Heterogeneity and the Distance Puzzle

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Introduction

- Is the world getting smaller?
  - seems obvious to most observers of globalization
  - but conflicting evidence in gravity equations:
  - trade more sensitive to distance since 1960s
- What explains this 'distance puzzle'?
  - estimation strategy
  - composition effect
- Not a puzzle, but a finding?
  - relative growth in short vs. long-distance trade
  - evolution of distance-related trade costs
    1. transport costs relatively to price of traded goods
    2. growing importance of certain trade cost components

Motivation

- This paper:
  - takes microfoundations of the gravity equation seriously
  - solves the distance puzzle over long time period
- The trick?
  - distance coefficient is a product of two elasticities:
    1. elasticity of trade to trade costs
    2. elasticity of trade costs to distance
  - focus on elasticity of trade to trade costs, call it 'heterogeneity'
  - document that the evolution in this parameter fully explains the distance puzzle
- Take from paper: Evolution of heterogeneity parameter provides a direct explanation of the distance puzzle

Summary of results

- Robustness of distance puzzle in 1962-2009: increase in distance coefficient
  - 8% controlling for estimation strategy
  - 14% controlling for composition and sample effects
- Evolution of heterogeneity parameter:
  - 13-29% increase in 1962-2009
  - this estimate is likely to be a lower bound
- Elasticity of trade costs to distance has not increased (4-16% decrease)
- Result obtained within the Armington framework
- Indicates increased substitutability of exporter-specific product bundles

Plan of the talk

The distance puzzle in our data

- Benchmark estimation
- Composition, sample, FTA effects

Interpreting properly the distance coefficient

- The heterogeneity dimension in each model
- The heterogeneity dimension captured in our data

Estimation strategy and results

- Benchmark estimation
- Robustness checks

Conclusion

Empirical strategy

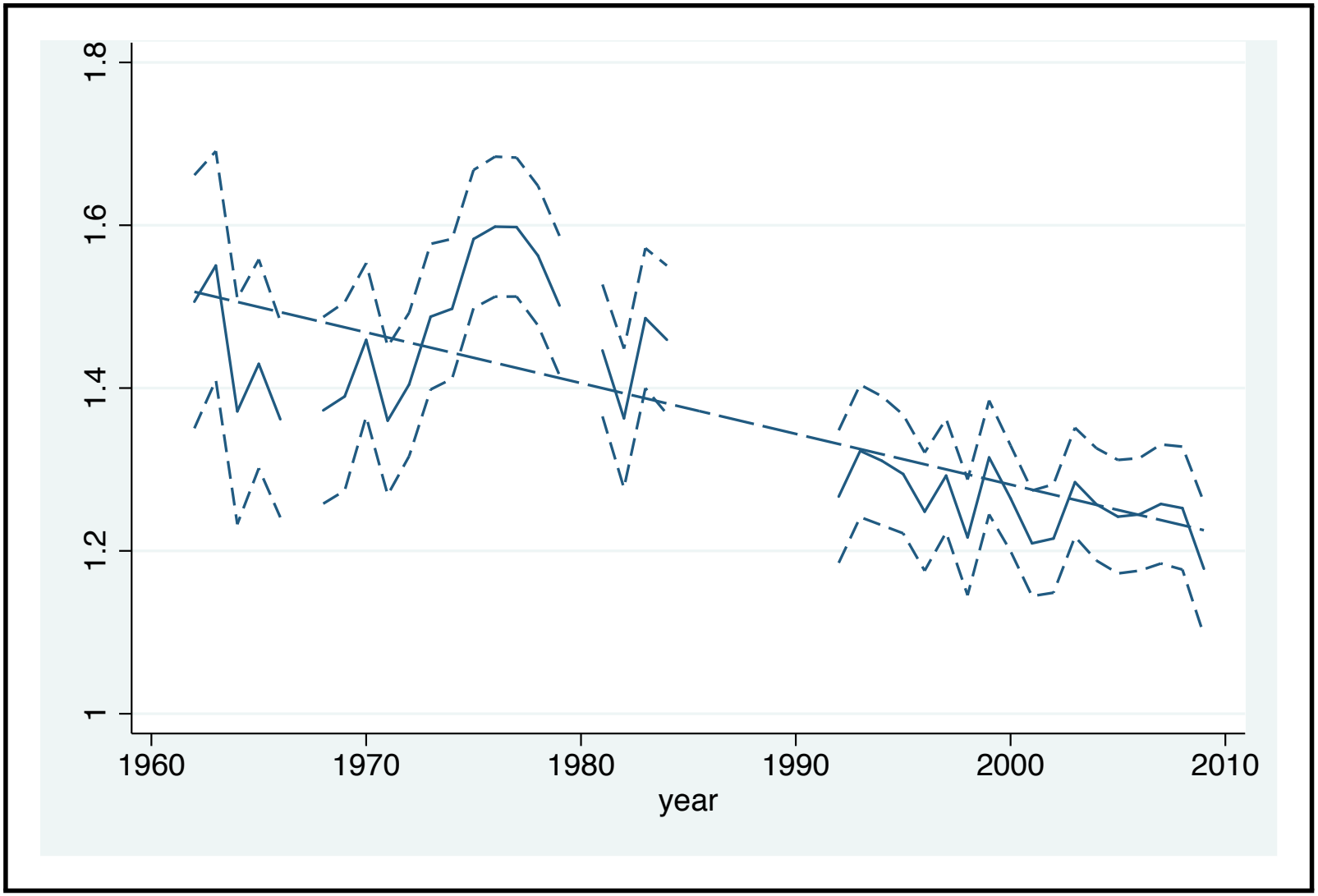
- COMTRADE data, 4-digit level (SITC), 1962-2009
- Run gravity equations (obviously)
- Cross section, no panel (evolution over time)
- Using the PPML estimator (consistency & efficiency)
- Using ZIP: logit + PPML
- Estimated equation:

$$X_{ij} = \exp\left(\alpha_0 - \alpha_1 \ln dist_{ij} + \beta_1 Z_1 + \beta_2 Z_2 + fe_{exp} + fe_{emp}\right)\epsilon_{ij}$$

  - trade cost controls (adjacency, common language..): Z_1
  - trade cost controls linked to FTA membership: Z_2
  - exporter and importer dummies: fe_{exp}, fe_{emp}
  - distance elasticity: α_1

Baseline regression (PPML)

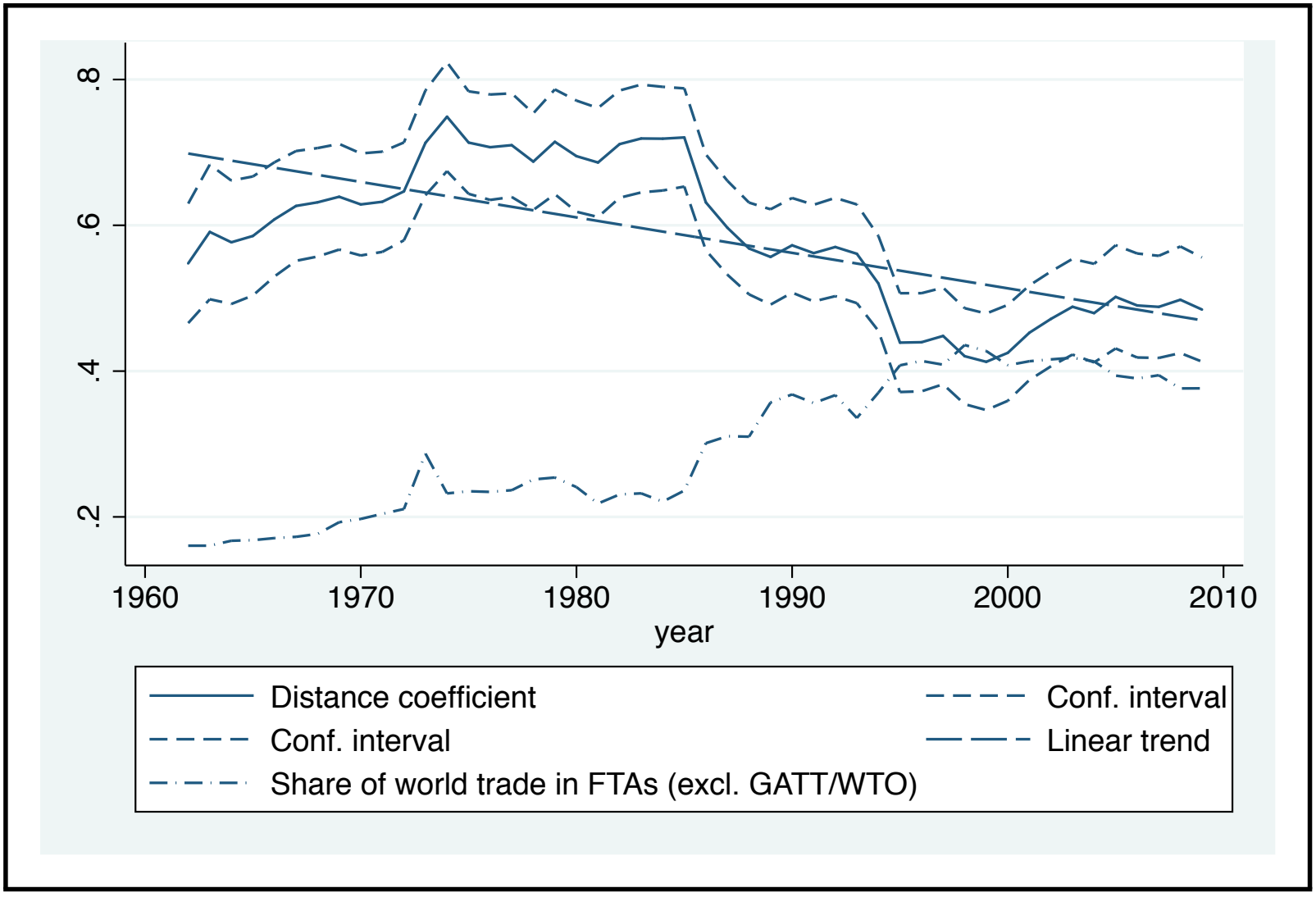
Logit baseline ZIP regression



Robustness of puzzle

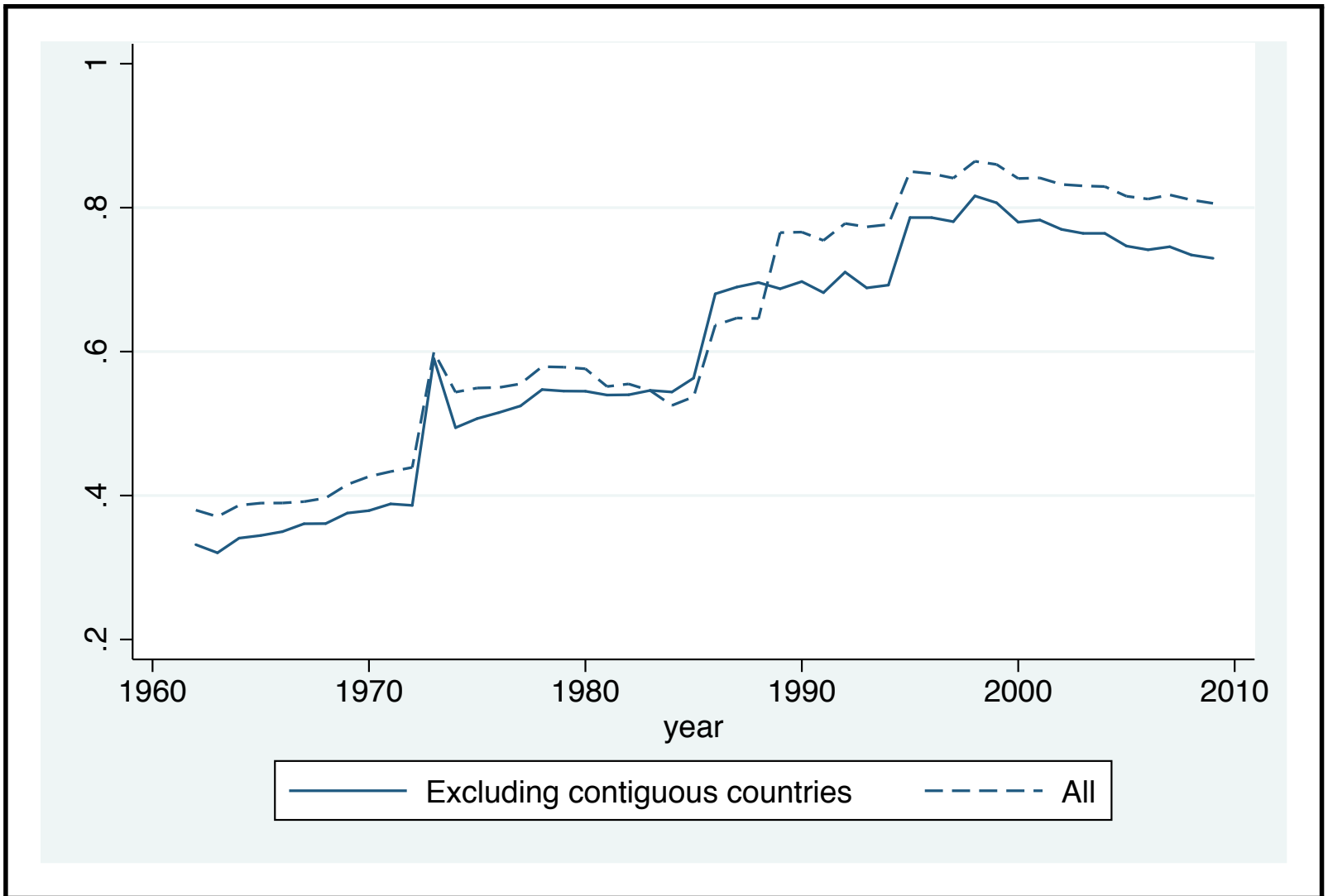
- Sample
  - Test: keep only trading pairs that have reciprocal non-zero trade every year from 1962 to 2009
  - It worsens the puzzle
- Composition
  - Test: suppose the composition of trade constant e.g. at 1962 shares for 4 digit goods
  - It worsens the puzzle (increse in manuf share)
- FTAs
  - Test: introduce FTA variables
  - It 'solves' the puzzle
  - But what does it mean ?
  - Increasing number of proximity controls overtime
  - Mechanically reduces the effect of distance

FTAs(1)


.2
.4
.6
.8
1960
1970
1980
1990
2000
2010
year
Distance coefficient
Conf. interval
Share of world trade in FTAs (excl. GATT/WTO)
Conf. interval
Linear trend

FTAs(2)

Figure: Share of intra-FTA trade among nearby countries (2000km or less)



Summary (ZIP)

	% change relatively to baseline	**Total change 1962-2009**
Baseline		1.08
Sample effect	5%	1.14
Composition effect	6%	1.15
FTA effect	-52%	0.52
Composition + sample	5%	1.14
Composition + FTA	-29%	0.77
Sample + FTA	-59%	0.44
Sample + Composition + FTA	-55%	0.49

Ingredients of the puzzle

- The distance coefficient is the elasticity of trade to distance
  - Trivial: the whole point of log-linear equations
  - Still the case in the Poisson specification
- It is a product of two coefficients:
  - Elasticity of trade flows to trade costs
  - Elasticity of trade costs to distance
- The 'death of distance' intuition is really about the elasticity of trade costs to distance
- Which should be going down
- But it does not tell much on the elasticity of trade to trade costs...

Short incursion in microfoundations (1)

- The gravity equation can be justified by three families of theories:

- Ricardian framework
  Homogeneous goods
  Shop around the world for lowest cost supplier
  (intersectoral productivity heterogeneity)

- Heterogeneous firms framework:
  Trade because all firms produce different varieties
  A subset of firms enters export markets (intrasectoral productivity heterogeneity)

- Armington framework
  Trade because consumers value variety
  Country-specific goods (heterogeneity: degree of substitutability between bundles)

Short incursion in microfoundations (2)

- Ricardian framework:
  - Distance coefficient: $\rho\theta$
  - θ captures intersectoral productivity dispersion
  - if sectors have similar productivity
    $\rightarrow$ small differences in variable costs have a large effect on trade flows
    $\rightarrow$ high elasticity of trade to trade costs

- Monopolistic competition between heterogeneous firms:
  - Distance coefficient: $\rho\gamma$
  - γ captures productivity dispersion across firms (parameter of Pareto)
  - if distribution decays swiftly, higher probability that productivity cut-off for exporting is close to the mass of firms
    $\rightarrow$ small differences in variable costs have large effect on entry
    $\rightarrow$ high elasticity of trade to trade costs

Short incursion in microfoundations (3)

- Armington framework
  - Distance coefficent: $\rho(\sigma - 1)$
  - σ captures degree of similarity between country-specific product bundles
  - if the set of goods produced by different countries is similar
    $\rightarrow$ high Armington elasticity
    $\rightarrow$ high elasticity of trade to trade costs

- In all cases: elasticity of trade flows to trade costs is inversely related to heterogeneity

Measuring the trade elasticity

- Features of our data: information on bilateral trade flows and unit values
- To measure efficiency heterogeneity: need information on domestic prices
  - intuition: country-specific cut-off for entry common to all exporters
  - price distribution in destination across all sources needed to estimate shape parameter of productivity distribution
- However we can measure substitutability across frameworks
  - use variation of market shares of country-level composite goods across export markets
  - construct relative prices of product bundles
  - estimate the aggregate Armington elasticity in cross section
- The estimated parameter is the trade elasticity in the Armington framework

Relative prices of product bundles

- Consistent aggregation procedure to get relative prices
  - CES preferences at inter- and intrasectoral level
  - Intra- and intersectoral elasticities assumed equal
  - Write sector-specific demand equation
  - Sum across all sectors
- Gives market share equation for aggregate bilateral trade as a function of the weighted average of sectoral relative prices of exporter in destination

$$\ln\left[\frac{X_{ij}}{Y_j}\right] \approx -(\sigma-1)\ln\left[\sum_{k=1}^{K}\omega_j(k)\frac{P_{ij}(k)}{P_j(k)}\right]$$

- Exponentiating gives equation estimated in Poisson:

$$X_{ij}/Y_j = \exp\left[\lambda_0 - (\sigma-1)\ln\left(\sum_k \omega_k \frac{P_{ij}(k)}{P_j(k)}\right) + fe_{exp} + fe_{imp}\right]\eta_{ij}$$

Dealing with missing unit values

- Trade flow observed, but information on quantities missing
- On average, this is the case for 14% of total trade
- Use stepwise price imputation procedure
  - construct relative prices at highest disaggregation level
  - construct next level relative price as weighted average of observed relative prices
  - destination-specific weights at each step
  - repeat at each aggregation level
- assumption: missing unit values can be best approximated by observed prices for similar goods

Dealing with zero trade flows

- Under model assumptions some trade would be observed in every sector between each pair
- Zero trade flows prevalent: from 86-90% of possible observations at 4-digit level
- Assumption: statistical, not structural zeros linked to data collection thresholds
- Same stepwise procedure used for price imputation
- Corresponds to assumption that unobserved relative price equal to observed
- Problem: unobserved prices much higher than imputed prices

Proportion of zero trade flows as a function of market share

Share of ZTF		
ms	-0.0427***	-0.2573***
	(0.0001)	(0.013)
year	-0.0033***	-0.0024***
	(0.0000)	(0.000)
$ms * year$		0.0001***
		(0.000)
constant	6.0976***	4.2515***
	(0.0366)	(0.134)
Observations	657001	657001

Overestimation bias

- Underestimation factor not constant across exporters
  - share of ztf decreasing in market share
  - reduction in share of ztf proceeds at quicker pace for small exporters
- Relative price underestimated by more for small exporters
- For given distribution of market shares, true underlying distribution of prices is greater than observed distribution
- Estimated parameter overestimates the true substitutability parameter
- But less so overtime
- If estimated elasticity increases, this is a lower bound on true parameter evolution

Results

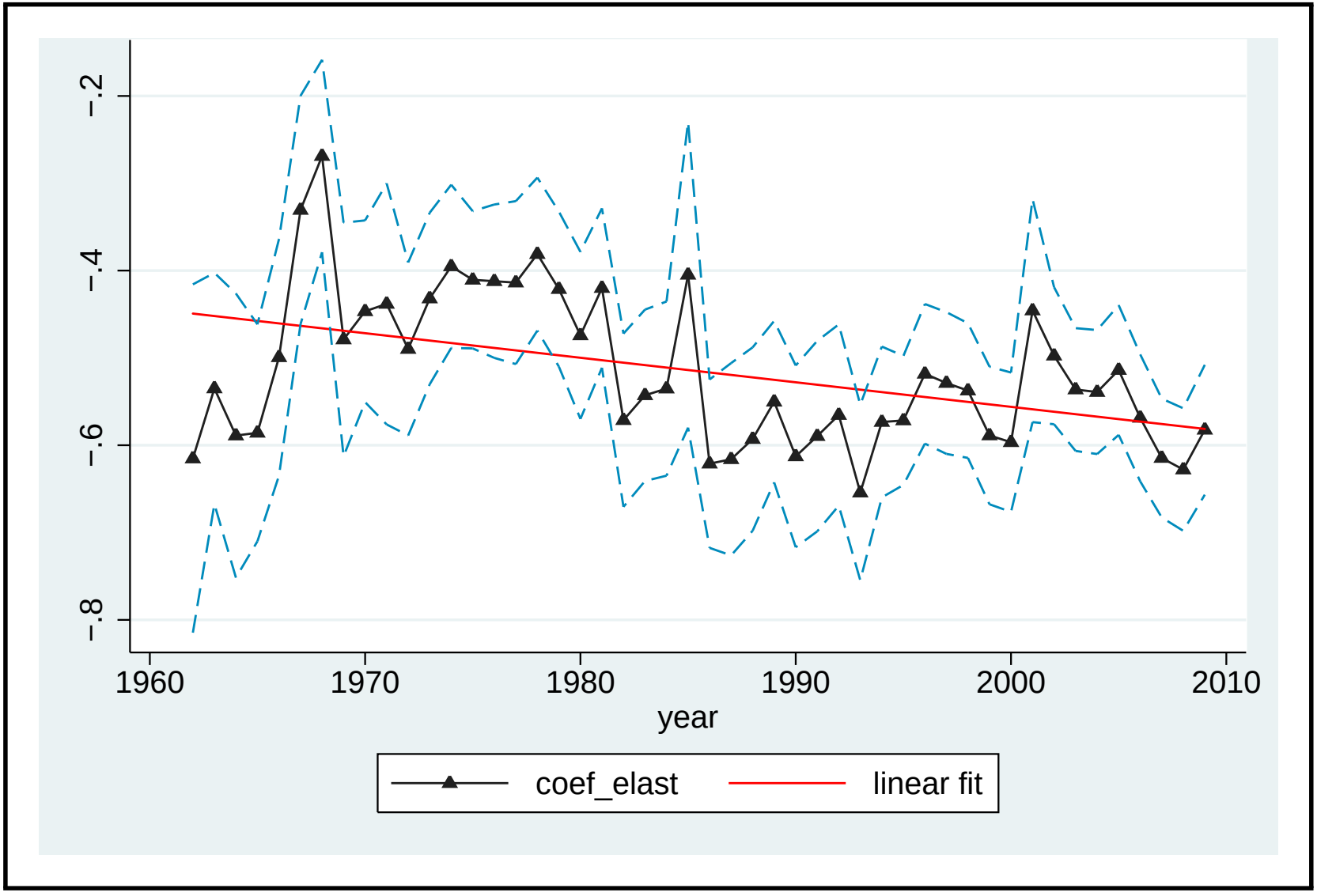


Figure: Estimated $(1 - \widetilde{\sigma})$

Changing the dataset: BACI

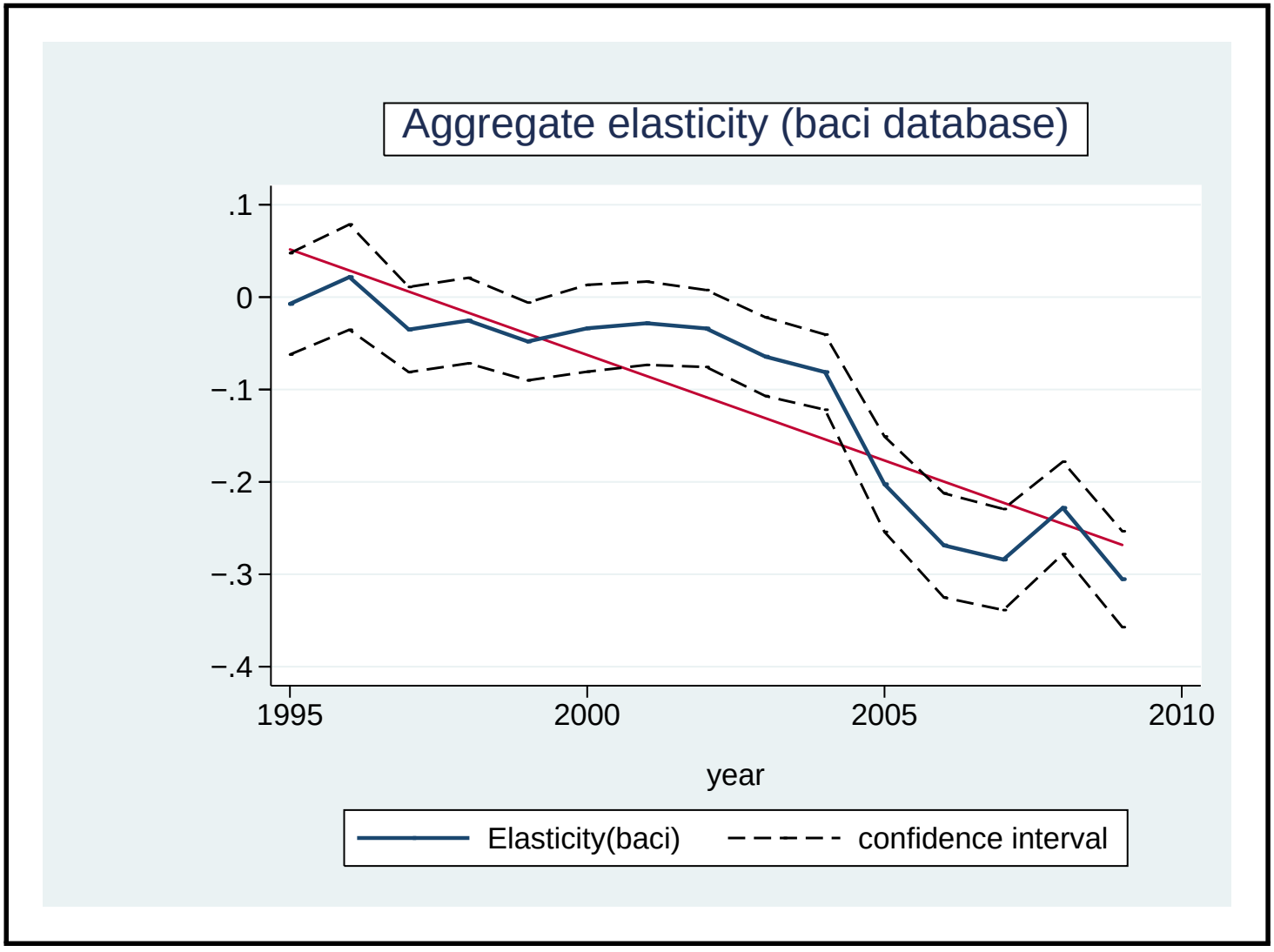


Figure: Estimated $(1 - \widetilde{\sigma})$, BACI database

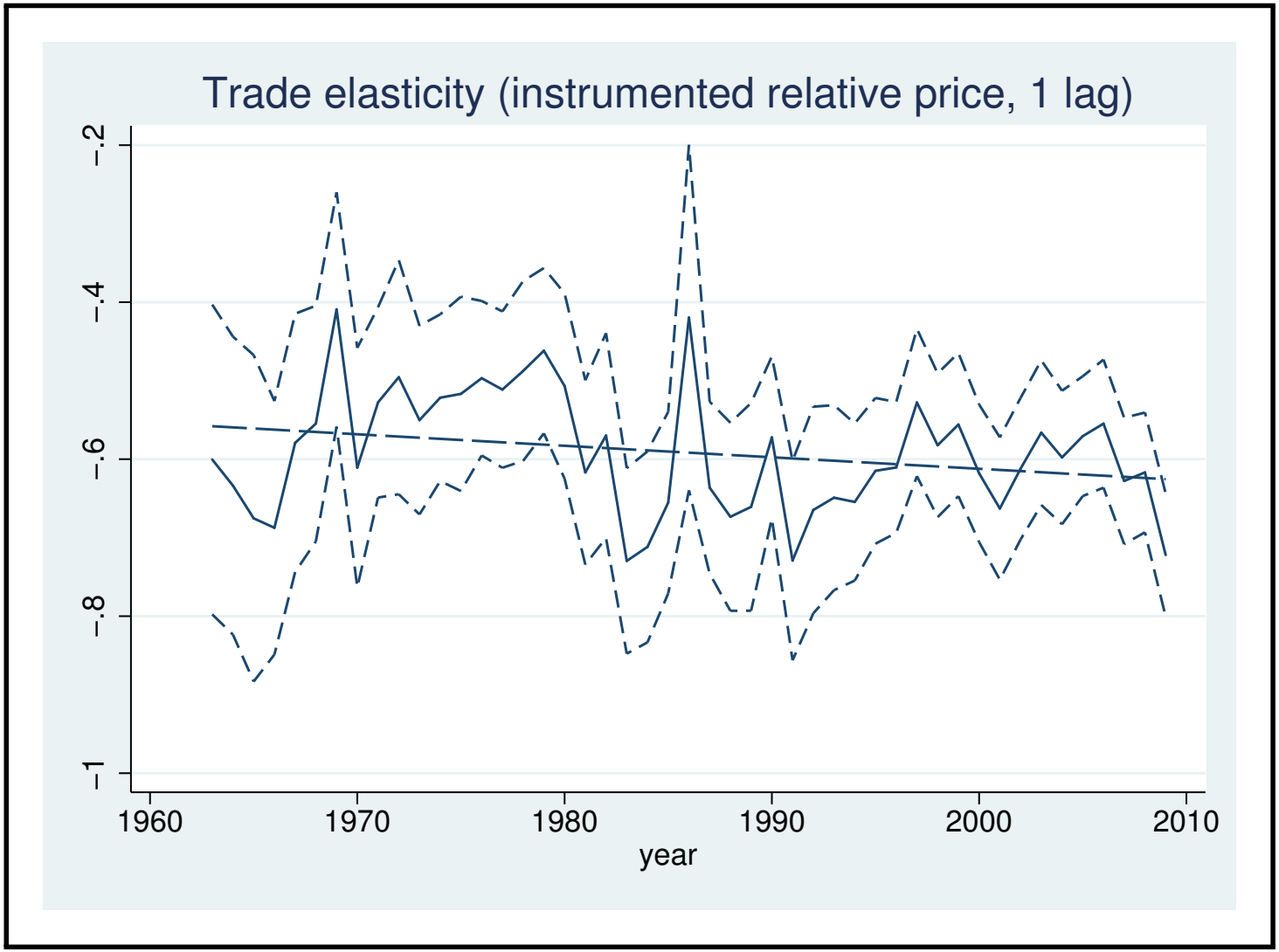
Instrumenting: motivation

- Results subject to caution?
  - attenuation bias (if supply schedules not horizontal)
  - matters not only for level, but for evolution (Feenstra(1994))
- Objective: capture exporter-specific shocks to the price of the composite good which are not demand-driven
- Indicator: GDP price level (Penn World Tables: 189 countries, 1950-2009)

Instrumenting: procedure

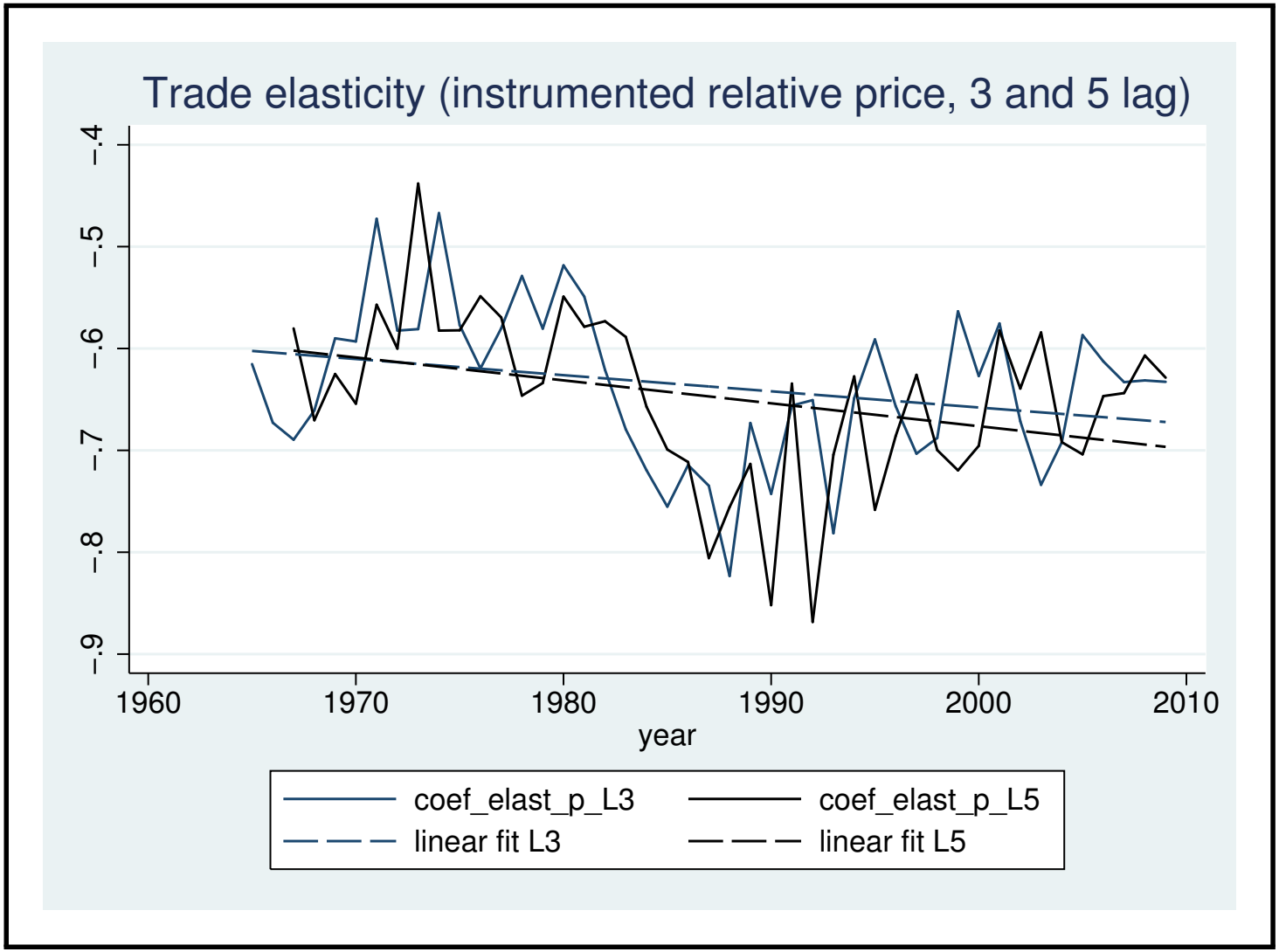
- compute evolution of relative prices for exporter-specific composite goods
- compute evolution of GDP price levels of trading partners, weighted by market shares (common currency)
- compute hypothetical relative price in t for each exporter as:
  - product of its relative price in $(t - s)$
  - evolution of its GDP price level between t and $(t - s)$ relatively to all other partners
- predict relative price of each exporter in t: regress observed relative price on hypothetical relative price.
- Idea: get an instrumented relative price which depends on past relative price and relative evolution of GDP price level.
- Estimate market share equation using instrumented relative prices

Instrumenting: one lag



- reassuring: level of parameter increases by 9%
- results on evolution hold: 13% increase

Increasing the number of lags



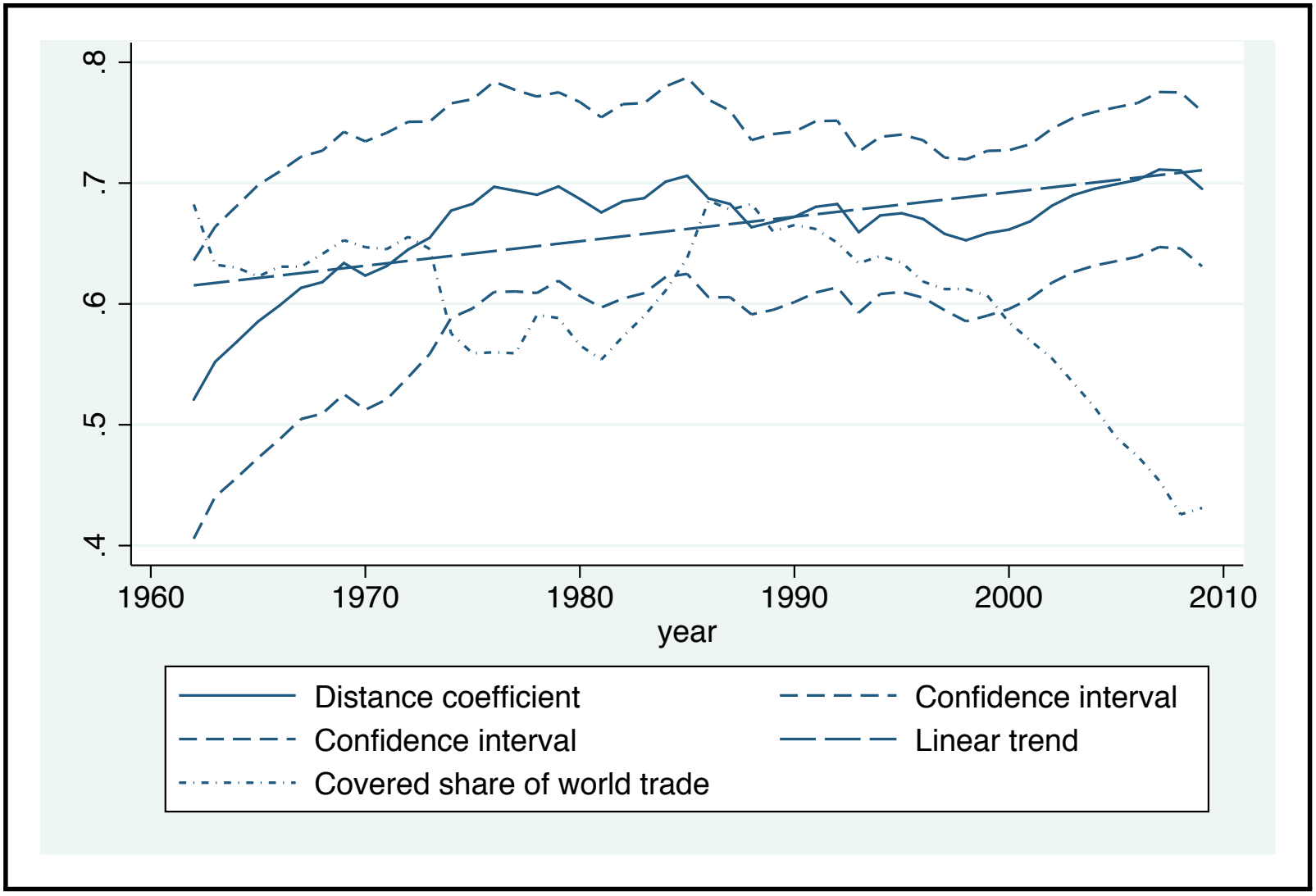
- level increases with number of lags: 20% for 5 lags
- results on evolution hold: 18% increase in 1967-2009

Is there a distance puzzle left?

- empirical evidence on 13-29% increase in substitutability parameter
- this is aggregate trade elasticity in Armington framework
- combining with 8% increase in distance elasticity
- provides a direct explanation of the distance puzzle
- economic interpretation of increased perceived substitutability of product bundles?
  - increasing similarity in set of traded goods across countries
  - composition effects (changes in range or shares of traded goods)
- Not done: separate out net effect of increased perceived similarity
- Not feasible? parameter estimated on aggregate data is not a weighted average of sectoral parameters

Composition

Sample


.4
.5
.6
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1960
1970
1980
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year
Distance coefficient
Confidence interval
Confidence interval
Linear trend
Covered share of world trade