Growing Apart: Tradable Services and the Fragmentation of the U.S. Economy

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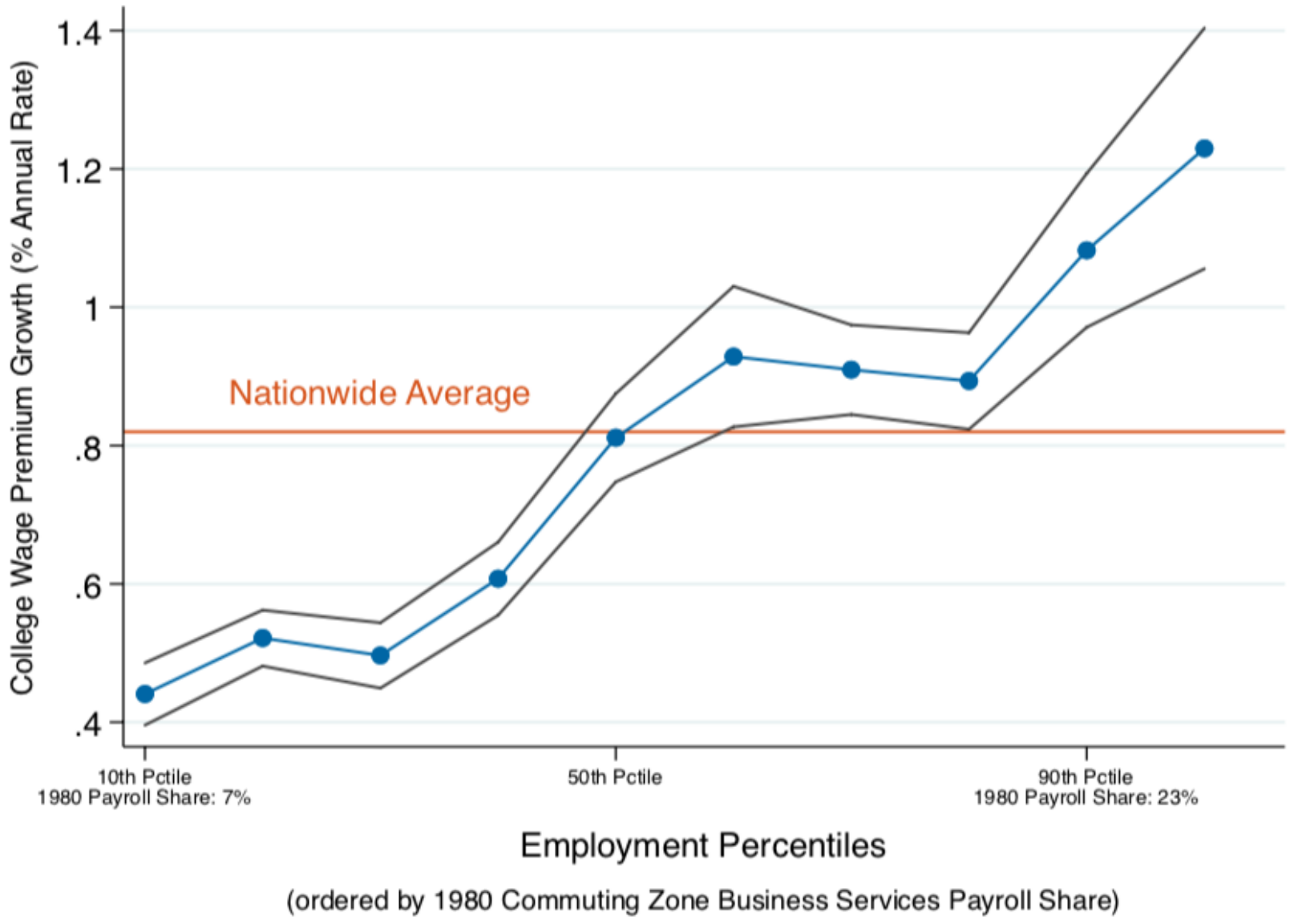
Motivation

- U.S. labor market has experienced a sustained increase in the return to skill.
- The rise in the college premium hasn't been homogeneous across regions, growing faster in larger metropolitan areas.
  - Interaction between SBTC and Agglomerations forces, SBTC biased towards high-skill workers
- Technological progress has increased labor markets' interconnectedness, in particular a fall in trade frictions for high-skill, information-intensive services (*communication costs*).

Business Services and College wage premium growth



Basic Idea

- Regions with a comparative advantage in BS benefited more from a fall in communication costs.
  - Export services to other regions in the US.
  - High-skill workers benefited more from this process of specialization.
- Construct a quantitative model of interregional trade and evaluate how changes in communication costs can explain the relation between specialization in BS and college wage premium growth.

Outline

1. Relevant facts about the Business Service Sector
2. Simplified version of the Model
3. Quantitative Model of Interregional Trade
4. Calibration of the Model
5. Counterfactual Exercise

Business Services

- BS are the 2-digits NAICS indsutries 51, 52, 53, 54, 55 and 56 (e.g. Professional and Business Services, Information).
- **Fact:** Business Services payroll shares differ widely across local labor markets

	p90/p10			p90/p50		
Year	Goods Sectors	Business Services	Local Services	Goods Sectors	Business Services	Local Services
1980	1.41	1.90	1.45	1.17	1.50	1.19
1990	1.45	1.94	1.40	1.17	1.51	1.19
2000	1.46	2.20	1.38	1.17	1.64	1.19
2010	1.51	2.27	1.31	1.18	1.67	1.16

Figure: Concentration Measures of Sectoral Production

Business Services (II)

- **Fact:** Business Services are more skill-intensive than the goods sector

	1980	1990	2000	2010
Goods	.12	.16	.19	.22
Business Services	.32	.41	.49	.56

Figure: College Share of Employment

Business Services (III)

- **Fact:** Business Services wage growth outpaced all other sectors

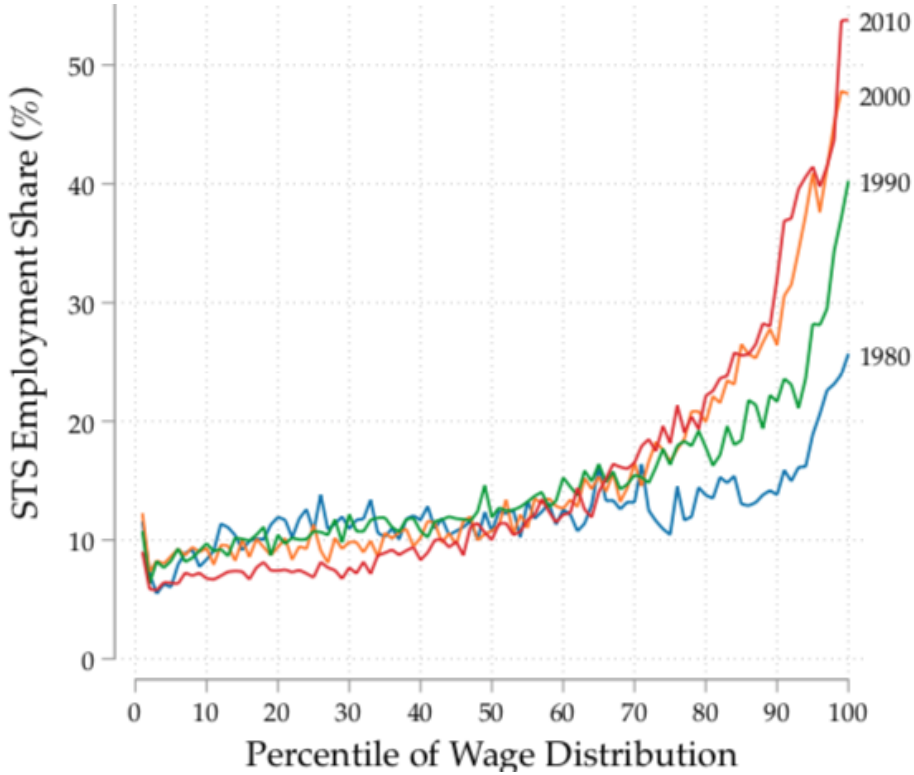


Figure: BS Employment shares

Business Services (III)

- **Fact:** Goods sector is an importnt destination for BS,

	Percentage of Output used as			
	Intermediate Inputs			Final Use
Sector	Goods Sectors	Business Services	Local Services	
Goods Sectors	48	1	8	43
Business Services	39	18	11	32
Local Services	9	3	6	82

Figure: College Share of Employment

Simple Model of Service Integration and Skill Premium Growth

- 2 regions (r), 2 sectors (s) and 2 skill groups (k).
- Producers: Region $r = 1$ has a comparative advantage in business services (b)

$$Y_1^b = AL_{1h}^b \quad Y_1^g = (L_{1l}^g)^\gamma \left(Q_1^{gb}\right)^{1-\gamma} \qquad Y_2^b = L_{2h}^b \quad Y_2^g = (L_{2l}^g)^\gamma \left(Q_2^{gb}\right)^{1-\gamma}$$

- Consumers: only demand goods and supply inelastically one unit of labor at a wage rate w_r^s.
- Simplifying assumptions: ratio of high- to low-skill workers is equal across regions (μ), no migration, goods trade is free and service trade is costly (i.e. iceberg cost).
- Contrast the autarky equilibrium with trade equilibrium

Simple Model - Autarky Equilibrium (II)

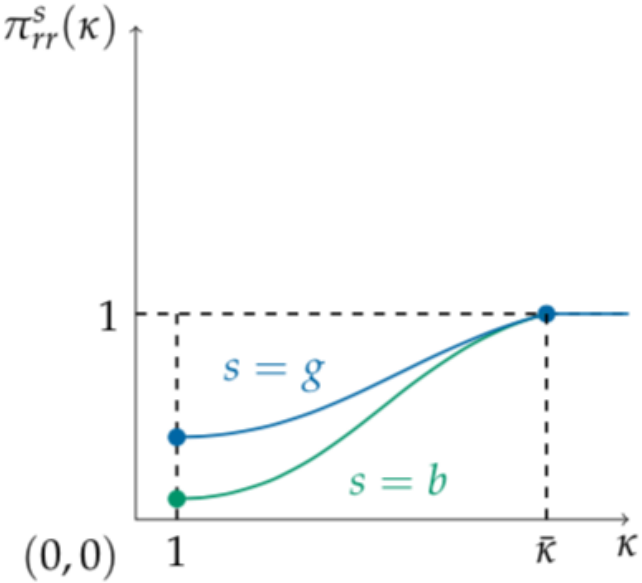
- No trade takes place.
- Use market clearing conditions and factor payments to obtain wage premium

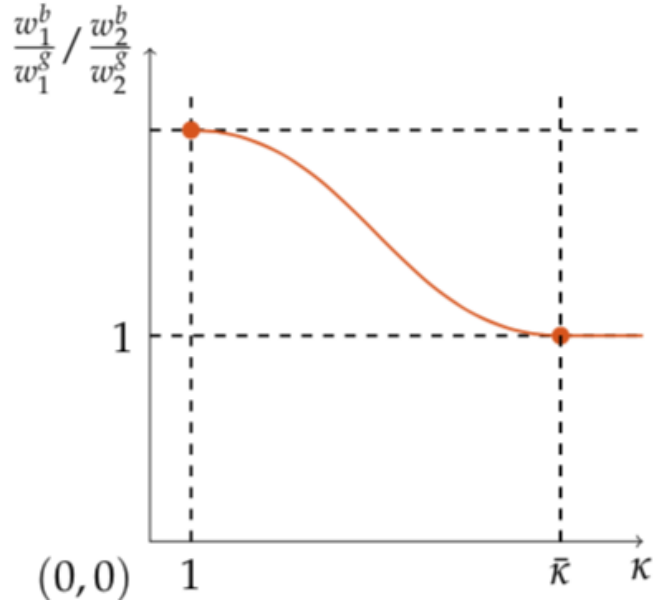
$$\frac{w_1^b}{w_1^g} = \frac{\mu^{-\gamma} A^{1-\gamma} \left(\frac{1-\gamma}{\gamma}\right)^{\gamma}}{\mu^{1-\gamma} A^{1-\gamma} \left(\frac{\gamma}{1-\gamma}\right)^{1-\gamma}} = \left(\frac{1-\gamma}{\gamma}\right) \mu^{-1} \quad \frac{w_2^b}{w_2^g} = \frac{\mu^{-\gamma} \left(\frac{1-\gamma}{\gamma}\right)^{\gamma}}{\mu^{1-\gamma} \left(\frac{\gamma}{1-\gamma}\right)^{1-\gamma}}$$

- High-skill workers depend on the local demand for goods. Goods sector needs low skill workers.
  Mutual dependence, whereby productive advantages are shared within a location.

Simple Model - Trade Equilibrium (II)

- Region 1 has a comparative advantage in b, and thus exports b, while region 2 exports g.
- As trade costs fall, exports/imports increase and the wage premium increases in the city and falls in the hinterland





- The positive effect of productivity advantages in sector b on the wage premium is related with the possibility to decouple high- and low-skill work.

Quantitative Model of Interregional Trade

- 741 regions (CZ, r), 3 sectors (s) and 4 occupations (o)
- Production: production uses a bundel of labor and intermediate goods from all the sectors

$$Y_r^s = A_{rs}\left(H_r^s\right)^{\gamma_s}\left(\prod_{s'}\left(Q_r^{ss'}\right)^{\gamma_s^{s'}}\right)^{1-\gamma_s}$$

  - H_r^s consist of the contribution of efficiency units of workers in different occupations

$$H_r^s = \left[\sum_o \mu_{rso}\left(h_r^{so}\right)^{\frac{\iota-1}{\iota}}\right]^{\frac{\iota}{\iota-1}}$$

  - Firms aggregate region-sector varieties

$$Q_r^{ss'} = \left[\sum_{r'} b_{r'}^{s}\left(q_{rr'}^{ss'}\right)^{\frac{\sigma_{s'}-1}{\sigma_{s'}}}\right]^{\frac{\sigma_{s'}}{\sigma_{s'}-1}}$$

Quantitative Model of Interregional Trade

- Workers obtain two idiosyncratic shocks $(\varepsilon_{so}, \eta_r)$, revealed one after the other. This drives their location and employment decisions.

1. Given region r, workers chooses the s, o combination paying the highest income $(y_r^i = \max_{s,o} \left\{ w_r^{so} \times \varepsilon_{so}^i \right\})$

$$\phi_{rk}^{so} = \frac{L_{rk}^{so}}{L_{rk}} = \frac{T_{rsok} \left(w_r^{so} \right)^{\rho_k}}{\sum_{s',o'} T_{rs'o'k} \left(w_r^{s'o'} \right)^{\rho_k}}$$

2. Given the expected income in region r $(\bar{V}_{rk}^i = {}^{E_k(y_r^i)}/_{\prod_s (P_r^s)^{\alpha_s}} \times \eta_r^i)$, workers choose the location that maximizes their income.

$$\Phi_{rk} = \frac{L_{rk}}{L_k} = \frac{G_{rk} \left(V_{rk} \right)^{\aleph}}{\sum_{r'} G_{r'k} \left(V_{r'k} \right)^{\aleph}}$$

Quantitative Model of Interregional Trade

- Given the parameters of the model and the level of workers (L_k), a set of prices ($p_r^s, P_r^s, w_r^{so}, w_{rk}, w_r^s$), shares ($\phi_{rk}^{so}, \Phi_{rk}$) and trade shares ($\pi_{r'r}^s$), such that agents maximize, markets clear and trade is balanced across regions.

- Counterfactual exercise: Model is calibrated to 1980 data and a *single* parameter related with the business services trade frictions is changed from its 1980 value to its 2010 value.
- Solution method: write the model in changes ($\hat{x} = {x'}/{x}$) and solve for the counterfactual equilibrium in changes

$$\pi_{r'r}^s = \frac{(p_r^s)^{1-\sigma_s}\left(\kappa_{r'r}^s\right)^{1-\sigma_s}}{\sum_{r''}\left(p_{r''}^s\right)^{1-\sigma_s}\left(\kappa_{r''r'}^s\right)^{1-\sigma_s}} \Longrightarrow \hat{\pi}_{r'r}^s = \frac{(\hat{p}_r^s)^{1-\sigma_s}\left(\hat{\kappa}_{r'r}^s\right)^{1-\sigma_s}}{\sum_{r''}\left(\hat{p}_{r''}^s\right)^{1-\sigma_s}\left(\hat{\kappa}_{r''r'}^s\right)^{1-\sigma_s}\pi_{r'',r}^s}$$

Quantitative Framework: Data Calibration

- Data Sources:
  - Decennial Census: hours worked, hourly wage
  - BEA: Input-Output Tables (intermediate inputs, value added, final consumption, exports, and imports)
- Calibration (Parameterization):
  - Parameters characterizing shares
  - Elasticities
  - Trade frictions

Data Calibration: Trade Frictions

- To compute the counterfactuals we need both the change in trade frictions and the bilateral trade flows for 1980.
- Community Flow Survey (CFS) provides data for state-to-state trade but only on manufacturing industries.

- Use the structure of the model to estimate trade frictions and bilateral trade between CZs.

Data Calibration: Trade Frictions

- The model implies values for $\{R_r^s, E_r^s\}$

$$R_r^s = \gamma_s^{-1} \sum_k w_{rk} L_{rk} \phi_{rk}^s \qquad E_r^s = \alpha_s \sum_k L_{rk} w_{rk} + \sum_{s'} R_r^{s'} \left(1 - \gamma_{s'}\right) \gamma_{s'}^s$$

- The model implies that

$$R_r^s = \sum_{r'} E_{r'}^s \pi_{rr'}^s = \sum_{r'} E_{r'}^s \frac{\left(p_r^s\right)^{1-\sigma_s} \left(\kappa_{r'r}^s\right)^{1-\sigma_s}}{\sum_{r''} \left(p_{r''}^s\right)^{1-\sigma_s} \left(\kappa_{r''r'}^s\right)^{1-\sigma_s}} = \sum_{r'} E_{r'}^s \frac{\lambda_r^s K_{rr'}^s}{\sum_{r''} \lambda_{r''}^s K_{r''r'}^s}$$

- Parameterize the trade cost matrix as a power function of the distance $K_{rr'}^s \equiv d_{rr'}^{(1-\sigma_s)\bar{\delta}_s} = d_{rr'}^{\delta_s}$
- This suggests the regression

$$\begin{aligned} \log X_{rr'}^s &= \log E_{r'}^s - \log\left(\sum_{r''} \lambda_{r''}^s K_{r''r'}^s\right) + \log \lambda_r^s + \delta^s \log d_{rr'} + \varepsilon_{rr'}^s \\ &= a_r + b_{r'} + \delta^s \log d_{rr'} + \varepsilon_{rr'}^s \end{aligned}$$

Data Calibration: Trade Frictions

- **Lemma.** For any $\{A_i\} \gg 0$, $\{B_i\} \gg 0$, and any strictly positive matrix $\mathbf{K} \gg 0$, such that $\sum_i A_i = \sum_i B_i$, there exists a unique (to-scale), strictly positive vector $\{\lambda_i\} \gg 0$ that solves

$$A_i = \sum_j B_j \frac{\lambda_i K_{ij}}{\sum_k \lambda_k K_{kj}}, \quad \forall i$$

- Use as an additional moment restriction, the aggregate ratio of gross-to-net trade flows to identify $\{\{\lambda_r^s\}, \delta^s\}$ (Gross to Net)
- Construct gross-to-net ratio (Y_t^s) assuming that gross and net flows coincide across regions within the United states.
  Find δ^s that minimizes

$$\Omega(\delta^s) = \left| \log \frac{\sum_r \sum_{r' \neq r} E_{r'}^s \frac{\lambda_r^s d_{rr'}^{\delta^s}}{\sum_{r''} \lambda_{r''}^s d_{r''r'}^{\delta^s}} \Big/ \sum_r |R_r^s - E_r^s|}{Y_t^s} \right|$$

Data Calibration: Trade Frictions

Year	Goods Sector	Business Services
1980	−1.6	−2.1
1990	−1.6	−1.8
2000	−1.6	−1.6
2010	−1.6	−1.5
$\Delta_{80\to10}\%$	0%	−28%

Figure: Calibrated Distance Elasticities, δ^s

- The increasing geographic concentration of BS production relative to BS consumption is mapped by the model into declines in trade frictions

- Validation:
  - In Canada services trade costs declined by about 25% between 1999 - 2015 Canada
  - Costs of data transmission and communication equipment have been falling since the 70s

Results

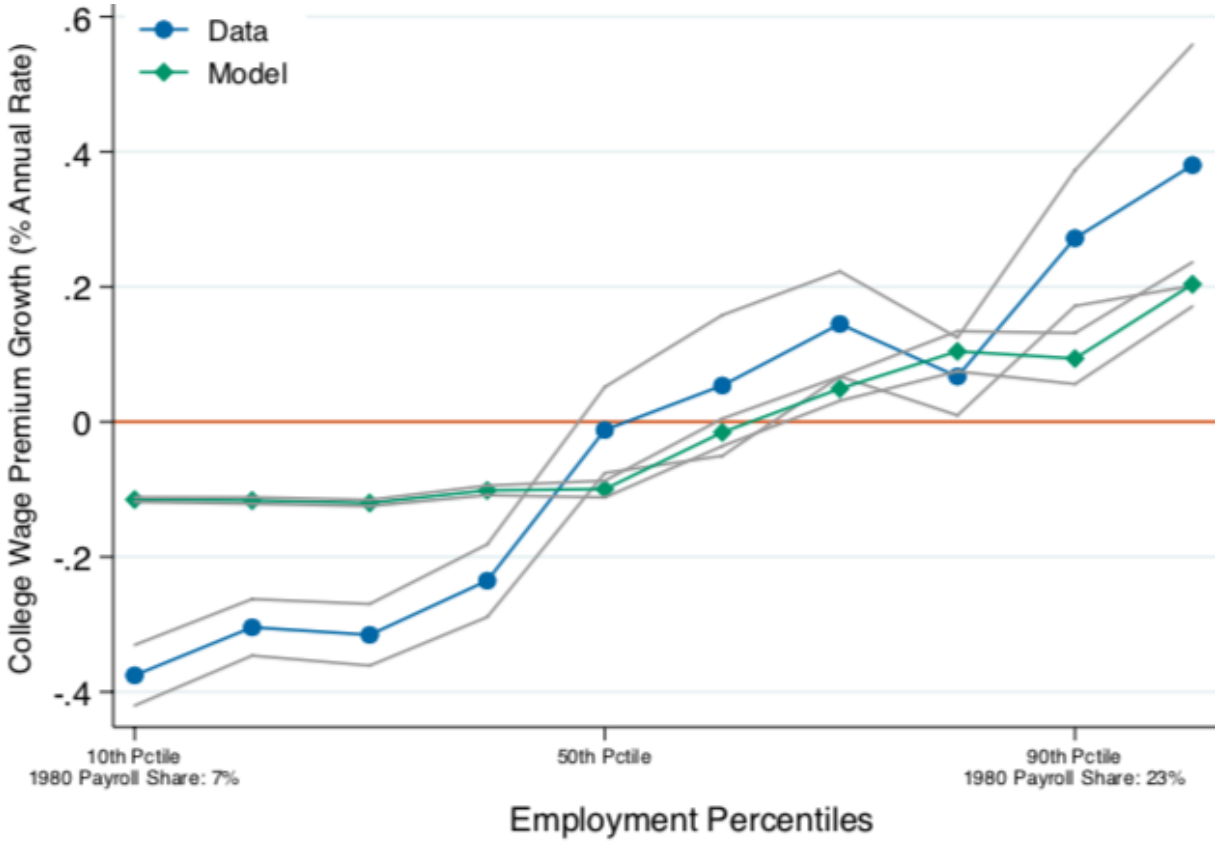


Figure: The Growing Apart Effect, 1980-2010

Results: Sectors

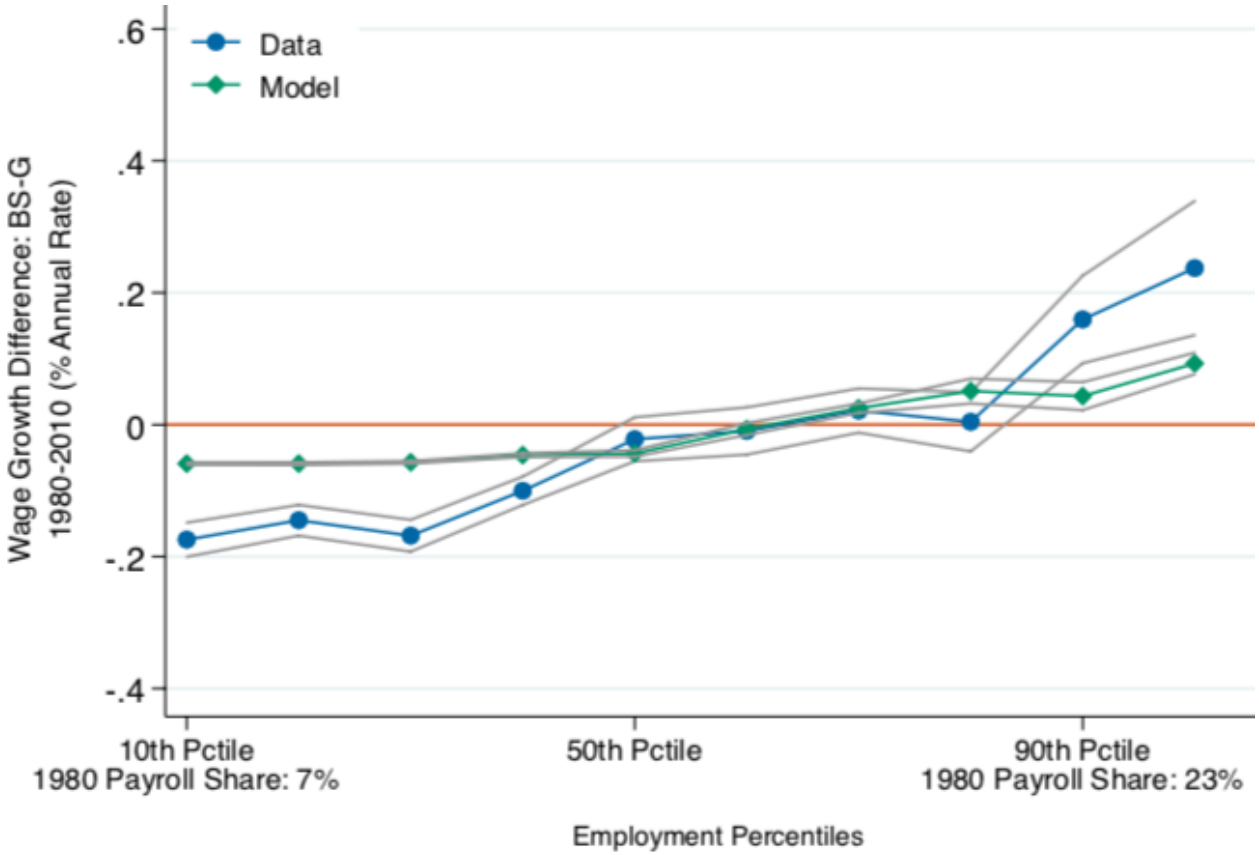


Figure: Business Services versus Goods Sector Wage Growth

Results: Occupations

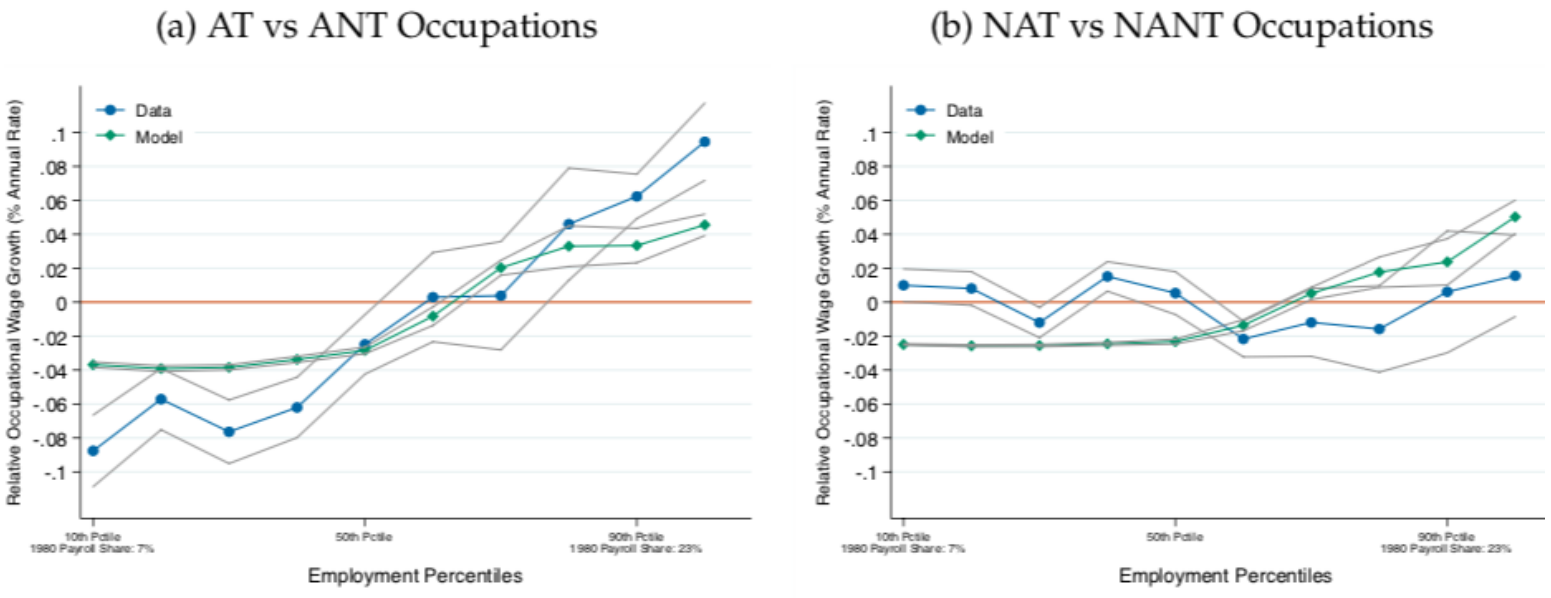


Figure: Communication Costs and Relative Occupational Wage Growth Shares

Results: Aggregate College Wage Premium

	Δ% Wage Premium
Data	27.6%
Model without Spatial Reallocation	5.7%
Model without Structures	4.3%
Full Model	10.0%

Figure: Changes in the Aggregate College Wage and Welfare Premium

Results: Real Wages

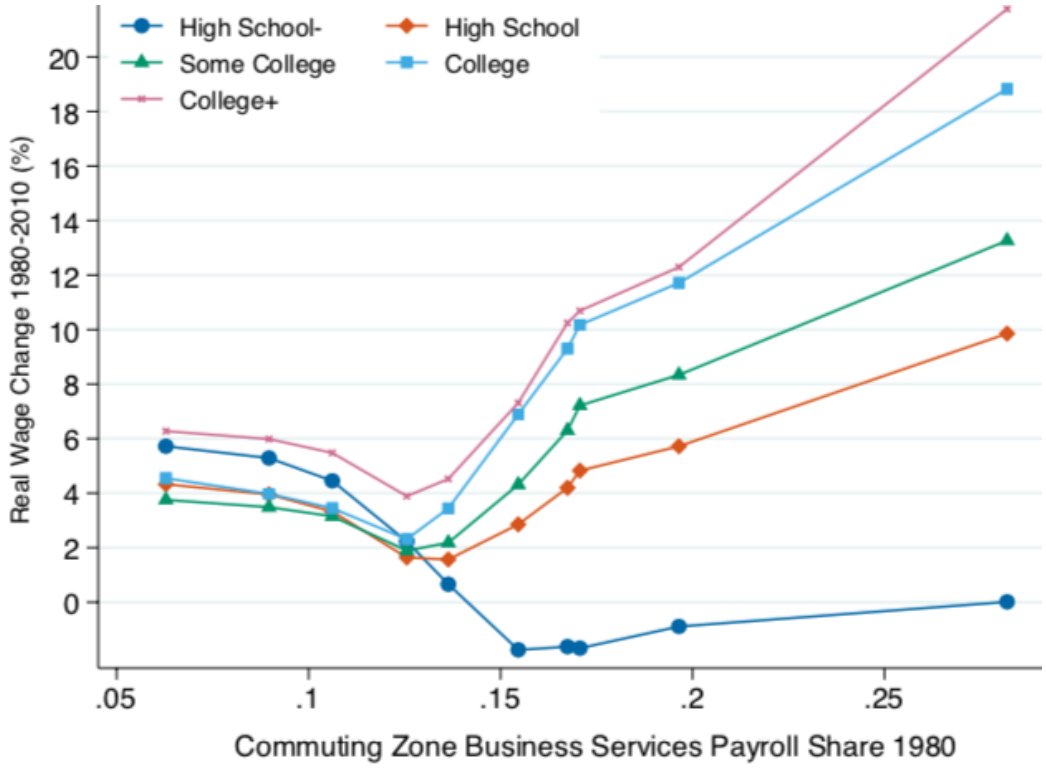


Figure: Real Wage Changes Across U.S. Commuting Zones, 1980-2010

- Communication cost declines pull high- and low-skill workers in different directions
- Mid-size labor markets suffer the most. These regions are not specialized enough in BS nor in goods.

Conclusions

- Relevant facts about Business Services and their possible relation with the change in the college wage premium across space in the US.
- Unexplored dimension of recent technological change, the fall of *communication costs*.
- Quantitative Model of Interregional Trade
  - Method to compute bilateral trade across regions
  - Counterfactual exercise of a fall in communication costs

Parameters

	Value	Description	Strategy	Source
δ^s	(-1.5)-(-2.1)	Distance Elasticity for Service Sectors	Estimated	IO Tables, Local Data, Armington Structure
δ^g	-1.23	Distance Elasticity of Goods Trade Costs	Literature	Monte et al. (2018)
ρ_k	1.14-1.47	Labor Supply Elasticity	Estimated	Within Group Variance of Earnings
α_s	0.52, 0.6, 0.42	Cobb-Douglas Coefficients in Utility Function	Calibrated	IO Table
γ_s, γ_s^k	...	Factor Shares in Production	Calibrated	IO Tables
ι	0.9	Elasitcity of Substitution between Occupations	Literature	Goos et al. (2014)
σ_s	5.5,5,6	Elasitcity of Substitution between Regional Varieties	Literature	Gervais and Jensen (2013)
$\varkappa$	1.5	Spatial Labor Supply Elasticity	Literature	Fajgelbaum et al (2018)

Figure: Overview of Parameterization of Model

Gross to Net Trade Flows

$$\text{gross}^s = \sum_r \sum_{r' \neq r} E^s_{r'} \frac{\lambda^s_r d^{\delta^s}_{rr'}}{\sum_{r''} \lambda^s_{r''} d^{\delta^s}_{r''r'}} \qquad \text{net}^s = \sum_r |R^s_r - E^s_r|$$

- Net trade is pinned down by $\{R^s_r, E^s_r\}$.
- The aggregate gross to net ratio, together with $\{R^s_r, E^s_r\}$ jointly identifies $\{\{\lambda^s_r\}, \delta^s\}$

Calibrated Distance Elasticities, δ^s

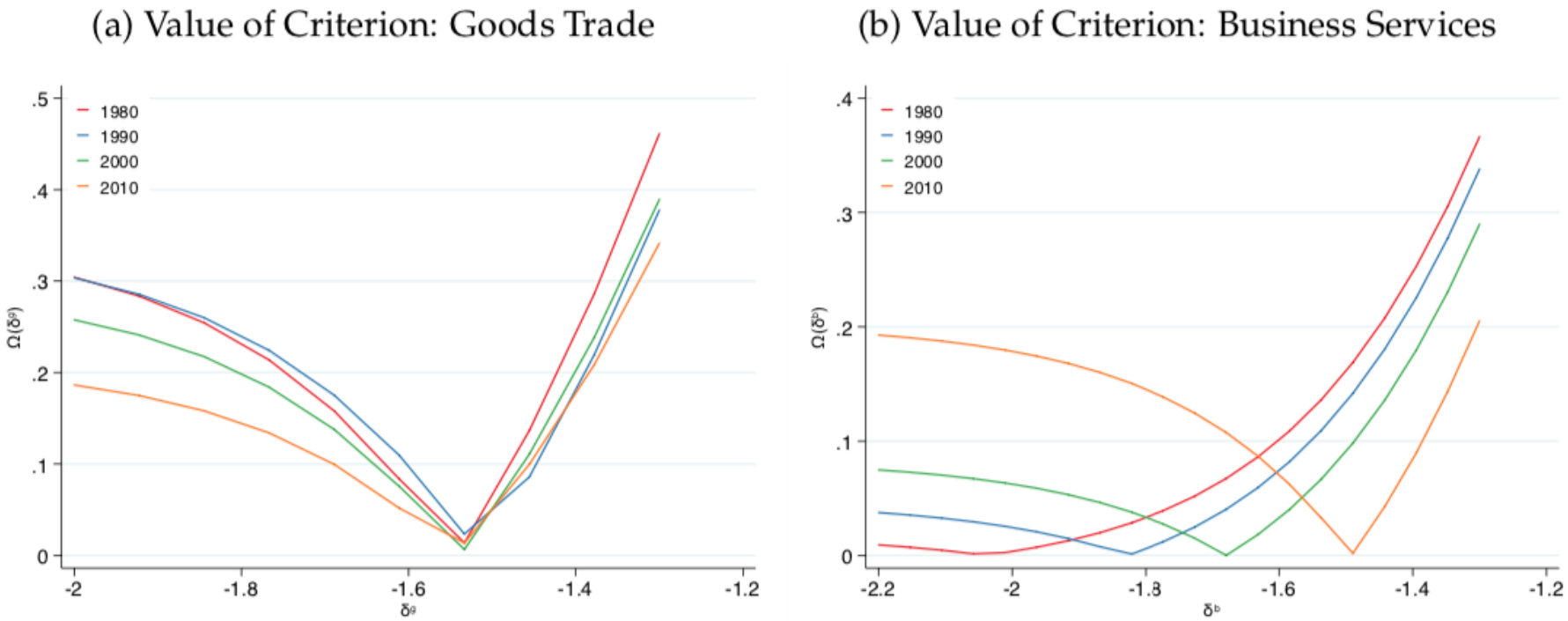


Figure: Criterion Functions for Sectoral Trade Elasticities

Model implied Trade Flows for Canada

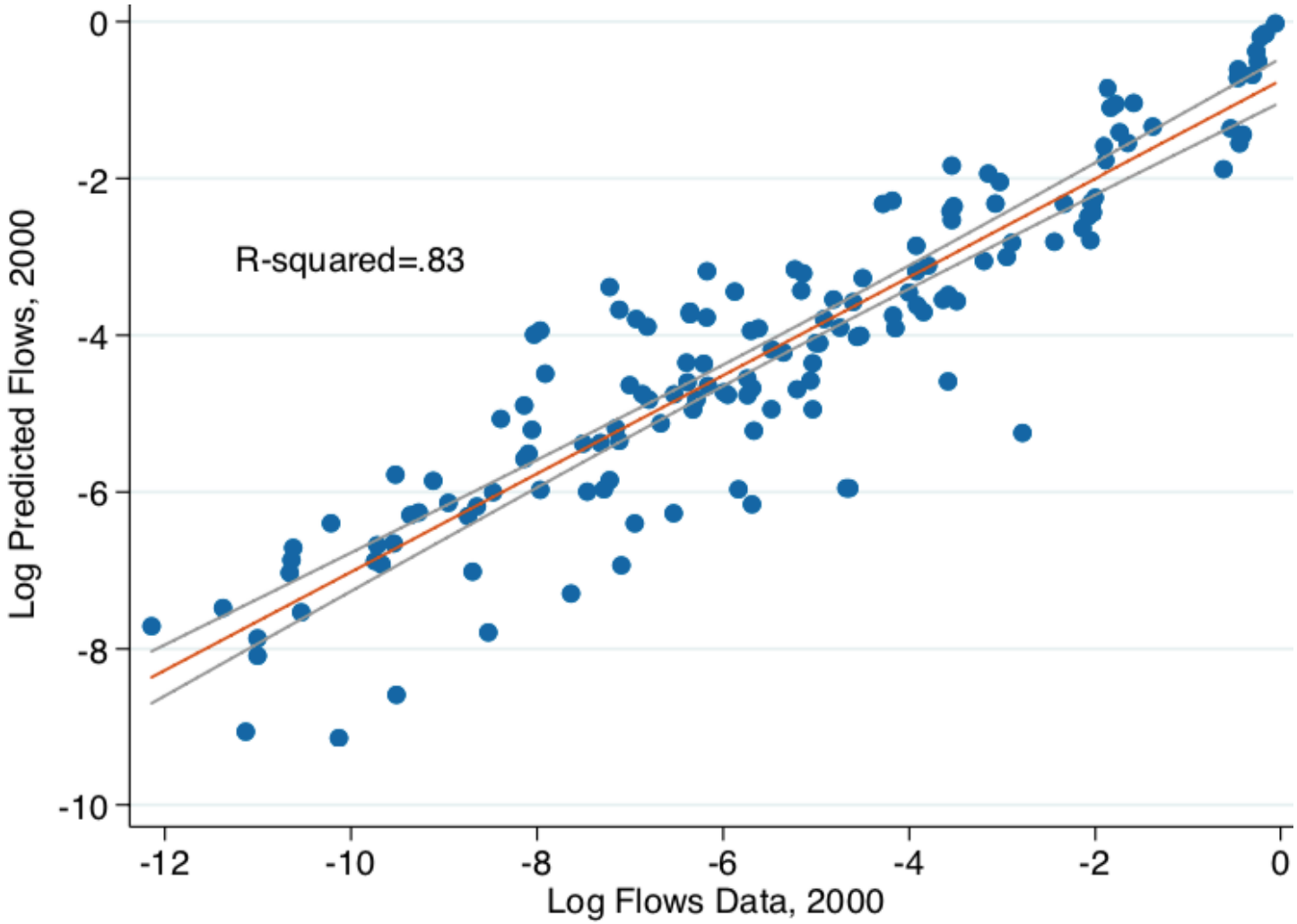


Figure: Predicted Trade Flows versus Actual Trade Flows across Canadian Provinces

Occupational Employment Across Skill Groups and Sectors

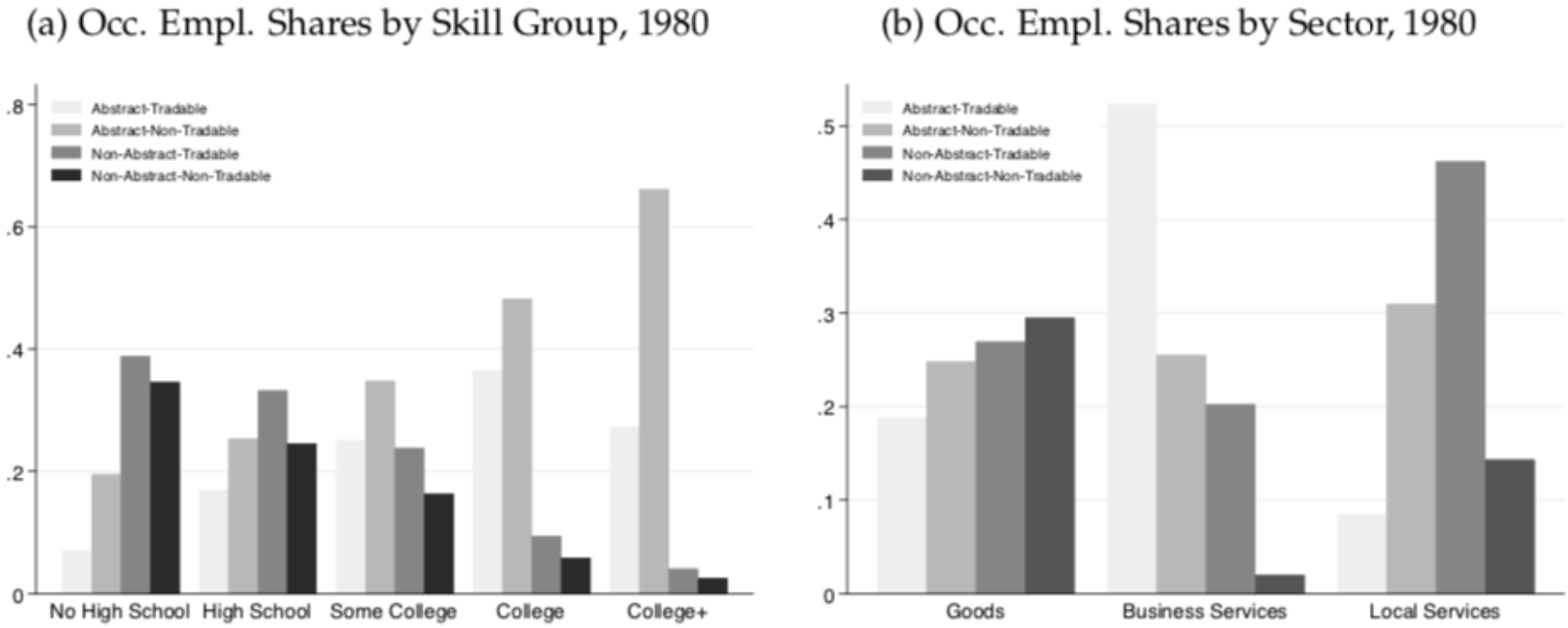


Figure: Occupational Employment Across Skill Groups and Sectors