Introduction

ECON 245
Winter 2024

International Trade

- globalization in the 20th/early 21st century = rising mobility of goods, services, and people across space
- accompanied by:
  - rising inequalities, both between and within countries
  - rising living standards
  - emergence of global superstar firms, rising market concentration
  - political polarization
  - rapid technological change
- recently, geopolitical tensions led to renewed calls for de-globalization

Why trade and spatial are interesting?

- international trade has a long intellectual history (Smith, Ricardo) and is a hot policy topic today (Brexit, Trump,...)
- healthy balance of theory and empirics in which each informs the other
- Highly interdisciplinary field that brings together tools from IO, macro, applied, labor, ...
- trade has insights relevant for topics ranging from intracity commuting to national TFP growth
- spatial has long been a small field, but is recently growing

Interplay of theory and empirics

- descriptive facts motivate theoretical work
  - observed intra-industry trade motivated “new trade theory” (e.g., Krugman 80)
  - observed firm-level heterogeneity motivated “new new trade theory” (e.g., Melitz 03)
- empirical evidence comes from a wide range of methods
  - descriptive statistics
  - estimated/calibrated quantitative models
  - sufficient statistics approaches
  - quasi-natural experiments (rare, but see Japanese autarky, the Suez Canal, etc)
- testing is tricky

International trade theory

- a dominant view is that international trade is an applied branch of general-equilibrium theory
- any GE model has preferences + technology + equilibrium
- international trade theory focuses on locations, such that preferences (rarely) and technology (typically) are location-specific
- trade theory traditionally has “international” goods markets and “domestic” factor markets
- consumer preferences are over goods; factors are employed to produce goods
- questions: how does international integration affect the goods market, the factor market, and welfare?
- one flavor of spatial economics is trade in goods plus mobile factors

Brief History: International Trade Theory

- 1830 - 1990: Neoclassical Trade Theory
  - Ricardo, Heckscher Ohlin Samuelson
  - perfect competition, constant returns to scale, no distortions
- 1980 - 2000: New Trade Theory
  - Krugman Helpmann, Grossman Helpman
  - monopolistic competition, increasing returns to scale
- 2000 - today: Quantitative New Trade Theory
  - Eaton Kortum, Melitz, Arkolakis Costinot Rodriguez-Clare; Muendler's, Eckert's and my work

Brief History: International Trade Empirics

- 1830 - 1990: Not much
- 1990 - 2000: Empirical Tests of Heckscher-Ohlin and Ricardo + Gravity
  - Leamer, Trefler, Davis Weinstein, Anderson van Wincoop
- 2000 - 2015: Firms
  - Bernard Jensen, Tybout, Eaton Kortum Kramarz
- 2010 - today: Distributional consequences of trade liberalization, services trade, local labor markets, market power
  - Autor Dorn-Hanson, Helpman Itskhoki Muendler Redding, Burstein Vogel, Muendler, Eckert's and my work

Our starting point

- the empirics and theory of gravity
  - brings “old theories” of trade to the modern era
- theories permit models with hierarchical market structures
  - global output markets + regional factor markets
  - trade flows and migration between regions determine factor prices (+allocations), often through “gravity” type equilibrium conditions
  - example: cModel underlying work of the new Global Prosperity Lab at UCSD founded by Muendler & Trottner
- theory of gravity encompasses many “canonical” frameworks in trade

Gravity

Empirics of gravity

- neoclassical theories of trade (Ricardo, Heckscher-Ohlin) are hard to generalize to settings with many countries and arbitrary trade costs
  - hard to bring to the data and do empirical work
  - will encounter these theories throughout the class
- empirical trade economists started using an a-theoretical model known as the “gravity equation” (due to similarity to Newton’s law of gravitation)
- huge literature on estimating gravity equations in trade, but also migration, commuting, financial flows, social connections
- most modern models in trade and spatial deliver “gravity equations”

Gravity fits the cross section well

- naive gravity, akin to physic's force $\propto$ mass$_i$ $\times$ mass$_j$/distance$_{ij}^2$ does very well with GDP as mass

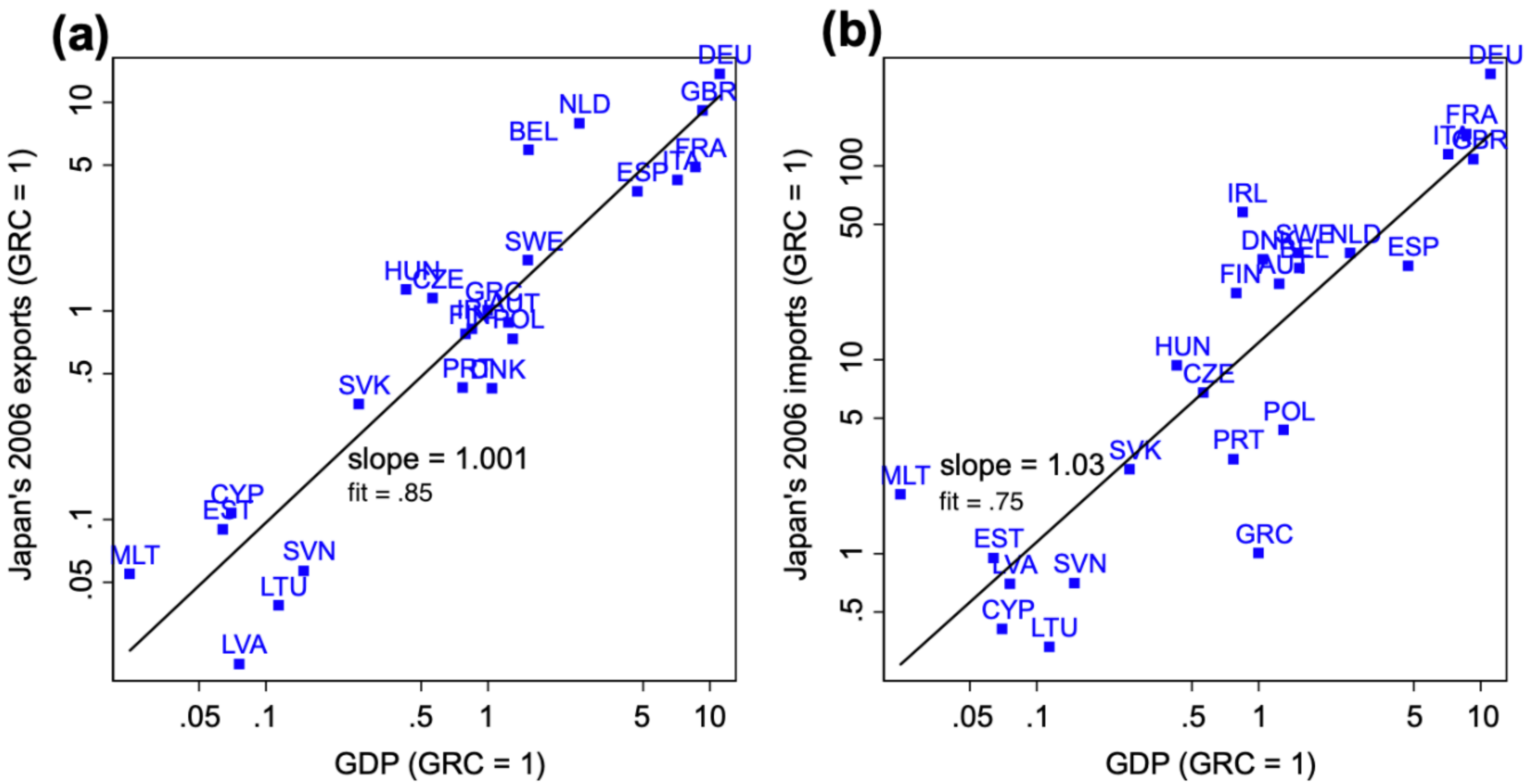
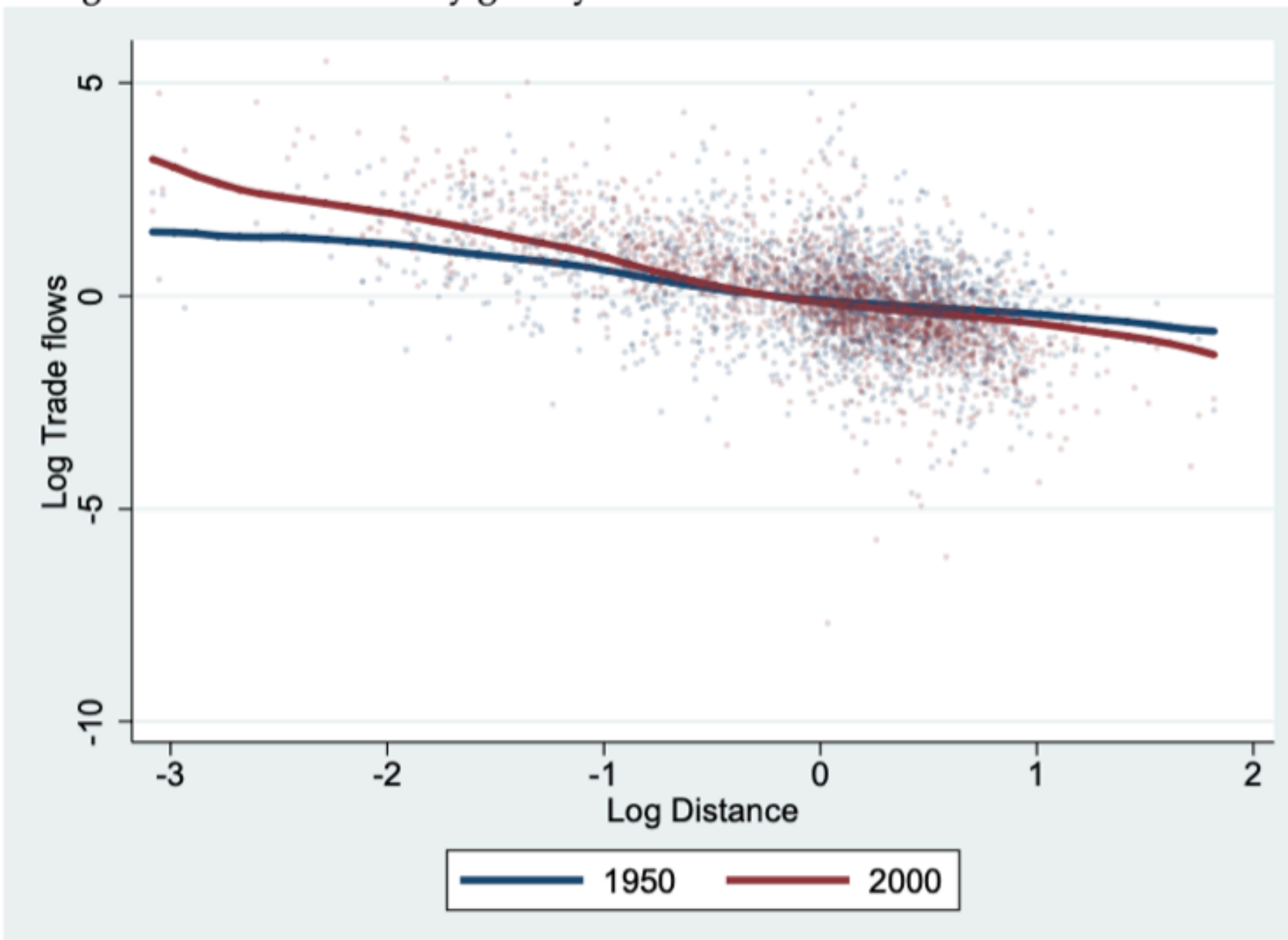


Figure 3.1 Trade is Proportional to Size; (a) Japan's Exports to EU, 2006; (b) Japan's Imports from EU, 2006. GRC: Greece

A broad notion of distance does well

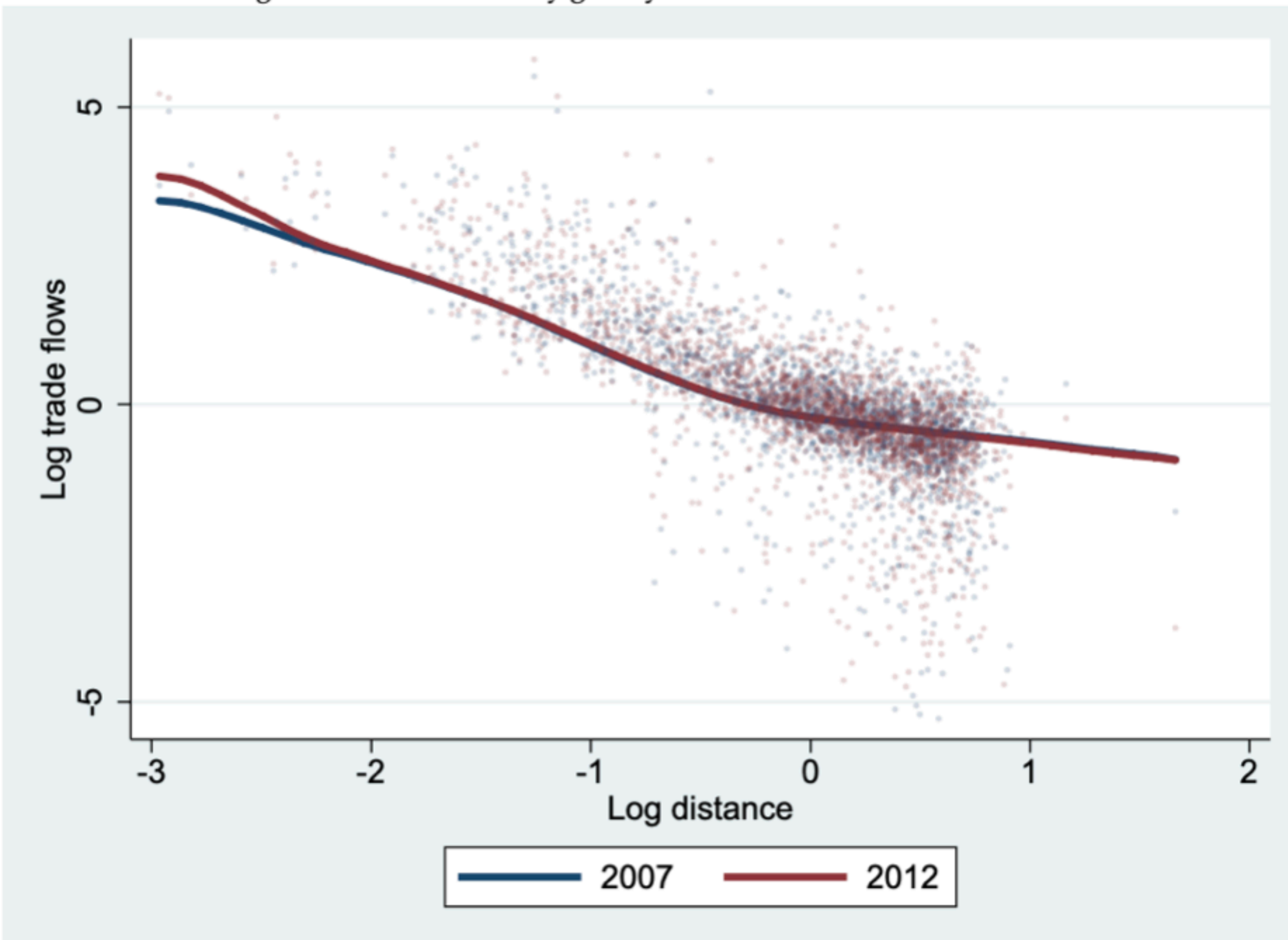
Figure 3.1: Across country gravity: Trade flows between countries over time



Notes: Data are from Head, Mayer, and Ries (2010). Only bilateral pairs with observed trade flows in both 1950 and 2000 are included. The thick lines are from a nonparametric regression with Epanechnikov kernel and bandwidth of 0.5 after partitioning out the origin-year and destination-year fixed effects.

Gravity: Within-Country trade flows

Figure 3.3: Within country gravity: Trade flows between U.S. states



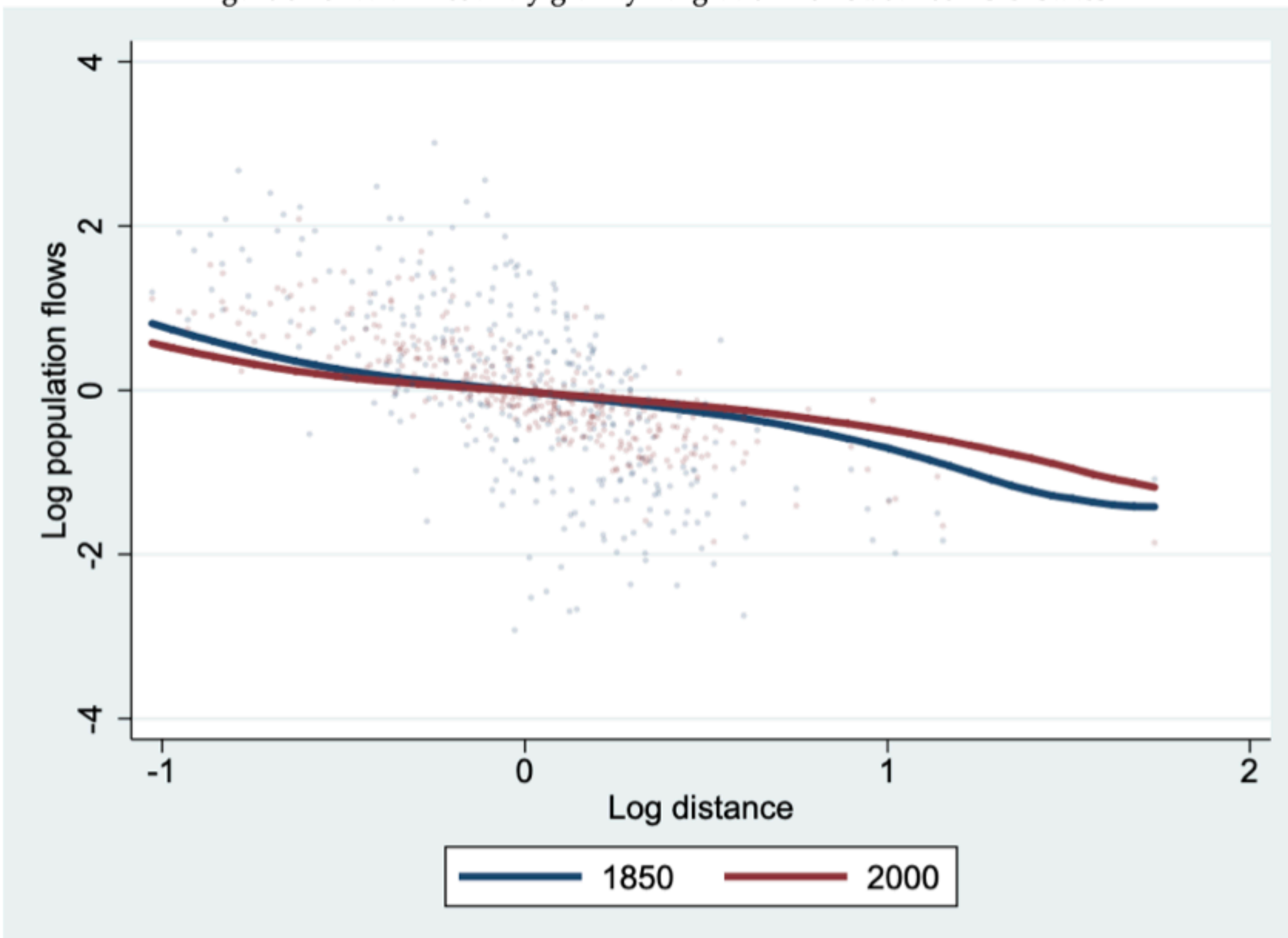
Gravity: Between-country migration flows

Figure 3.8: Across country gravity: Migration flows between countries over time

Notes: Data are from Yeats (1998). Excludes own country population shares (i.e. non-migrants). The thick lines are from a nonparametric regression with Epanechnikov kernel and bandwidth of 0.5 after partitioning out the origin-year and destination-year fixed effects.

Gravity: Within-country migration flows

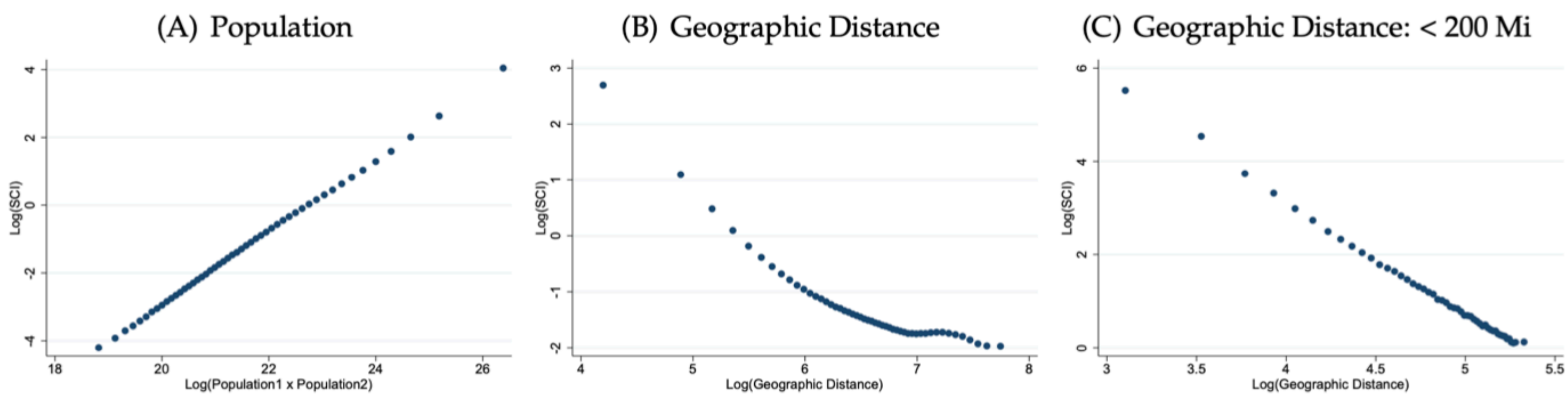
Figure 3.10: Within country gravity: Migration flows between U.S. states



Notes: Data are from the 1850 and 2000 U.S. Censuses Ruggles, Fitch, Kelly Hall, and Sobek (2000), where migration flows are comparing current state of residence of 25-34 year olds to their state of birth. The thick lines are from a nonparametric regression with Epanechnikov kernel and bandwidth of 0.5 after partitioning out the origin-year and destination-year fixed effects.

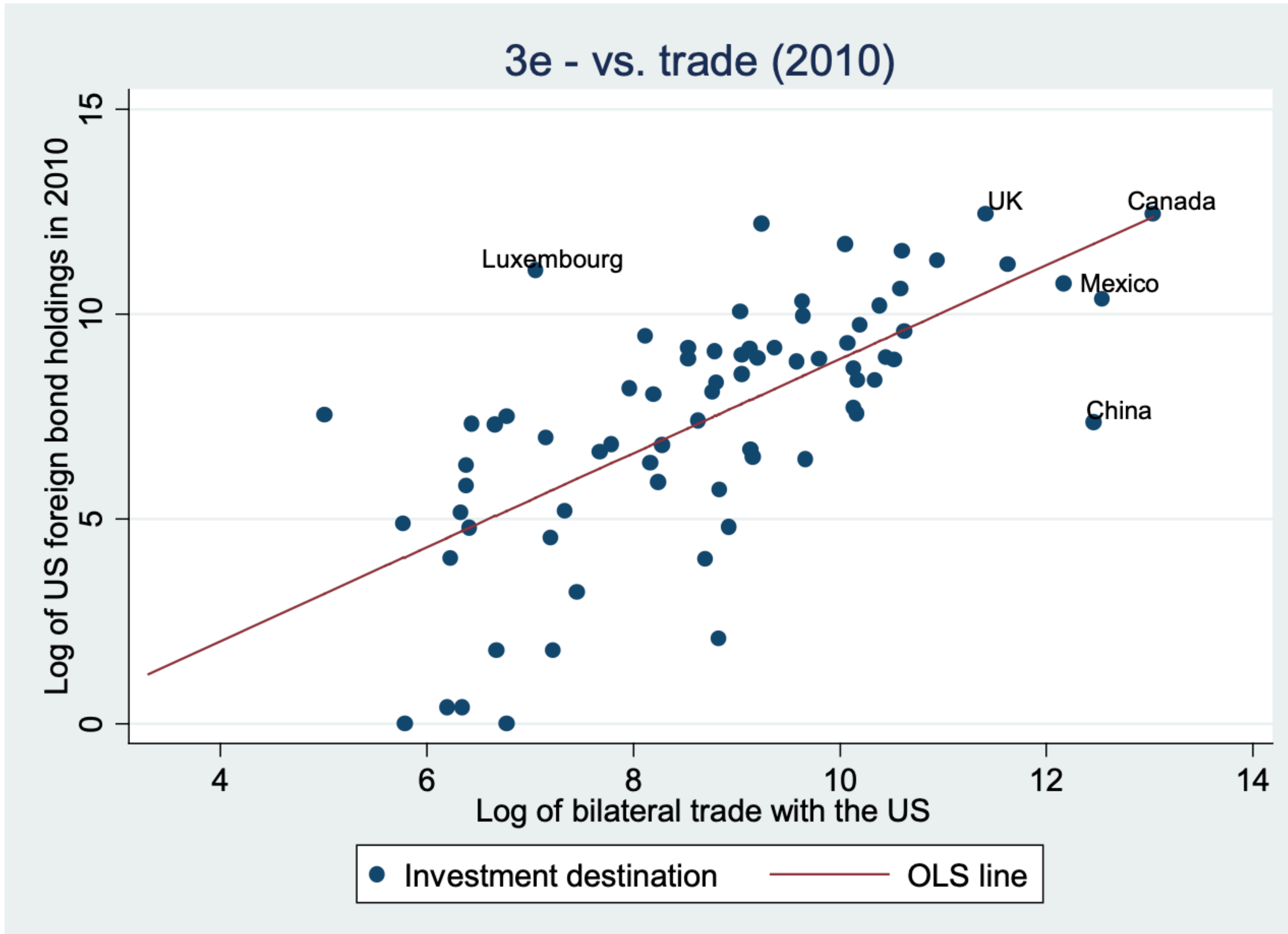
Gravity: Social Connectedness

Figure 3: County-Level Social Connectedness



Note: Figure shows binned scatter plots with county-pairs as the unit of observation. In Panel A, the log of the product of the county populations is on the horizontal axis, and the log of the SCI is on the vertical axis. Panel B shows a conditional binned scatter plot, where we flexibly condition on the log of the product of the populations in the two counties; on the horizontal axis is the log of the distance between the two counties, measured in miles, and on the vertical axis is the log of the SCI. Panel C shows a subset of Panel B focused on county-pairs that are less than 200 miles apart.

Gravity: Financial flows



Gravity equation

- naive + general gravity

$$X_{ij} = \alpha \times \frac{Y_i \times Y_j}{D_{ij}} = K_{ij} \times \gamma_i \times \delta_j$$

- D_{ij} is the physical distance between two countries i and j
- Y_i is the GDP of country i
- the latter (the "generalized" gravity equation) is in terms of a general bilateral resistance term K_{ij}, origin and destination fixed effects
- empirically successful; yet, for a long time a-theoretical: No ability to do counterfactuals!

Theory of Gravity

General Setup

- S is a discrete set of countries (locations), i for origin, j for destination
- X_j is the total spending of country j
- L_j is the total population of country j
- Each consumer inelastically supplies one unit of labor
- Labor is the only factor of production
- "Iceberg trade costs" $\tau_{ij} \geq 1$: Need to ship τ_{ij} units for 1 unit of a good to arrive
- for now, focus on one industry

CES demand system

- constant elasticity of substitution demand system
- bread and butter in trade, spatial, macro: Simple yet versatile
  - homothetic (no need to worry about aggregation)
  - nests Cobb-Douglas
  - highly tractable
  - natural micro foundation through random discrete choice
- “Unrealistic”, but tractability makes its reign supreme
  - Will cover extensions throughout the class

CES Demand

- representative consumer in country j derives utility U_j from the consumption from a set of varieties Ω_{ij} shipped from country $i \in S$ to s

$$U_j = \left(\sum_{i \in S} \int_{\omega \in \Omega_{ij}} a_{ij}(\omega)^{1/\sigma} q_{ij}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

- $\sigma \geq 1$ is the (constant) elasticity of substitution
- $a_{ij}(\omega)$ is an exogenous demand shifter
- $q_{ij}(\omega)$ is the quantity of a good shipped from i to j that is consumed in j

CES Demand

- consumer maximizes utility subject to budget constraint

$$\max_{q_{ij}(\omega)} \left(\sum_{i \in S} \int_{\Omega_{ij}} a_{ij}(\omega)^{1/\sigma} q_{ij}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \text{ s.t. } \sum_{i \in S} \int_{\Omega_{ij}} q_{ij}(\omega) p_{ij}(\omega) d\omega \leq X_j$$

- solving this problem, we attain the CES demand system:

$$q_{ij}(\omega) = a_{ij}(\omega) p_{ij}(\omega)^{-\sigma} X_j P_j^{\sigma-1}$$

$$(P_j)^{1-\sigma} = \sum_{i \in S} \int_{\Omega_{ij}} a_{ij}^{1/\sigma}(\omega) p_{ij}(\omega)^{1-\sigma} d\omega$$

- P_j = CES price index
- derivation: left to problem set

CES Demand

- demand

$$q_{ij}(\omega) = a_{ij}(\omega)p_{ij}(\omega)^{-\sigma}X_jP_j^{\sigma-1}$$

- the value of total trade between i and j for variety ω then equals:

$$X_{ij}(\omega) = p_{ij}(\omega)q_{ij}(\omega) = a_{ij}(\omega)p_{ij}(\omega)^{1-\sigma}X_jP_j^{\sigma-1}$$

- integrate over all varieties produced in i to obtain total trade volume:

$$X_{ij} = \int_{\Omega_{ij}} X_{ij}(\omega)d\omega = X_jP_j^{\sigma-1}\int_{\Omega_{ij}} a_{ij}(\omega)p_{ij}(\omega)^{1-\sigma}d\omega$$

- to solve for prices, we need to specify the market structure

Market Structure

- we will cover four canonical models in trade and spatial
- Armington: Perfect competition with homogeneous firms [Armington 69, Anderson 79, Anderson and van Wincoop 03]
- Eaton-Kortum 02: Perfect competition with heterogeneous firms
- Krugman: Monopolistic competition with homogeneous firms [Krugman 78,80,81]
- Melitz 03: Monopolistic competition with heterogeneous firms

Armington

Armington 69 and Anderson 79

- premise: each country produces a representative final good under perfect competition
- equivalent to assuming that varieties are not differentiated within countries and produced by homogeneous firms under constant returns to scale and perfect competition
- reason for trade: countries' final goods are imperfectly substitutable
- ad-hoc, but important milestone since it delivered the first theoretical justification for the gravity equation
- counterfactual predictions of the model are very robust to changes in the market microstructure (see Arkolakis, Costinot, Rodriguez Clare 12)

Armington: Setup

- index a country and its representative variety by i
- goods are produced with linear technologies using labor as the only input and productivity shifters A_i
- perfect competition implies: price of good = marginal cost
- wage is w_i, so "factory-gate" price equals: $p_i = w_i / A_i$
- international trade is subject to iceberg costs, τ_{ij}
    - iceberg: consumers in j have to purchase τ_{ij} units from i to consume one unit.
    - easy to incorporate ad-valorem tariff
- price of variety i in country j is then: $p_{ij} = \tau_{ij} \times w_i / A_i$

Armington Gravity

- Substitute prices $p_{ij}(\omega) = p_{ij} = \tau_{ij} p_i$ into the CES demand equation

$$X_{ij} = a_{ij} \tau_{ij}^{1-\sigma} (\frac{w_i}{A_i})^{1-\sigma} X_j P_j^{\sigma-1}$$

- If $\sigma > 1$, trade flows decline with trade costs τ_{ij}
- Total income in country i is given by

$$Y_i = w_i L_i = \sum_j X_{ij} \Leftrightarrow (\frac{w_i}{A_i})^{1-\sigma} = \frac{Y_i}{\sum_j a_{ij} \tau_{ij}^{1-\sigma} X_j P_j^{1-\sigma}} \equiv \frac{Y_i}{\Theta_i}$$

Armington Gravity

$$X_{ij} = a_{ij}\tau_{ij}^{1-\sigma}(\frac{w_i}{A_i})^{1-\sigma}X_jP_j^{\sigma-1}$$

$$Y_i = w_iL_i = \sum_j X_{ij} \Leftrightarrow (\frac{w_i}{A_i})^{1-\sigma} = \frac{Y_i}{\sum_j a_{ij}\tau_{ij}^{1-\sigma}X_jP_j^{1-\sigma}} \equiv \frac{Y_i}{\Theta_i}$$

- Combining these results:

$$X_{ij} = a_{ij}\tau_{ij}^{1-\sigma}\left(\frac{Y_i}{\Theta_i}\right)\left(\frac{X_j}{P_j^{1-\sigma}}\right)$$

- Gravity! Bilateral trade flows become a function of the GDP of both countries
- But: A-theoretical gravity equation missed GE effects
  - Relative flows depend on the access that j has to other sellers (P_j) and that i has to other buyers (Θ_i)

Closing the model

- Denote $\lambda_{ij} = X_{ij}/X_j$ and note that w/o intermediates $Y_i = X_i$.
- goods market clearing

$$Y_i = w_i L_i = X_i = \sum_j X_{ij}$$

- can be written as a labor market clearing condition

$$w_i L_i = \sum_j \lambda_{ij} w_j L_j = \sum_j \frac{a_{ij}(\frac{w_i}{A_i})^{1-\sigma}}{\sum_{i'} a_{i'j}(\frac{w_{i'}}{A_{i'}})^{1-\sigma}} w_j L_j$$

- immobile labor (no migration): Solve for general equilibrium using S goods market clearing equations to solve for S wages w_i
- mobile labor: Need another set of equations to pin down L_i in each S, i.e. a migration “module”

Look Ahead

- estimation of gravity models
  - Two-way fixed effect models
  - estimates of the trade elasticity
- introduce richer market structures
  - Eaton-Kortum: Heterogeneous firms, trade due to comparative advantage, i.e., Ricardian forces
  - Krugman: Increasing returns with homogeneous firms, trade due to love-for-variety, introduces market size effects
  - Melitz: Increasing returns and heterogeneous firms, brings heterogeneous firm macro into trade