The Puzzling Persistence of the Distance Effect on Bilateral Trade

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What non-academics say about distance:

"The death of distance as a determinant of the cost of communicating will probably be the single most important force shaping society in the first half of the next century."
(Frances Cairncross, *The Death of Distance*)

"Distance has disappeared. The world has shrunk to a global village..."
(Kishore Mahbubani, Singapore's ambassador to the United Nations, quoted in *The Economist*, February 20th, 2003)

What urban and trade economists say about distance

"Over the twentieth century, the costs of moving [manufactured] goods have declined by over 90% in real terms, and there is little reason to doubt that this decline will continue...it is essentially free to move goods..."
(Glaeser and Kohlhase, "Cities, Regions and the Decline of Transport Costs", 2003)

"The death of distance is exaggerated. Trade costs are large..."
(Anderson and van Wincoop, *Journ. of Econ. Lit.*, 2004)

Little consensus about the exact magnitude of the distance effect

"These and many subsequent studies have found a distance elasticity of about -0.6...[E]stimates of gravity models...have produced some of the clearest and most robust findings in economics."
(Leamer and Levinsohn, "International Trade Theory: The Evidence", 1995)

"Distance is the most important [determinant of trade costs], and the elasticity of trade volumes with respect to distance is usually estimated to be in the interval -0.9 to -1.5."
(Overman, Redding, and Venables, "The Economic Geography of Trade, Production, and Income: A Survey of Empirics", 2003)

Aim of the paper:

- Assess in a systematic and thorough way the magnitude of the distance effect on trade.
- Determine sources of within-study and between-study variation in estimates.
- Combine information from studies whose data span 130 years to verify whether distance effects are dying.

Meta-analysis: What is it good for?

- Quantitative assessment of results from original analyses.
- Avoid the potential selection bias of qualitative literature reviews.
- Meta-analysis could also be used to test for publication bias.
- Applications in economics: the union-nonunion wage gap (Jarrell and Stanley, 1990), Ricardian equivalence (Stanley, 1998 and 2001), gender wage discrimination (Stanley and Jarrell, 1998), taxes and FDI (de Mooij and Ederveen, 2003), productivity spillovers (Görg and Strobl, 2001), the effects of currency unions on trade (Rose, 2004), the relationship between location decisions of firms and environmental regulations (Jeppesen et al., 2002), transport issues (Button, 1995 ; van den Bergh and Button, 1997).

Distance Effects

Estimates come from the Gravity Equation:

$$\ln X_{ij} = \zeta + \alpha \ln Y_i + \beta \ln Y_j - \theta \ln D_{ij} + \epsilon_{ij}.$$

X_{ij}: value of i's exports to j,

Y_i and Y_j: Origin and destination GDPs,

D_{ij}: Distance between origin and destination,

θ is the "distance effect", the negative of the elasticity of bilateral trade with respect to distance.

Database comprises 1052 estimates from 78 papers

- 55 studies selected through *Econlit* searches
  - "gravity equation",
  - "gravity and distance and trade",
  - "border and distance and trade",
  - "home bias and trade",
  - "gravity and history and trade".
  - 42 papers published in academic journals, 4 chapters published in books, and 9 working papers.
- 23 additional papers from high-quality journals
  - *American Economic Review*,
  - *Review of Economics and Statistics*,
  - *Journal of International Economics*.

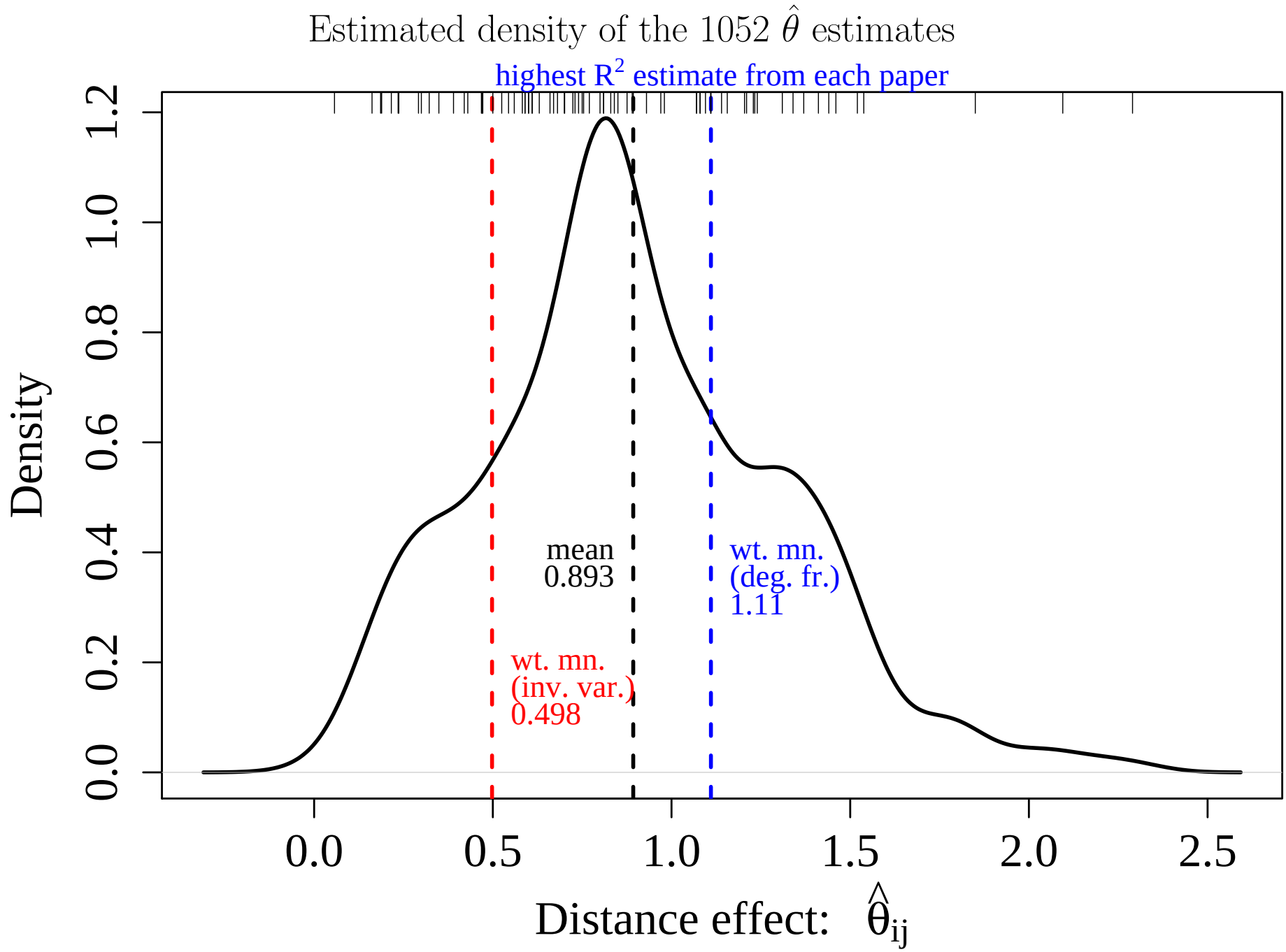
Screening the sample

- Include only observations using the standard log-log specification.
- Include only estimates of distance effects on bilateral trade in goods.
- Exclude 8 extreme outliers using the Grubbs Test.
- Final database comprises 1052 estimates from 78 papers.
- The sample include estimates from data ranging from 1870 to 1999. 137 pre-1970 sample estimates.
- Estimates from the same study are considered as different observations.

The Grubbs Procedure

1. Calculate $G^* = (N-1)\sqrt{t^2/[N(N-2+t^2)]}$, where t is the critical value of a t-distribution with $N-2$ degrees of freedom and a confidence interval of $\alpha/(2N)$ and α is the confidence level.
2. Calculate $G = \max\{\mid x_i - \bar{x} \mid /s\}$, the maximum deviation from the sample mean, $\bar{x}$, divided by the standard deviation, s, calculated including that observation.
3. If $G > G^*$ delete the observation.
4. Repeat.

We started with $N = 1060$ observations and set $\alpha = .05$, yielding $G^* = 4.05$. Application of this procedure led to the removal of 8 distance effects: 51.71, -26.68, 7.28, 6.53, 2.84, 2.8, 2.63, and 2.62. A Stata program is available on Keith's webpage.


Estimated density of the 1052 $\hat{\theta}$ estimates
highest R^2 estimate from each paper
Density
0.0
0.2
0.4
0.6
0.8
1.0
1.2
mean
0.893
wt. mn.
(deg. fr.)
1.11
wt. mn.
(inv. var.)
0.498
0.0
0.5
1.0
1.5
2.0
2.5
Distance effect: $\hat{\theta}_{ij}$

Why Distance Effects Vary

- **"Sampling" variation:** random error in estimating a population parameter due to use of data from a finite sample drawn from that population.

- **"Structural" variation:** differences in parameters across subpopulations of the data

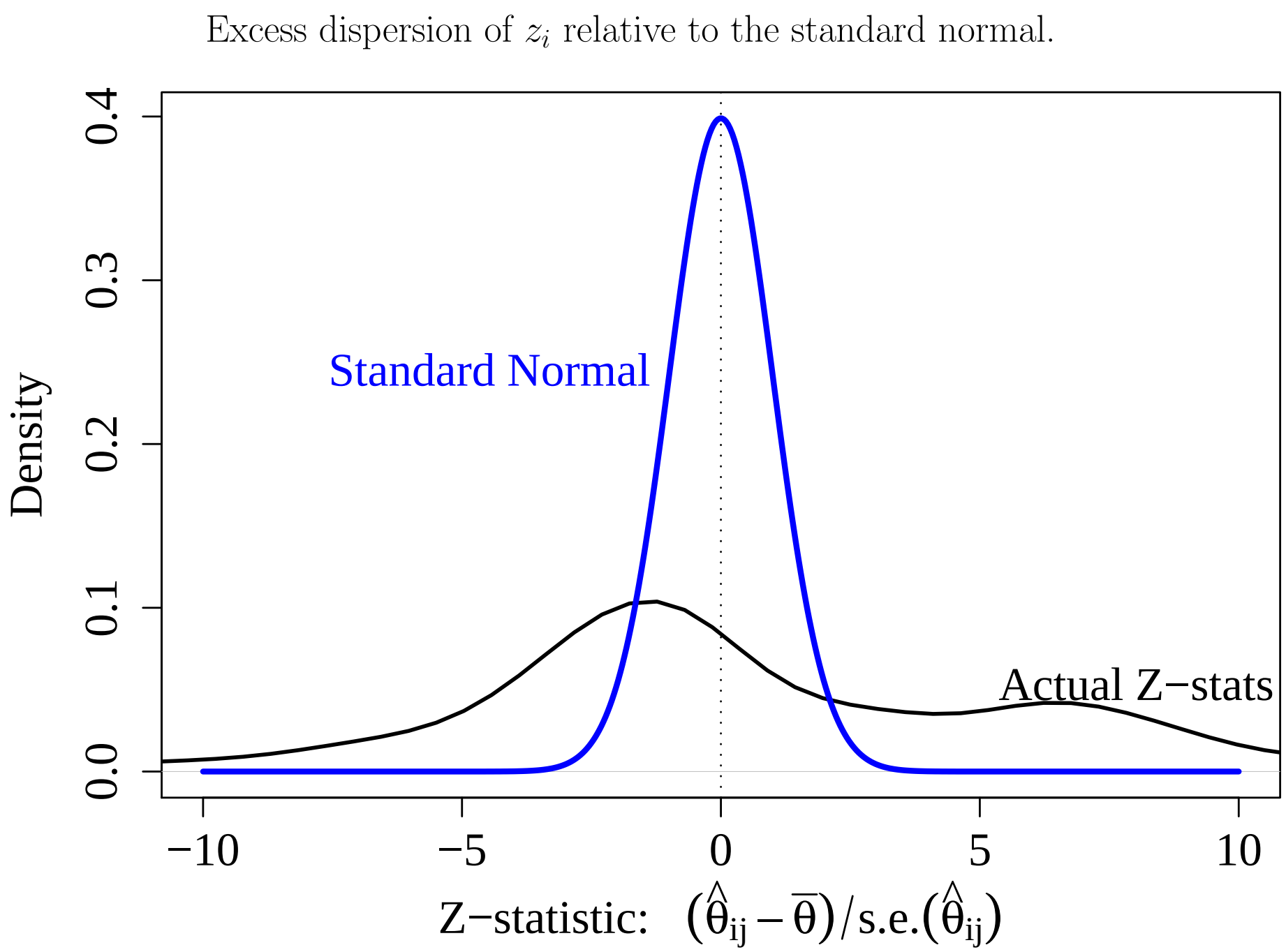
$$\theta = (\sigma - 1)(\delta_p + \delta_\nu)$$

σ: elasticity of demand with respect to quality-adjusted price.

δ_p: elasticity of delivered price with respect to distance

δ_ν: elasticity of delivered quality with respect to distance

- **"Method" variation:** differences in statistical technique lead to different estimates.


Excess dispersion of z_i relative to the standard normal.
Density
0.0
0.1
0.2
0.3
0.4
Standard Normal
Actual Z−stats
−10
−5
0
5
10
Z−statistic: $(\hat{\theta}_{ij} - \bar{\theta})/\text{s.e.}(\hat{\theta}_{ij})$

Descriptive statistics

Name	**Mean**			
	≤1969	**1970s**	**1980s**	**1990s**
Dependent variable				
Distance Effect (− elasticity of trade w.r.t. dist.)	0.645	0.881	0.935	0.941
Structural variables				
Average Year (Midpoint of estimation period)	1943.15	1974.28	1984.94	1992.85
Single Continent	0.204	0.200	0.314	0.334
Developed Economies Only	0.394	0.452	0.439	0.546
No Developed Economies	0.000	0.111	0.050	0.034
Disaggregated Data	0.248	0.407	0.161	0.442
Method Variables				
Total Bil. Trade (sum of two-way trade flows)	0.401	0.326	0.393	0.242
Road/Sea distance	0.175	0.281	0.150	0.168
Adjacency Control	0.723	0.756	0.471	0.456
Common Lang. Control	0.175	0.459	0.539	0.450
Trade Agreements Control	0.883	0.911	0.729	0.640
Remoteness Control	0.007	0.185	0.268	0.286
GDP Endogeneity Correction	0.095	0.007	0.146	0.128
Incorporates Zero Flows	0.766	0.607	0.625	0.404
High Quality Review	0.496	0.496	0.232	0.310

Specification with random effects

$$\hat{\theta}_{ij} = \beta X_{ij} + u_i + e_{ij}$$

$\hat{\theta}_{ij}$ is the jth distance coefficient reported by study i,

X_{ij} is the matrix of the meta-explanatory variables,

β: vector of meta-regression coefficients,

u_i are the "random study" effects,

e_{ij} is all remaining cross-estimate variation.

Meta-Regression Results - Random Effects

Specification:	(1)	(2)	(3)	(4)	(5)
Sample:	All	All	All	All	Econlit
# of Obs.:	1052	1052	1052	1052	774
Intercept	0.55^a	0.74^a	0.64^a	0.66^a	0.64^a
	(0.12)	(0.05)	(0.06)	(0.08)	(0.09)
Avge. Year of Sample - 1870	0.003^a				
	(0.001)				
$1970 \leq$ Avge. Year ≥ 1979		0.13^a	0.12^a	0.12^a	0.08^c
		(0.04)	(0.04)	(0.04)	(0.04)
$1980 \leq$ Avge. Year ≥ 1989		0.17^a	0.16^a	0.15^a	0.15^a
		(0.04)	(0.04)	(0.04)	(0.05)
$1990 \leq$ Avge. Year ≥ 1999		0.18^a	0.17^a	0.16^a	0.19^a
		(0.05)	(0.04)	(0.04)	(0.05)
R^2 between	0.044	0.071	0.139	0.130	0.172
R^2 within	0.006	0.012	0.073	0.111	0.149
Std. error of u_i	0.338	0.338	0.327	0.340	0.372
Std. error of e_{ij}	0.210	0.210	0.203	0.200	0.205

Note: Standard errors in parentheses with ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels.

Meta-Regression Results (continued)

Sample:	All	All	All	All	Econlit
# of Obs.:	1052	1052	1052	1052	774
Single Continent			0.41^a	0.32^a	0.32^a
			(0.06)	(0.07)	(0.08)
Developed Economies Only			-0.10^b	-0.11^b	-0.10^c
			(0.05)	(0.05)	(0.05)
No Developed Economies			0.18^b	0.19^a	0.22^a
			(0.07)	(0.07)	(0.08)
Disaggregate Data			0.14^b	0.14^b	0.28^a
			(0.06)	(0.06)	(0.07)
Total Bilateral Trade				-0.05	-0.08
				(0.06)	(0.06)
Road/Sea Distance				-0.02	0.05
				(0.11)	(0.13)
Adjacency Control				-0.16^a	-0.17^a
				(0.03)	(0.03)
Common Language Control				0.12^a	0.13^a
				(0.04)	(0.05)
Trade Agreements Control				-0.02	-0.02
				(0.03)	(0.04)
Remoteness Control				0.001	-0.01
				(0.04)	(0.04)
GDP Endogeneity Correction				-0.004	-0.02
				(0.03)	(0.04)
Incorporates Zero Flows				0.07^b	0.03
				(0.03)	(0.04)
High Quality Review				0.10	0.03
				(0.08)	(0.16)
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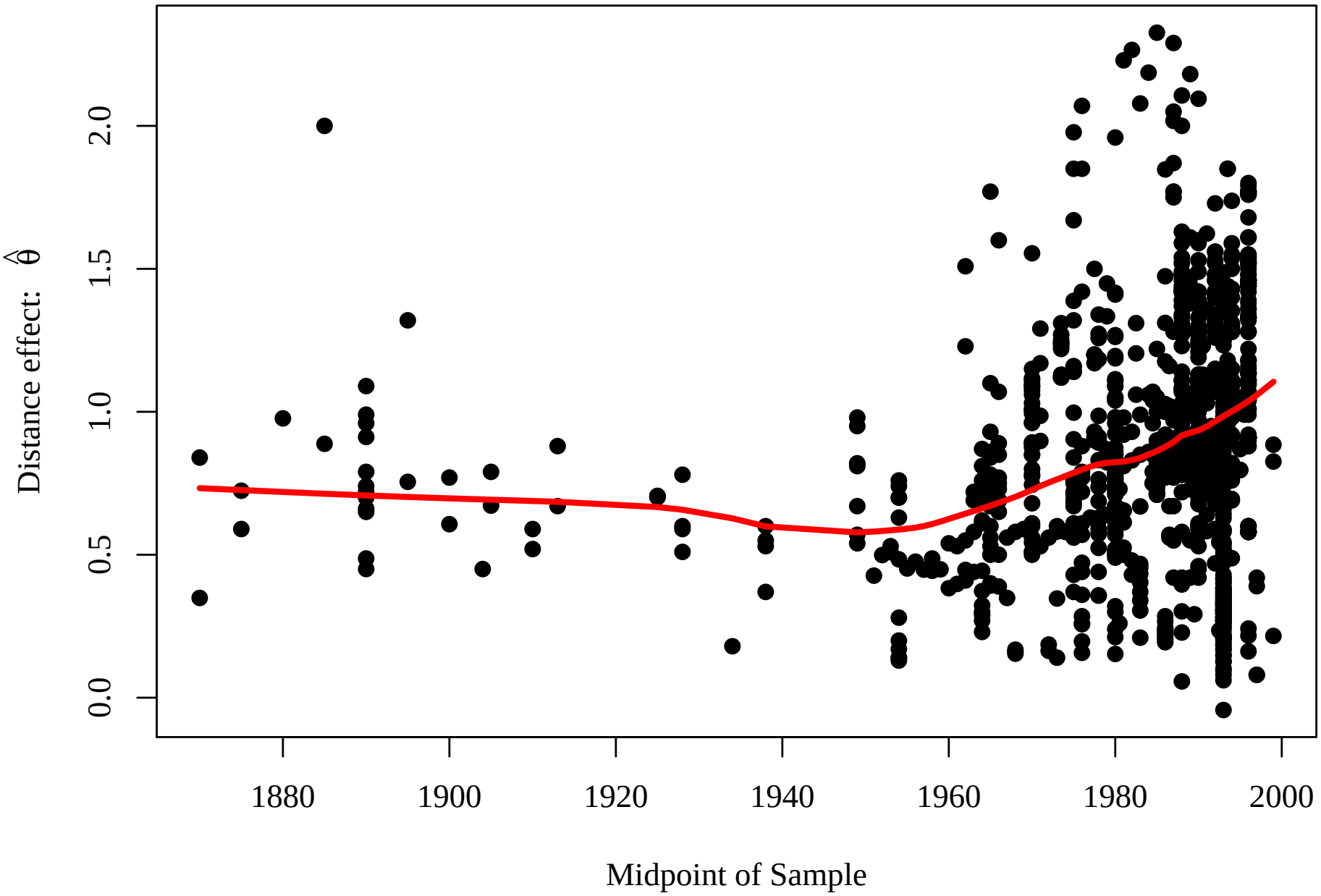
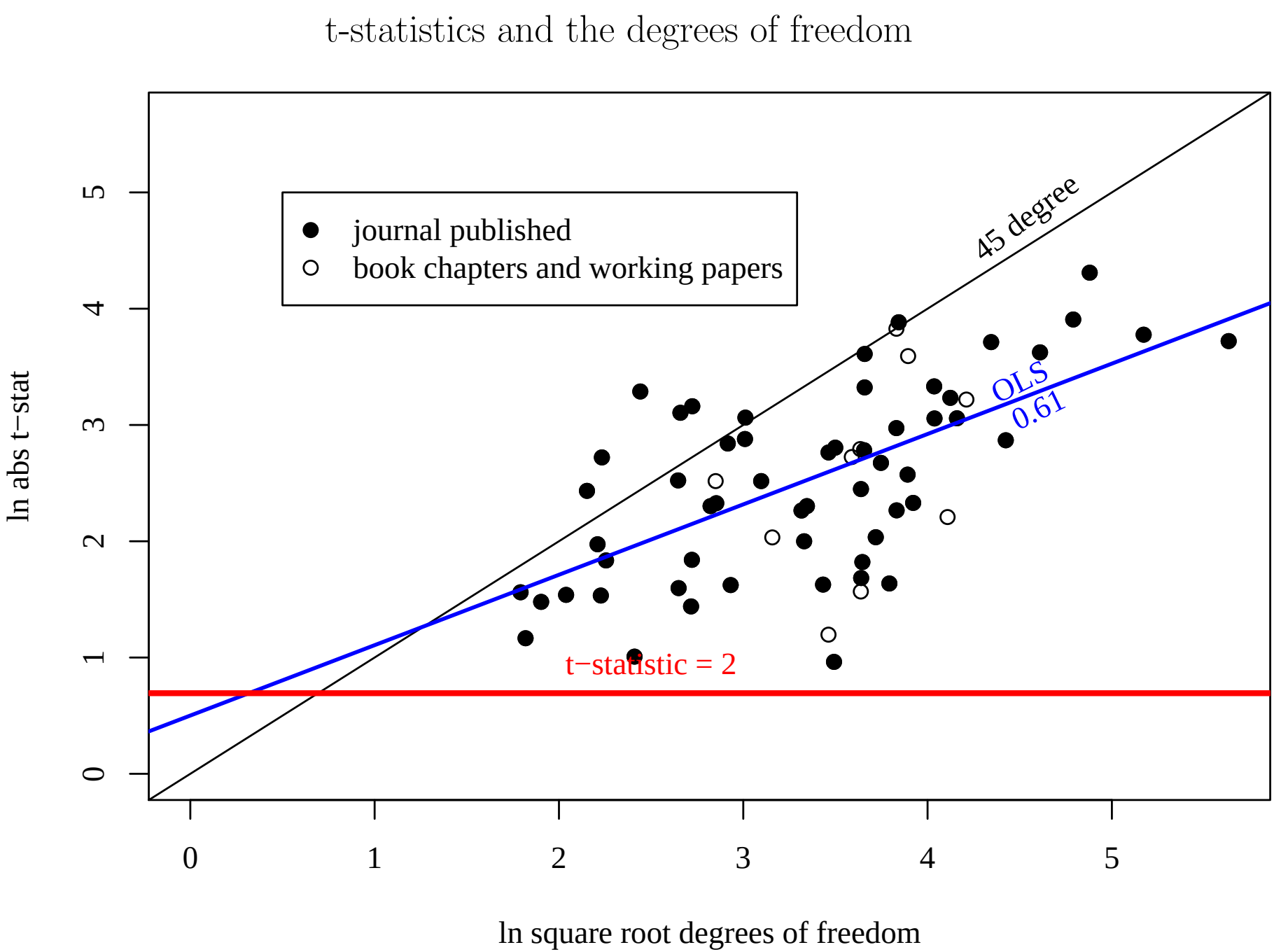
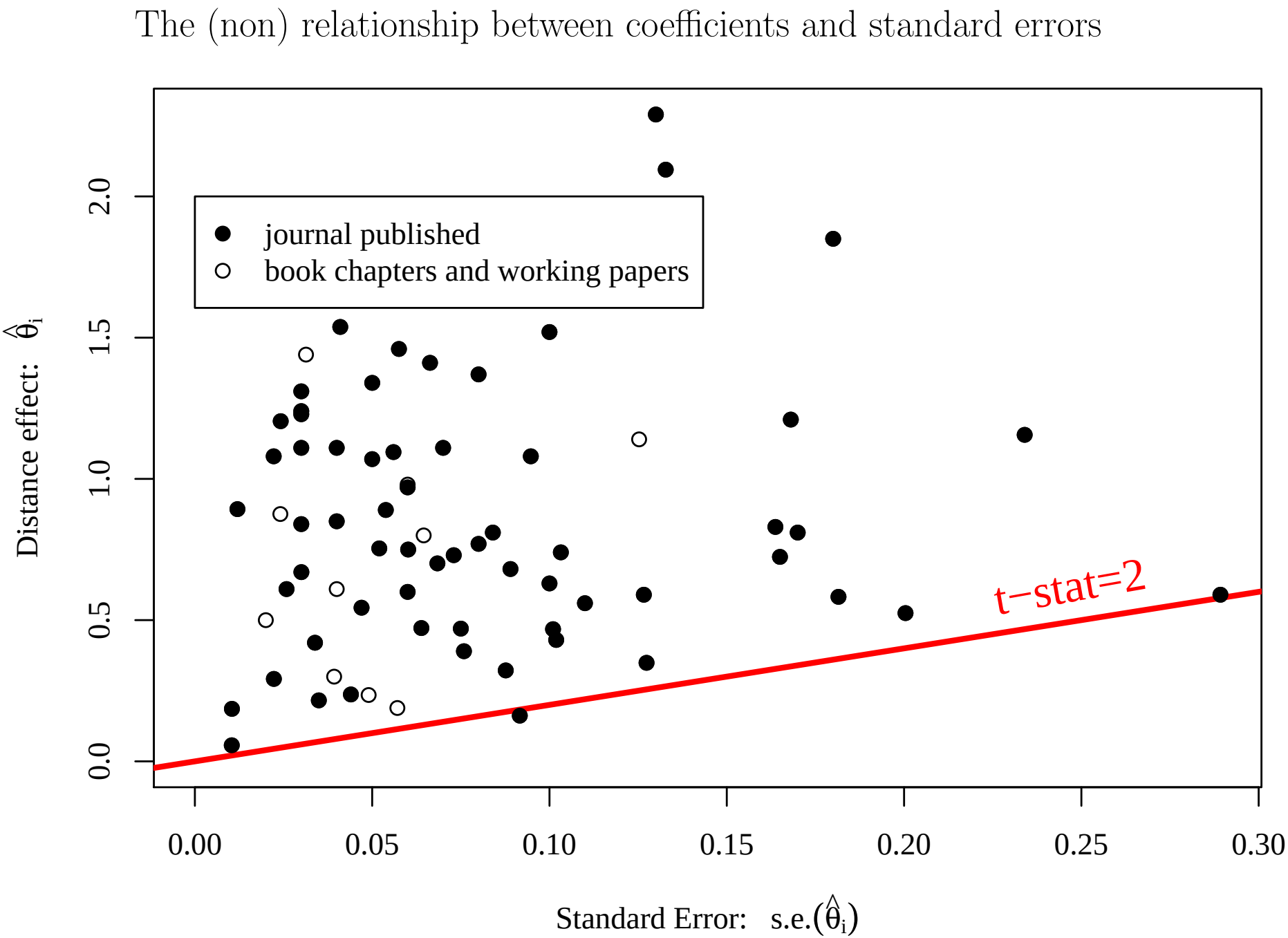
The variation of $\hat{\theta}$ graphed relative to the mid-period of the data sample.




t-statistics and the degrees of freedom
journal published
book chapters and working papers
45 degree
OLS
0.61
t−statistic = 2
ln abs t−stat
ln square root degrees of freedom
0
1
2
3
4
5


The (non) relationship between coefficients and standard errors
journal published
book chapters and working papers
t−stat=2
Distance effect: $\hat{\theta}_i$
Standard Error: s.e.($\hat{\theta}_i$)
0.0
0.5
1.0
1.5
2.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30

Conclusion

- Huge variation in the estimated distance effect cannot be explained by mere sampling error.
- The negative impact of distance in trade is not shrinking, but increasing over time.
- Distance impedes trade by 24% more—(0.18/0.74)—in the 1990s than it did from 1870 to 1969!
- This increase occurs even after controlling for differences in the samples and methods.
- Technological change has failed to end spatial separation.
- Explaining the large and increasing impact of distance on bilateral trade remains an important challenge.