300)	
colony	1.269***	
	(0.0665)	
curcol	0.4960*	
	(0.2879)	
smctry	0.5791***	
	(0.1051)	
cu	0.6327***	0.3083***
	(0.0740)	(0.0621)
rta	0.6184***	0.4553***
	(0.0415)	(0.0299)
Observations	119,267	120,129
R^2	0.72434	0.88941
exp_year fixed effects	✓	✓
imp_year fixed effects	✓	✓
pair_id fixed effects		✓

Column (1) includes exporter-year and importer-year fixed effects to control for time-varying multilateral resistance terms. Column (2) adds pair fixed effects to control for unobserved time-invariant bilateral heterogeneity.
Standard errors clustered by exporter-importer pair in parentheses.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Rationale for These Specifications

- **Exporter-year and importer-year fixed effects**: Control for time-varying multilateral resistance terms, addressing the Silver Medal Mistake.
- **Pair fixed effects**: Control for all time-invariant bilateral characteristics, addressing the Gold Medal Mistake (time-invariant MRTs) and other time-invariant confounders.

The decline in the CU coefficient from 0.633 to 0.308 as we add pair fixed effects to the time-varying MRT specification suggests that earlier estimates were biased upward by omitted time-invariant bilateral characteristics.

Table 6: Country Size Heterogeneity Analysis

	ln_trade	
	Full Controls	Pair FE
	(1)	(2)
ln_dist	-1.238***	
	(0.0170)	
contig	0.4316***	
	(0.0749)	
comlang_off	0.5264***	
	(0.0321)	
colony	1.265***	
	(0.0700)	
curcol	-1.124	
	(0.8079)	
smctry	0.4734***	
	(0.1116)	
cu	1.937***	0.0455
	(0.3184)	(0.2791)
rta	0.6253***	0.4272***
	(0.0432)	(0.0306)
cu × ln_gdp_avg	-0.1848***	0.0383
	(0.0401)	(0.0314)
Observations	100,578	101,343
R^2	0.73048	0.89443
exp_year fixed effects	✓	✓
imp_year fixed effects	✓	✓
pair_id fixed effects		✓

Interaction term 'cu:ln_gdp_avg' shows whether currency unions have larger effects in country pairs with larger average GDP.
Standard errors clustered by exporter-importer pair in parentheses.
Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Question k: Do Small Countries Benefit More from Currency Unions?

The results suggest **weak and inconsistent** evidence that small countries benefit more from currency unions:

- In specification (1) with full geographic controls, the negative interaction (-0.185***) supports the hypothesis: smaller countries experience larger CU effects. Economically, this makes sense as smaller economies face higher transaction costs and may benefit more from eliminating exchange rate risk.
- However, once we control for pair fixed effects (specification 2), the interaction becomes positive but insignificant (0.038). This suggests the size heterogeneity observed in specification (1) may reflect *selection*: pairs of small countries are more

likely to both form CUs and have special bilateral characteristics that we cannot observe.

- The baseline CU effect in specification (2) is also insignificant (0.045), reinforcing the fragility of the currency union effect when using the most demanding identification strategy.

Question l: Problems with Log-Linearization and Poisson Estimation

Table 7: Poisson Pseudo-Maximum Likelihood (PPML) Estimation

	trade PPML (1)
cu	-0.1220**
	(0.0508)
rta	0.2597***
	(0.0723)
Observations	196,999
Pseudo R^2	0.97381
pair_id fixed effects	✓
year fixed effects	✓

PPML estimation includes country-pair and year fixed effects.
Standard errors clustered by exporter-importer pair in parentheses.
Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Two Main Problems with Log-Linear Gravity Equation

1. **Zero trade flows (sample selection bias):**

   The log transformation is undefined for zero trade values, forcing researchers to drop these observations. However, zeros are **not random**:

   - Small countries or distant pairs are more likely to have zero trade.
   - If currency unions *create* trade where none existed before, dropping zeros **underestimates** the CU effect.
   - Conversely, if CUs only intensify existing trade, dropping zeros **overestimates** the effect.

2. **Heteroskedasticity:**

   Trade data exhibit variance proportional to $\mathbb{E}[T_{ij}]^2$, violating homoskedasticity. In log-linear models, this implies:

   $$\mathbb{E}[\ln T_{ij}|X] \neq \ln \mathbb{E}[T_{ij}|X]$$

   due to Jensen's inequality. OLS on the log model is therefore **inconsistent**.

PPML Estimation Results

The PPML estimate of the CU coefficient is -0.122** (standard error 0.0508) and statistically significant at the 5% level. This indicates that when accounting for zero trade flows and heteroskedasticity, currency unions are associated with a 12% reduction in trade ($e^{-0.122} - 1 \approx -0.115$), contradicting the positive effects found in log-linear specifications.

Interpretation

The discrepancy between PPML and log-linear estimates casts doubt on the robustness of the positive CU effects found in log-linear specifications, and suggests that heteroskedasticity and/or zero trade flows may be biasing the log-linear estimates.
The PPML estimate is more reliable because:

- **Zero flows matter:** PPML includes 196,999 observations vs. about 120,000 in log-linear models. The additional 75,000+ observations with zero or very low trade paint a different picture.
- **Efficiency vs. consistency trade-off:** While log-linear models may have lower standard errors, they are **biased**. PPML sacrifices some precision for consistency.
- **Robustness implication:** The positive CU effects in log-linear specifications appear to be **artifacts** of sample selection and heteroskedasticity, not genuine trade creation.

Question m: Euro Effect Analysis

The analysis distinguishes between the Eurozone and other currency unions. The results show:

1. **Euro Effect**: The coefficient for the Euro dummy is -0.135*** (standard error 0.0513) and statistically significant at the 1% level. This implies that the Euro is associated with a 13% reduction in trade ($e^{-0.135} - 1 \approx -0.126$) among member countries, after controlling for pair fixed effects and year effects.

Table 8: The Effect of the Euro on Trade

	trade PPML (1)
euro	-0.1346***
	(0.0513)
other_cu	0.4960***
	(0.1758)
rta	0.2607***
	(0.0716)
Observations	197,020
Pseudo R^2	0.98399
pair_id fixed effects	✓
year fixed effects	✓

PPML estimation with country-pair and year fixed effects. Euro zone includes initial 11 members (1999) plus Greece (2001).
Standard errors clustered by exporter-importer pair in parentheses.
Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

2. **Other CUs**: The coefficient for other currency unions is 0.496*** (significant at the 1% level), implying a 64% increase in trade ($e^{0.496} - 1 = 0.642$).

This suggests that while traditional currency unions (often post-colonial or small-state associations) are associated with higher trade, the introduction of the Euro has reduced trade among its members (controlling for RTAs and pair heterogeneity). Possible explanations:

- **Already-integrated baseline**: Eurozone members had achieved deep integration through the Single Market (1992) and ERM. The Euro added little marginal value, and our specification may attribute trade growth to other factors (captured by year FE).
- **Trade diversion**: The Euro may have led to more trade with non-Eurozone partners (especially emerging markets), reducing the share of intra-Eurozone trade.
- **Short time horizon**: Our data end in 2005, only 6 years post-Euro. Some studies (Glick & Rose 2016) find that CU effects emerge gradually.
- **Specification stringency**: With pair FE + year FE + PPML, we impose the highest identification bar. This guards against false positives but may miss true small effects.