Market Size and Trade in Medical Services

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Economies of scale and trade in medical services

Perpetual policy discussion of geographic variation in medical services:

- Less populous places have worse health outcomes...
- ...but US doctors are disproportionately in big cities (50% more per capita)

Evaluating this hypothesis hinges on returns to scale and tradability

- Increasing returns → geographic concentration of production yields benefits
- Trade costs for services → proximity-concentration trade-off
- If patients vary in willingness to travel, efficiency and equity considerations

How do local increasing returns and trade costs govern the geography of US healthcare production and consumption? (18% of US GDP)

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Plan

Questions

- How much care is traded across regions?
- Do trade patterns reflect quality of service?
- Are there home-market effects? In which services?
- How large are economies of scale?
- Do patients benefit equally from access to big markets?

Approach

- Setting: Medicare (regulated provider payments)
- Model: Trade costs & scale economies $\rightarrow$ home-market effect
- Implementation: Logit demand $\rightarrow$ gravity equation $\rightarrow$ quality estimates

Summary of findings and implications

Positive results:

- Domestic trade in medical services mimics trade in manufactures
- Home-market effects are stronger in less common services
- Geographic concentration $\rightarrow \uparrow$ service quality, $\uparrow$ specialization

Normative considerations:

- Proximity-concentration tradeoff interacts with equity-efficiency tradeoff
- Subsidize production in or travel from smaller markets?
- Defining relevant market for measuring concentration, place-based inequality

Contributions

Medical care: trade & increasing returns

- Distribution of physicians/rural access Newhouse 1982a,b,c, 1990; Rosenthal, Zaslavsky & Newhouse, 2005; Buchmueller et al. 2006, Alexander & Richards, 2021; ...
- Studies mostly treat markets as local Dartmouth; Baumgardner 1988a,b; Bresnahan & Reiss 1991; Chandra & Staiger 2007; Finkelstein, Gentzkow & Williams 2016

Home-market effect for trade in services

- Trade in services: Lipsey 2009 Eaton and Kortum 2019
- Market size and goods: Davis and Weinstein 2003; Hanson and Xiang 2004; Dingel 2017; Bartelme et al. 2019 Acemoglu and Linn 2004; Costinot et al. 2019

Spatial shopping

- Credit-card trade matrices: Agarwal et al. 2017; Dunn and Gholizadeh 2021
- Central place theory: Christaller 1933; Hsu, Holmes and Morgan 2014; Schiff 2015

Roadmap

- Theoretical framework
- Data description
- Market-size effects
  - Larger markets are net exporters of medical services
  - Gravity-based empirics
- Rare procedures have stronger market-size effects
  - Population elasticities by procedure
  - Gravity-based empirics
- Mechanisms
  - Scale improves quality
  - The division of labor is limited by the extent of the market
- Tradeoffs and counterfactual scenarios

Theoretical framework

Model of a market for a medical procedure

- Partial-equilibrium competitive model of one procedure with a fixed price
- N_j potential patients in region j. Patient k choosing provider in region i gets

$$U_{ik} = \ln \delta_i + \ln \phi_{ij(k)} + \epsilon_{ik}$$

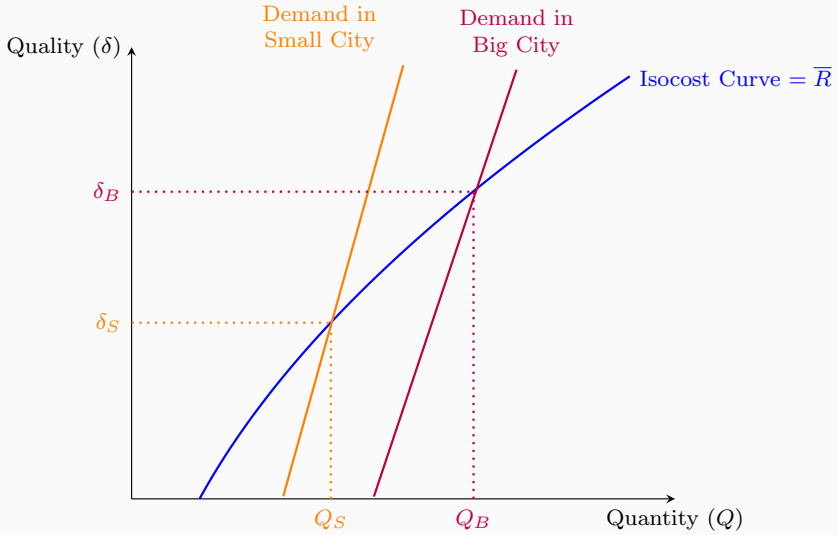
- Provider in region i chooses inputs L and quality δ to maximize profits, given input price w_i, reimbursement $\overline{R}$, productivity shifter A_i, regional output Q_i

$$\max_{L,\delta} \overline{R} A_i \frac{H(Q_i)}{K(\delta)} L - w_i L$$

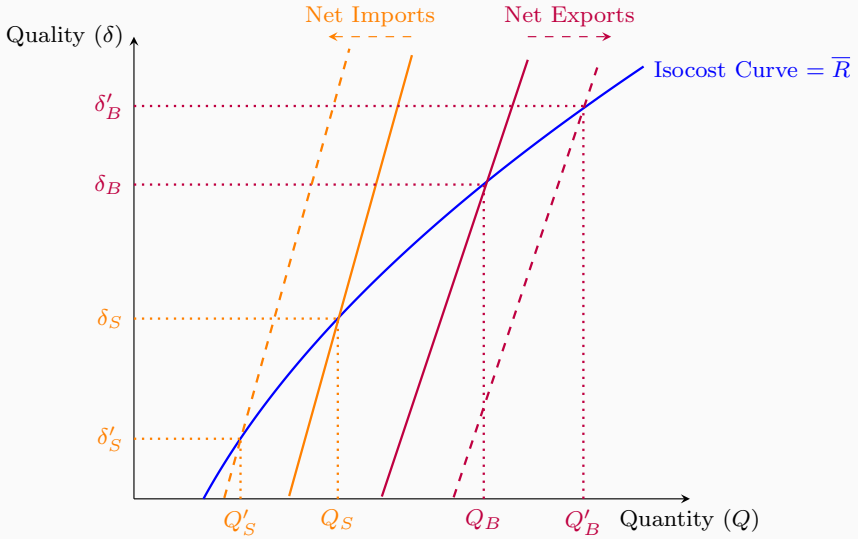
- Optimal quality and zero-profit conditions define isocost curve in (Q, δ) space:

$$\overline{R} = \frac{w_i K(\delta_i)}{A_i H(Q_i)} \equiv C(Q_i, \delta_i; w_i, A_i)$$

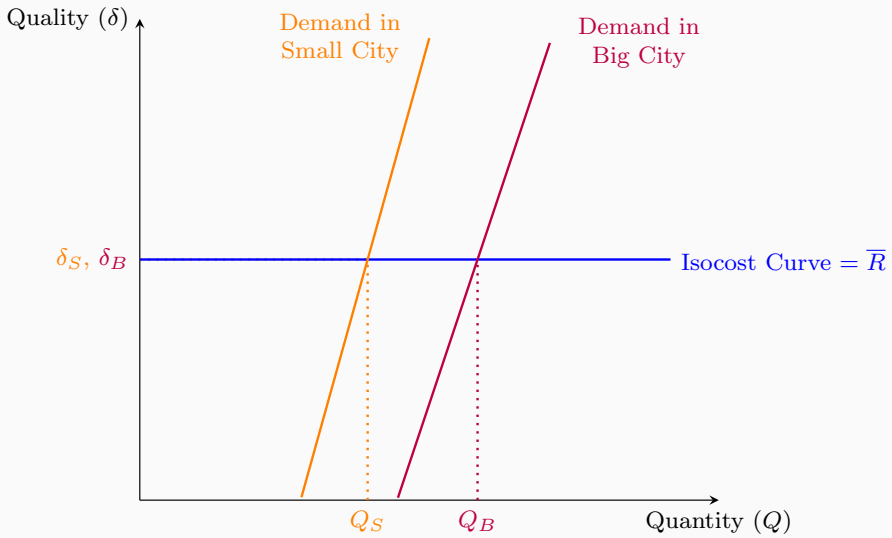
Equilibrium in autarky



Equilibrium with trade

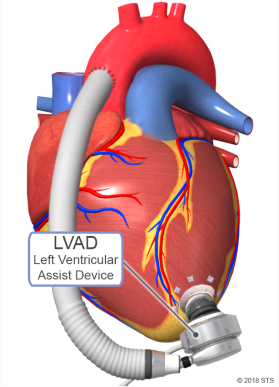


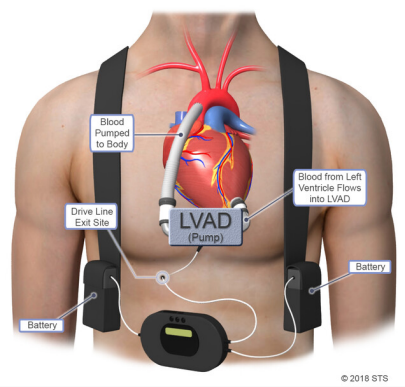
Equilibrium with constant returns to scale, $H'(Q_i) = 0$



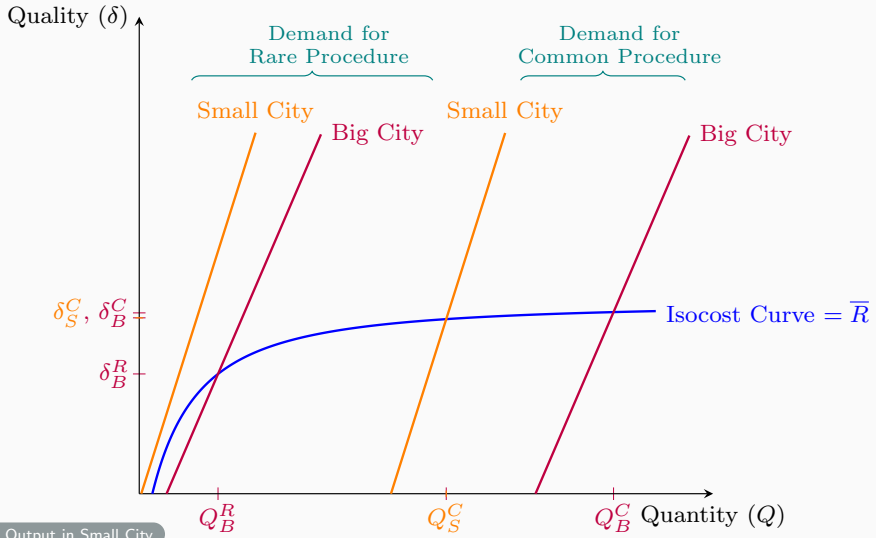
Common and rare procedures: 2 examples

- Colonoscopy (N=220,430 in our sample)
- Implanting LVAD—pump for severe heart failure patients (N=346)



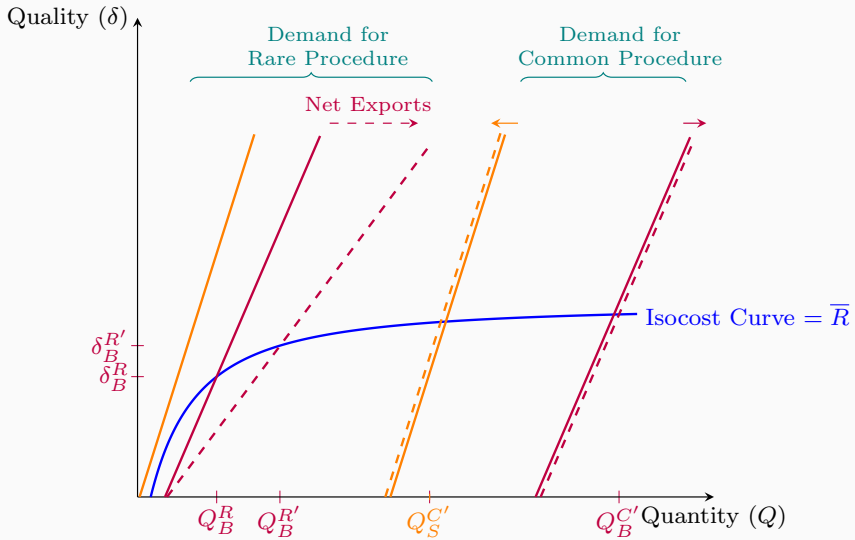


Rare vs common procedures: Autarky



▸ Non-Zero Output in Small City

Difference-in-differences prediction



Logit preferences and isoelastic external economies

$$U_{ik} = \ln \delta_i + \ln \phi_{ij(k)} + \epsilon_{ik}$$

- Preference shocks $\epsilon_{ik} \overset{\text{iid}}{\sim}$ T1EV $\implies$ Q_{ij} patients from j choosing i:

$$\mathbb{E}\left[Q_{ij}\right] = \frac{\delta_i \phi_{ij}}{\sum_{i'} \delta_{i'} \phi_{i'j}} N_j$$

$$\ln \mathbb{E}\left[Q_{ij}\right] = \ln \delta_i + \ln \left(\frac{N_j}{\Phi_j} \right) + \ln \phi_{ij}$$

- $H(Q_i) = Q_i^\alpha$ and $K(\delta) = \delta \to$ scale elasticity of quality is α:

$$\ln \delta_i = \alpha \ln Q_i + \ln \overline{R} - \ln w_i + \ln A_i$$

Home-market effects with many regions

- Log-linearize at symmetric equilibrium: $N_i = \bar{N}\ \forall i, \phi_{ij} = \phi \in (0,1)\ \forall i \neq j$
- With scale economies ($\alpha > 0$), ↑ region 1's size ($\mathrm{d}N_1 > 0$) → ↑ quality:

$$\frac{\mathrm{d}\ln\delta_1 - \mathrm{d}\ln\delta_{j\neq 1}}{\mathrm{d}\ln N_1} = \left[\frac{1-\alpha}{\alpha}\frac{(\bar{\Phi}-1)}{(1-\phi)\bar{\delta}} + \frac{(1-\phi)\bar{\delta}}{\bar{\Phi}}\right]^{-1} > 0$$

- Larger market size → more gross exports (weak HME):

$$\frac{\mathrm{d}\ln Q_{1j}}{\mathrm{d}\ln N_1} = \left(\frac{\bar{N}-Q_{1j}}{\bar{N}}\right)\left[\frac{\mathrm{d}\ln\delta_1 - \mathrm{d}\ln\delta_j}{\mathrm{d}\ln N_1}\right] + \frac{Q_{0j}}{\bar{N}}\frac{\mathrm{d}\ln\delta_j}{\mathrm{d}\ln N_1} > 0$$

- If α large enough and $\bar{N}$ small enough, net exports increase (strong HME):

$$\frac{\mathrm{d}\ln Q_{1,j\neq 1} - \mathrm{d}\ln Q_{j\neq 1,1}}{\mathrm{d}\ln N_1} > 0 \iff \frac{\alpha}{1-\alpha} > \frac{1+(\mathcal{I}-1)\phi}{1-\phi}\bar{N}$$

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Data description

Medicare

- Medicare insures almost all Americans > 65 years old or disabled
  - 59 million beneficiaries and about 23% of healthcare expenditure (in 2017)
  - 39 million in Traditional Medicare (physicians & facilities bill Medicare)
- All willing providers covered; vast majority of doctors/hospitals
  - cf. private insurance: limited network, opaque pricing $\rightarrow$ patients have different choice sets
- Medicare regulates payment ("reimbursement") rates
  - Based on each procedure's estimated average cost
  - Constant across physicians within a region
  - Limited geographic variation (89 regions)
- Separate *professional* and *facility* fees
  - Professional fee $\rightarrow$ physician (we study these)
  - Facility fee $\rightarrow$ hospital (see appendix)

Data

Medicare professional claims data for 2017

- Carrier (fee-for-service claims) file reports procedure, provider, date, payment
- Remove all Emergency Department care
- 20% representative sample of patients contains ∼185 million claims
- 13,000 5-digit procedures in Healthcare Common Procedure Coding System (HCPCS)
- ZIP codes of patient and place of service

National Plan and Provider Enumeration System (NPPES)

- Physician ID, name
- Physician specialization and location

We aggregate ZIP codes to hospital referral regions (HRRs)

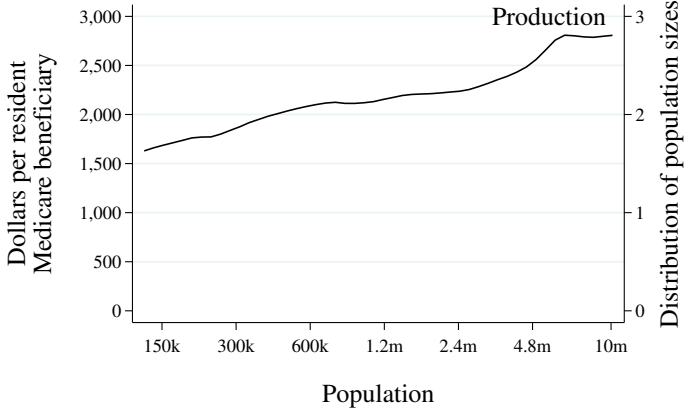
▸ HCPCS code examples ▸ Claim form ▸ HRR definition

Market-size effects

Market-size effects

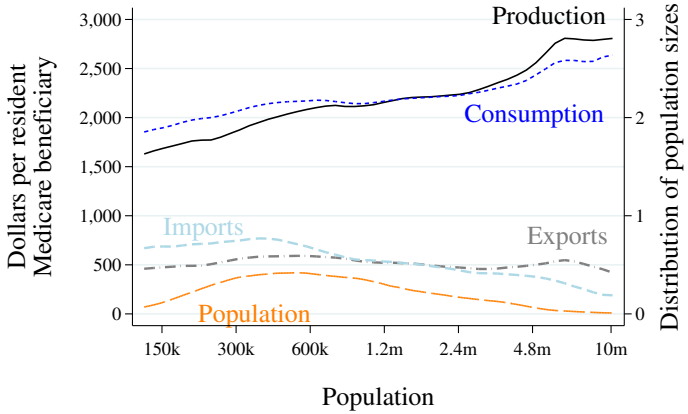
Larger markets are net exporters of medical services

Production of medical services and market size



Population elasticity (log–log regression slope) of transactions per resident Medicare beneficiary:
Production: 0.13 (0.02)

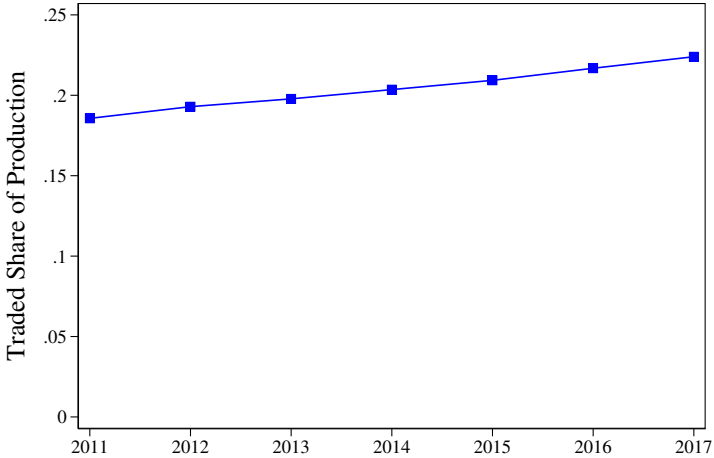
Production, consumption, trade, and market size



Population elasticity (log–log regression slope) of transactions per resident Medicare beneficiary:
Production: 0.13 (0.02), Consumption: 0.06 (0.01)
Exports: −0.00 (0.05), Imports: −0.25 (0.03)

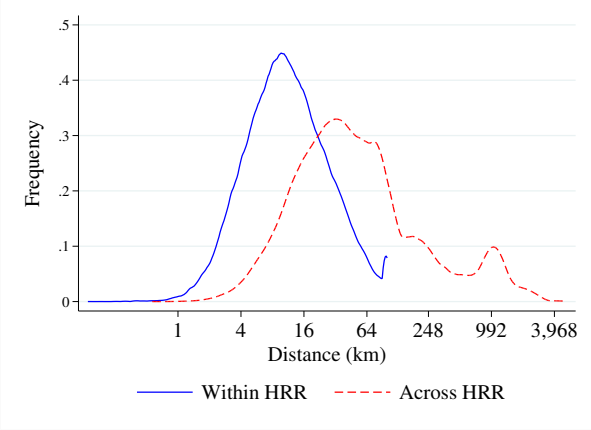
▸ HRR scatterplots ▸ CBSAs ▸ Facility fees: HRRs ▸ Facility fees: CBSAs

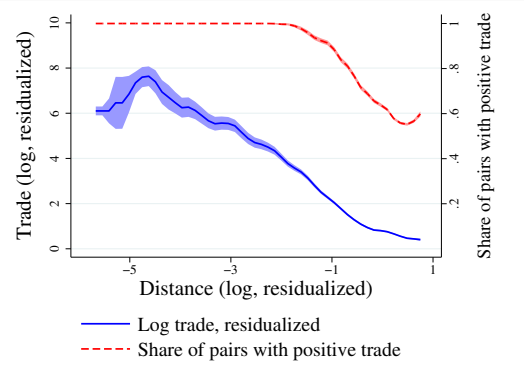
22% of production is exported to another region



Average annual growth rate: 3.2%. Trade measured using HRRs.

Trade declines with distance





▸ CBSAs ▸ Intra-procedure trade ▸ By frequency

Market-size effects

Gravity-based empirics

Estimating home-market effect: 1-step gravity regression

$$\ln \mathbb{E}\left[Q_{ij}\right] = \ln \delta_i + \ln\left(\frac{N_j}{\Phi_j}\right) + \gamma \ln \text{distance}_{ij}$$

- Estimate HME by parameterizing gravity equation à la Costinot et al. 2019:

$$\ln \mathbb{E}\left(\overline{R}Q_{ij}\right) = \lambda_{\mathbf{X}} \ln \text{population}_i + \lambda_{\mathbf{M}} \ln \text{population}_j + \gamma \ln \text{distance}_{ij}$$

- $\lambda_{\mathbf{X}} > 0$ is a weak home-market effect: $\uparrow N_i \implies \uparrow$ gross exports
- $\lambda_{\mathbf{X}} > \lambda_{\mathbf{M}} > 0$ is a *strong* home-market effect: $\uparrow N_i \implies \uparrow$ *net* exports

Two instruments:

- Population in 1940
- Depth to bedrock (Levy & Moscona, 2020)

Gravity regression: Strong HME for aggregate medical services

Estimation method:	(1) PPML	(2) PPML	(3) PPML	(4) IV
$\lambda_{\mathbf{X}}$ Provider-market population (log)	0.636	0.641	0.643	0.594
	(0.0627)	(0.0603)	(0.0448)	(0.0719)
$\lambda_{\mathbf{M}}$ Patient-market population (log)	0.378	0.376	0.405	0.365
	(0.0608)	(0.0580)	(0.0417)	(0.0515)
Distance (log)	-1.656	0.0550		0.0362
	(0.0498)	(0.305)		(0.268)
Distance (log, squared)		-0.173		-0.171
		(0.0296)		(0.0262)
Observations	93,636	93,636	93,636	93,636
Distance elasticity at mean		-2.42		-2.42
Distance deciles			Yes	

Two-way clustered standard errors in parentheses

▸ CBSAs ▸ More FEs (HRR) ▸ More FEs (CBSA) ▸ Facility (HRR) ▸ Facility (CBSA) ▸ Labor costs by size ▸ Bedrock IV

Rare procedures have stronger market-size effects

Rare procedures have stronger market-size effects

Population elasticities by procedure

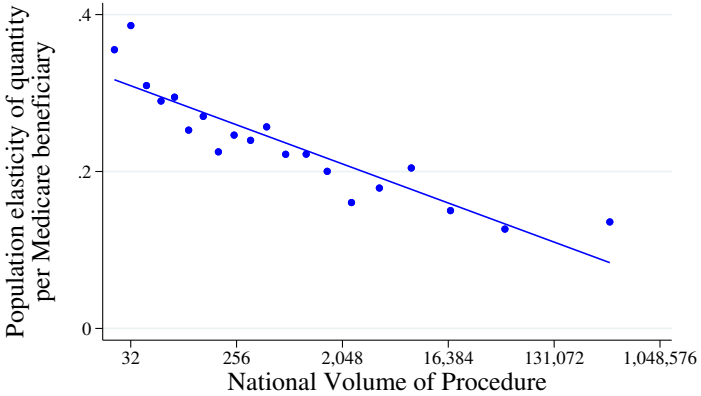
Estimating procedure-level population elasticities

- Q_{pi} is the count of procedure p produced in region i
- Q_{pi}/M_i is production per Medicare beneficiary residing in region i
- Use Poisson PML to estimate the population elasticity of economic activity

$$\ln \mathbb{E}\left[\frac{Q_{pi}}{M_i}\middle|\, \ln \text{population}_i\right] = \zeta_p + \beta_p \ln \text{population}_i$$

- We estimate elasticities for production and consumption
- Then relate estimated population elasticity $\widehat{\beta}_p$ to p's national frequency

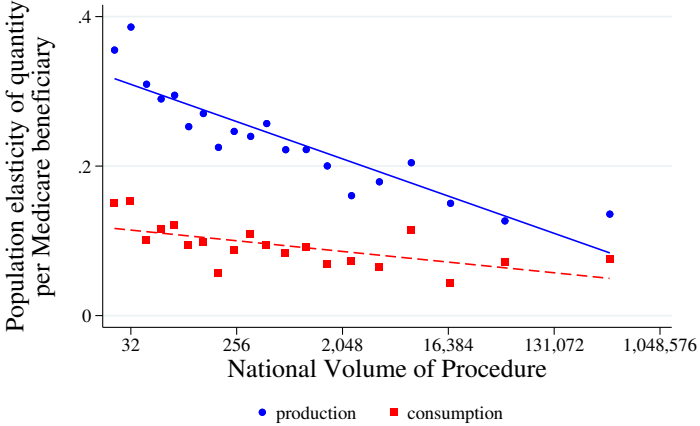
Population elasticity of production declines with frequency



Production fitted line: y = −0.024 (0.002) * x + 0.391 (0.016)
This plot depicts estimated population elasticities per Medicare beneficiary for 8,253 procedures produced at least 20 times nationally.

▸ CBSAs

Population elasticity of consumption declines less with frequency



Production fitted line: y = −0.024 (0.002) * x + 0.391 (0.016)
Consumption fitted line: y = −0.007 (0.002) * x + 0.138 (0.014)
This plot depicts estimated population elasticities per Medicare beneficiary for 8,253 procedures produced at least 20 times nationally.

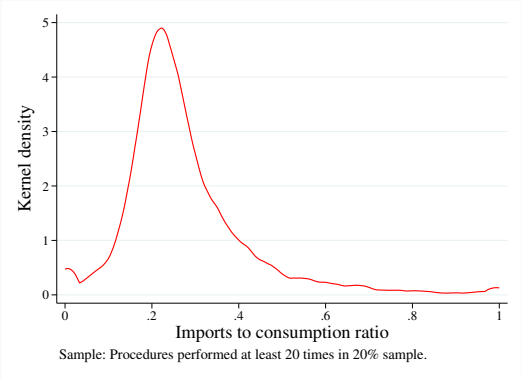
▸ CBSAs ▸ By diagnosis

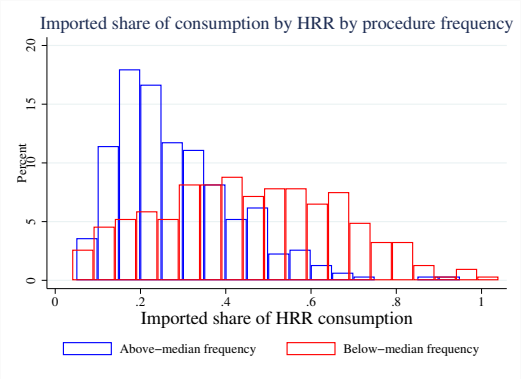
Example procedures: Trade in colonoscopy & LVAD

	Colonoscopy	LVAD Insertion
Code	G0121	33979
N	58,828	334
Physicians	13,475	177
$\hat{\beta}_p^{\text{production}}$	0.00	0.71
$\hat{\beta}_p^{\text{consumption}}$	-0.01	0.03
Share traded (HRR)	0.15	0.50
Share traded (CBSA)	0.15	0.48
Median distance traveled (km)	18.44	65.50
Share $>$ 100km	0.06	0.37

Imports play a larger role in less-common procedures

- Imported share of consumption varies widely across procedures
- Imported share of consumption larger for less-common procedures

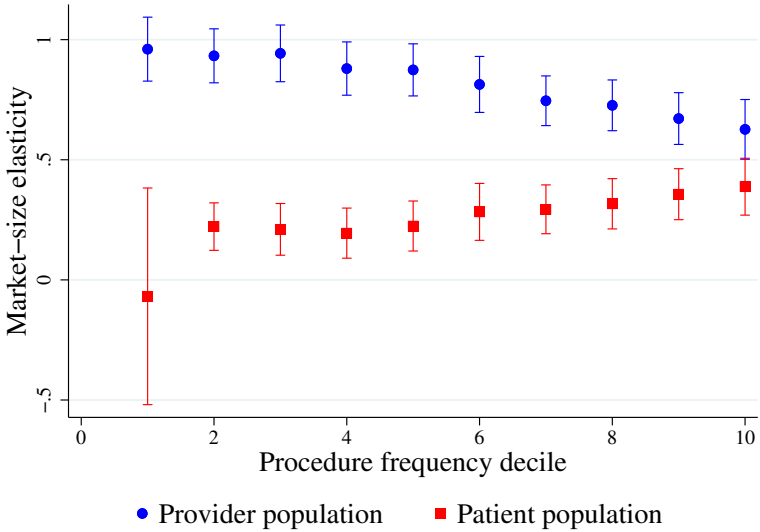




Rare procedures have stronger market-size effects

Gravity-based empirics

HME stronger for rarer procedures



HME stronger for rarer procedures

	(1)	(2)	(3)	(4)	(5)	(6)
Provider-market population (log)	0.638	0.624	0.623		0.630	
	(0.0634)	(0.0613)	(0.0614)		(0.0598)	
Patient-market population (log)	0.377	0.379	0.380		0.379	
	(0.0615)	(0.0590)	(0.0591)		(0.0572)	
Provider-market population (log) × rare			0.306	0.291	0.316	0.287
			(0.0472)	(0.0455)	(0.0480)	(0.0458)
Patient-market population (log) × rare			-0.229	-0.219	-0.232	-0.211
			(0.0698)	(0.0671)	(0.0704)	(0.0658)
Observations	187,272	113,468	113,468	113,468	113,468	113,468
Distance controls	Yes	Yes	Yes	Yes		
Distance [quadratic] controls					Yes	Yes
Patient-provider-market-pair FEs				Yes		Yes

Two-way clustered standard errors in parentheses

▸ Full table ▸ Split by expenditures ▸ CBSAs ▸ By diagnosis ▸ Bedrock IV ▸ IV common-rare results ▸ Specific procedures

Strong HME for specific common & rare services (HRRs)

	(1)	(2)	(3)	(4)	(5)	(6)
Procedure:	Colonoscopy	Cataract surgery	Brain radiosurgery	Brain tumor	LVAD	Colon removal
HCPCS code:	G0121	66982	61798	61510	33979	44155
$\lambda_{\mathbf{X}}$ Provider-market population (log)	0.504	0.550	1.164	0.940	1.187	0.998
	(0.0647)	(0.0616)	(0.118)	(0.0779)	(0.155)	(0.184)
$\lambda_{\mathbf{M}}$ Patient-market population (log)	0.334	0.408	0.172	0.201	0.223	-0.0859
	(0.0643)	(0.0557)	(0.0744)	(0.0692)	(0.133)	(0.163)
Distance (log)	0.239	-0.00287	1.453	0.862	1.882	2.477
	(0.393)	(0.344)	(0.729)	(0.518)	(1.091)	(1.674)
Distance (log, squared)	-0.198	-0.177	-0.303	-0.257	-0.342	-0.443
	(0.0394)	(0.0352)	(0.0726)	(0.0541)	(0.111)	(0.173)
Observations	93,636	93,636	93,636	93,636	93,636	93,636
Distance elasticity at mean	-2.60	-2.54	-2.88	-2.82	-3.02	-3.87
Total count	58,798	43,604	752	1,922	333	112

Two-way clustered standard errors in parentheses

▸ CBSAs

Mechanisms

Mechanisms

Scale improves quality

Estimating the scale elasticity: 2-step estimator

1. Estimate exporter fixed effects from gravity regression:

$$\ln \mathbb{E}\left(\overline{R}Q_{ij}\right) = \underbrace{\ln \delta_i}_{\text{exporter FE}} + \underbrace{\ln \theta_j}_{\text{importer FE}} + \gamma \ln \text{distance}_{ij}$$

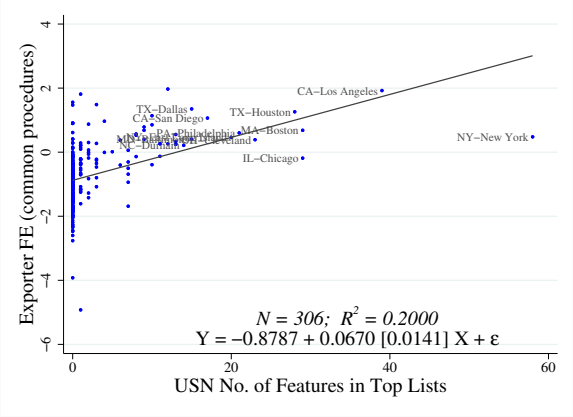
2. Regress them on output:

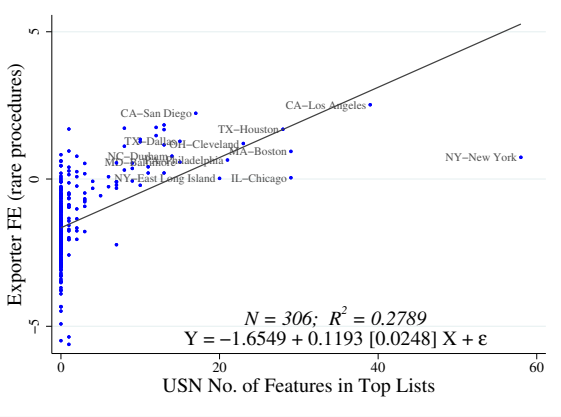
$$\widehat{\ln \delta_i} = \alpha \ln Q_i + \ln \overline{R} - \ln w_i + \ln A_i$$

- High-quality locations can be:
  - large ($Q_i \uparrow$),
  - cheap ($w_i \downarrow$),
  - or idiosyncratic ($A_i \uparrow$) [e.g., Mayo Clinic's historical investment in quality or reputation]
- 3 instruments for $\ln Q_i$: population, 1940 population, bedrock depth

Exporter fixed effects are correlated with other quality measures

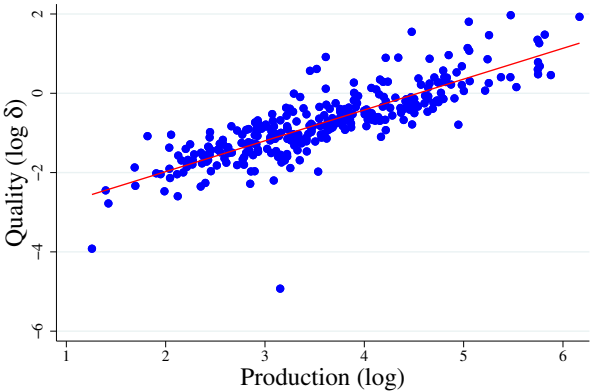
Hospital referral regions with more USNWR-ranked hospitals export more, especially rare procedures





▸ Dummy for ranked ▸ Leapfrog Safety Grades

Scale improves quality: $\alpha \approx 0.7$



The estimated elasticity is 0.778.

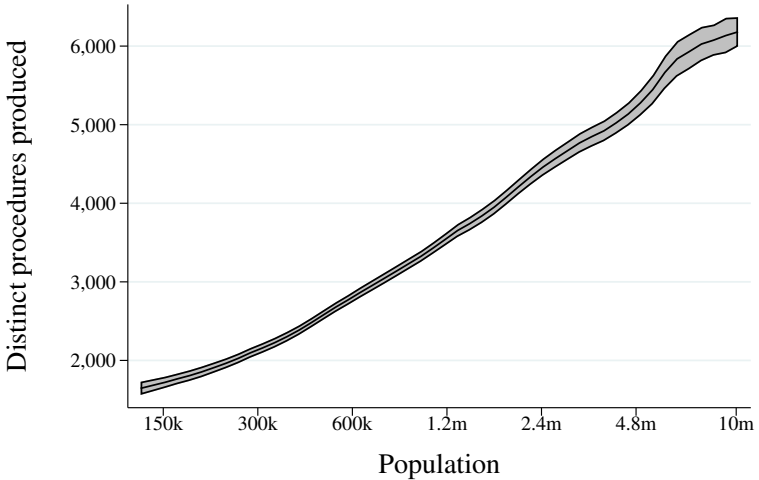
	No Controls		Controls	
	No Diag	Diag	No Diag	Diag
OLS	0.804	0.778	0.875	0.791
	(0.044)	(0.030)	(0.046)	(0.037)
2SLS: *pop*	0.799	0.716	0.861	0.720
	(0.049)	(0.030)	(0.052)	(0.036)
2SLS: *pop1940*	0.660	0.550	0.638	0.561
	(0.093)	(0.069)	(0.081)	(0.058)

▸ CBSAs ▸ By procedure

Mechanisms

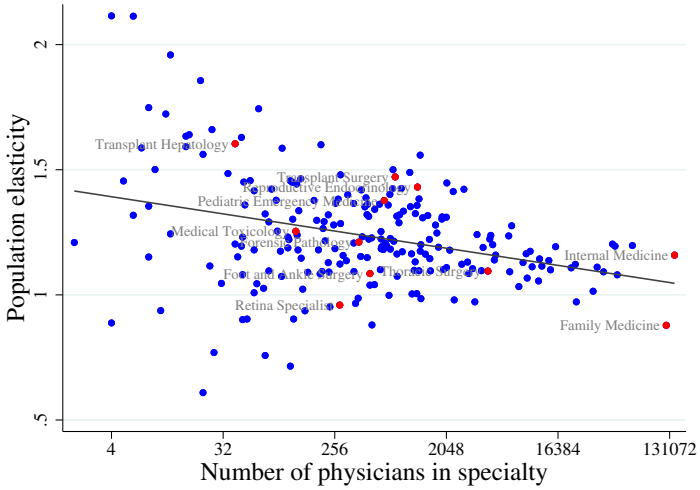
The division of labor is limited by the extent of the market

Larger markets produce greater set of procedures



Population elasticity (log–log regression slope) of number of distinct procedures: 0.37 (0.01).

Rare specialties have higher population elasticities

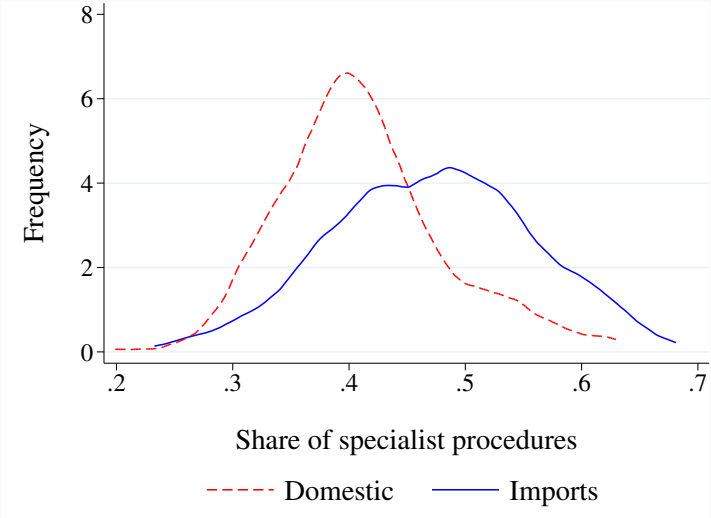


One source of increasing returns could be division of labor among physicians

Pearson correlation: -0.349.
Fitted line: $y = -0.039(0.007)\ln x + 1.484(0.046)$
Plot excludes 1 observation with elasticity greater than 2.12.

▸ CBSAs ▸ Earnings vs frequency ▸ Population elasticities of earnings ▸ Population elasticities of earnings by specialty

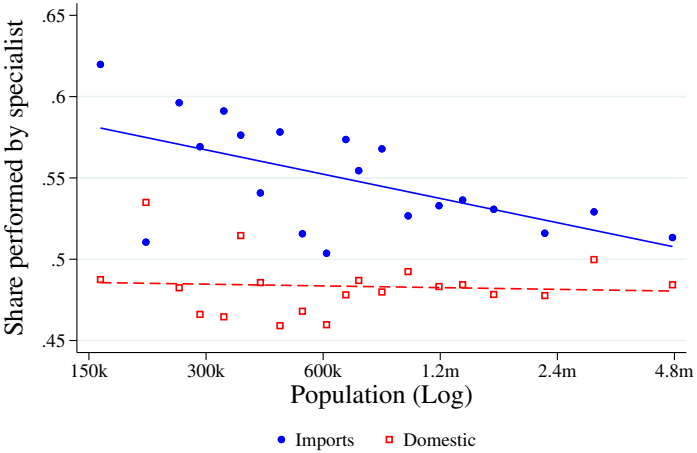
Traded procedures are specialist-intensive



- Classify a procedure as "generalist" if performed by Internal Medicine, Family Medicine, and General Practice $\geq 70\%$ (2,492 procedures)
- Classify as "specialist" if top two specializations do $\geq 70\%$ (7,533 procedures)
- Imports are more likely to be specialty care than locally produced consumption

▸ CBSAs

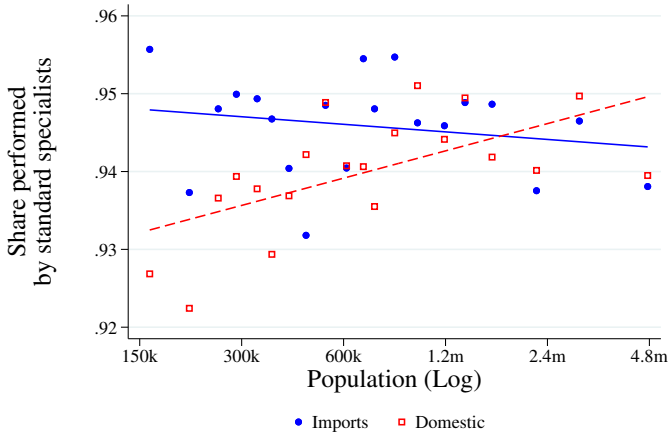
Smaller places more likely to import specialty procedures



Imports: y = −0.021 (0.005) * x + 0.837 (0.071)
Domestic: y = −0.002 (0.004) * x + 0.510 (0.060)

▸ CBSAs

Care provided by "wrong" specialties in smaller places



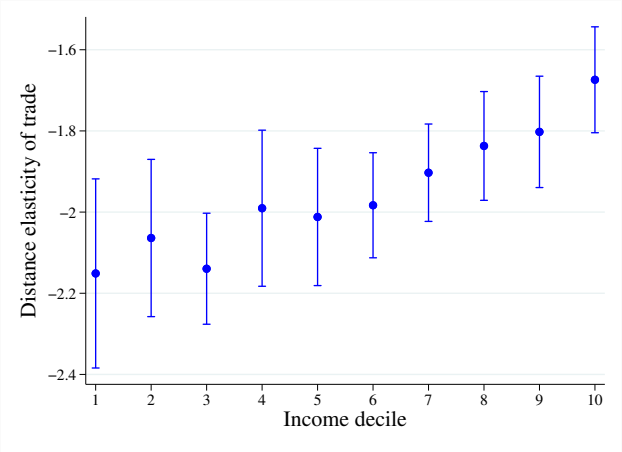
In smaller regions,

- domestically produced care less likely performed by "standard" specialist
- imports more likely performed by "standard" specialist

▸ CBSAs

Tradeoffs and counterfactual scenarios

Higher-SES patients are more willing to travel



Note: Coefficient on log distance estimated separately for each decile of the national ZIP-level median-household-income distribution. 95% CIs using standard errors clustered by both patient HRR and provider HRR.

▸ By procedure

Counterfactual scenario 1: Reallocate production

Reallocate production to smaller markets

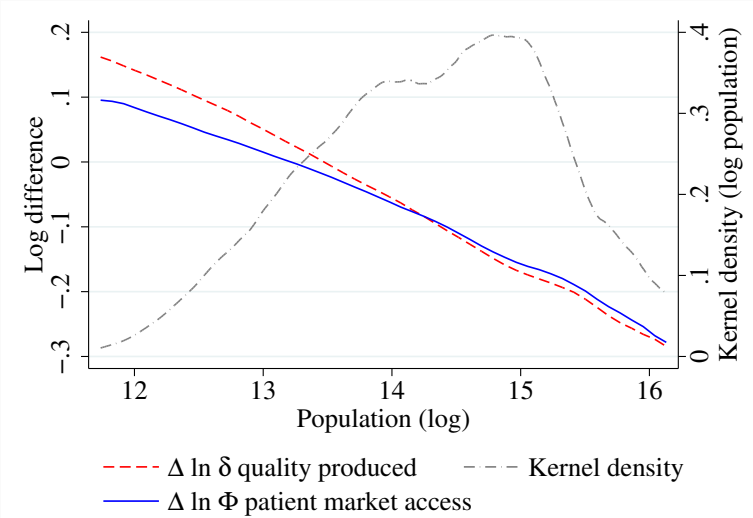
- Reduce population elasticity of output by 0.15

$$Q_i' = Q_i \left(\text{population}_i \Big/ \overline{\text{population}} \right)^{-0.15}$$

$$\delta_i' = \delta_i \left(\frac{Q_i'}{Q_i} \right)^{\alpha}$$

$$\Phi_i' - \delta_{0,i} = \sum_j \exp(\beta X_{ji}) \delta_j'$$

Reallocation reduces average patient market access



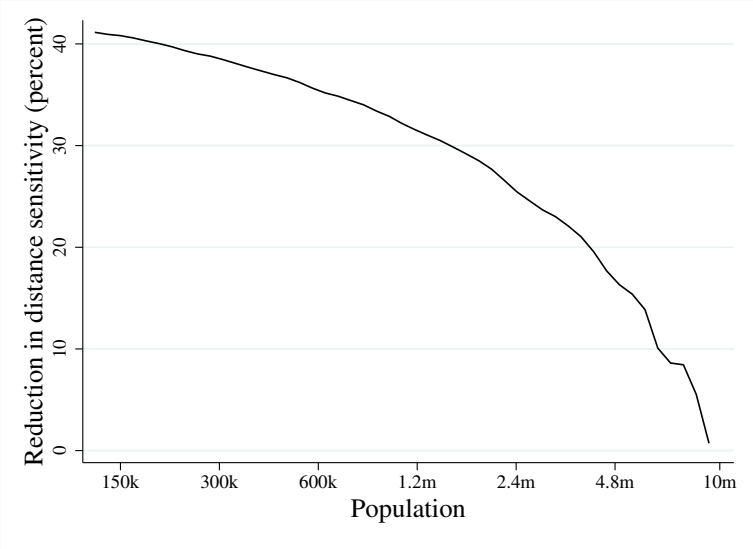
Counterfactual scenario 2: Increase patients' willingness to travel

- Increase log distance coefficient to γ' such that

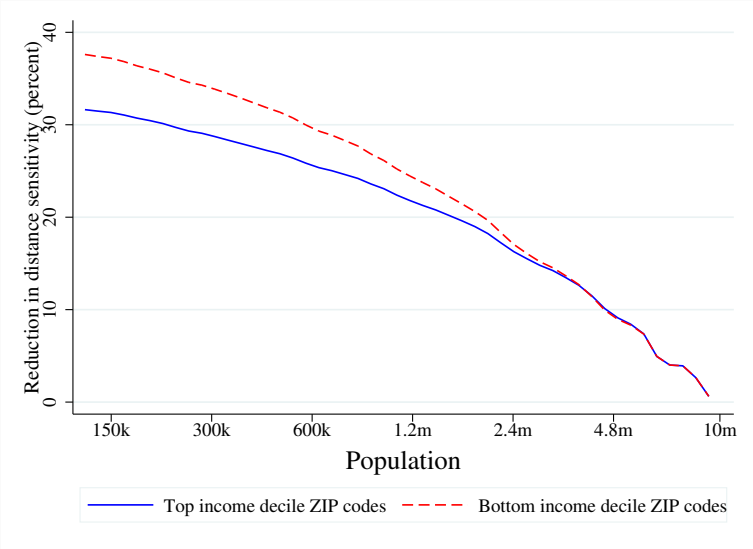
$$\begin{aligned}\Phi_i' - \delta_{0,i} &\equiv \sum_j \exp(\gamma' X_{ji})\delta_j \\ &= \Phi_{\text{biggest city}} - \delta_{0,\text{biggest city}}\end{aligned}$$

- Separate calculation for highest- and lowest-decile income ZIP codes

How much cheaper travel would equalize patient market access?



How much cheaper travel would equalize patient market access?



Conclusions

Conclusions

Personal services are tradable:

- Interregional trade in medical care behaves like manufactures
  - But higher distance sensitivity
  - High-SES patients less sensitive to distance
- Market size matters despite price controls
- Market size $\rightarrow$ quality & specialization

Implications:

- Proximity-concentration tradeoff interacts with equity-efficiency tradeoff
- Policy and research should account for trade
  - Impacts of location, access, concentration
  - Policies to improve access

Thank you

Geographic "maldistribution" of physicians

Council on Graduate Medical Education Tenth Report (1998):

> *Geographic maldistribution of health care providers and service is one of the most persistent characteristics of the American health care system. Even as an oversupply of some physician specialties is apparent in many urban health care service areas across the country, many inner-city and rural communities still struggle to attract an adequate number of health professionals to provide high-quality care to local people. This is the central paradox of the American health care system: shortages amid surplus.*

Simoens and Hurst (2006): "Most, if not all, OECD countries suffer from an unequal geographical distribution of their physician workforce."

Back

Economists on tradability of medical services

"An industry can bring in new dollars by selling its goods or services to persons or businesses from outside the local economy ('export-base production')... For health care institutions, demand for services tends to be more local." (Bartik and Erickcek, 2007)

"Outside of education and healthcare occupations, the typical 'white-collar' occupation involves a potentially tradable activity." (Jensen and Kletzer, 2005)

"This ability to scale production in a single plant was, however, of little use outside of manufacturing. Producing many cups of coffee, retail or health services in the same location is of no value, since it is impractical to take them to their final consumers." (Hsieh and Rossi-Hansberg, 2021)

Back

Services share of trade is growing (Eaton and Kortum, 2019)

Table 4.1 Services trade

Country	*Services exports (% of total exports)*			*Services imports (% of total imports)*		
	1985	*2000*	*2015*	*1985*	*2000*	*2015*
Australia	16.5	23.0	21.9	23.7	22.0	22.2
Austria	30.8	26.9	29.2	17.0	20.7	24.6
Canada	10.8	12.2	16.3	15.4	15.0	18.8
Denmark	24.6	33.0	38.4	20.3	33.5	39.9
Finland	12.9	14.9	30.3	17.2	23.3	33.5
France	24.4	22.2	28.4	20.7	19.1	28.0
Germany	10.9	13.8	17.3	20.0	23.0	22.4
Greece	26.8	55.9	48.4	11.3	23.1	19.5
Iceland	31.3	37.0	48.3	29.7	31.4	36.4
Israel	33.6	34.4	39.4	24.7	26.4	29.0
Italy	20.4	20.2	17.9	15.5	20.6	20.5
Japan	11.6	12.5	19.6	20.3	25.1	20.3
Korea	15.4	15.2	12.3	11.8	16.8	19.9
Luxembourg	37.2	73.2	85.1	25.4	58.9	82.0
Netherlands	16.2	20.4	22.8	17.5	24.3	27.3
Norway	27.5	23.2	29.3	28.8	31.8	36.7
Sweden	17.5	19.3	32.1	20.0	26.6	31.4
Switzerland	27.9	33.1	28.1	17.9	24.8	27.4
United Kingdom	24.7	30.5	44.2	17.6	23.7	25.9
United States	25.0	27.3	33.9	17.7	15.0	17.9

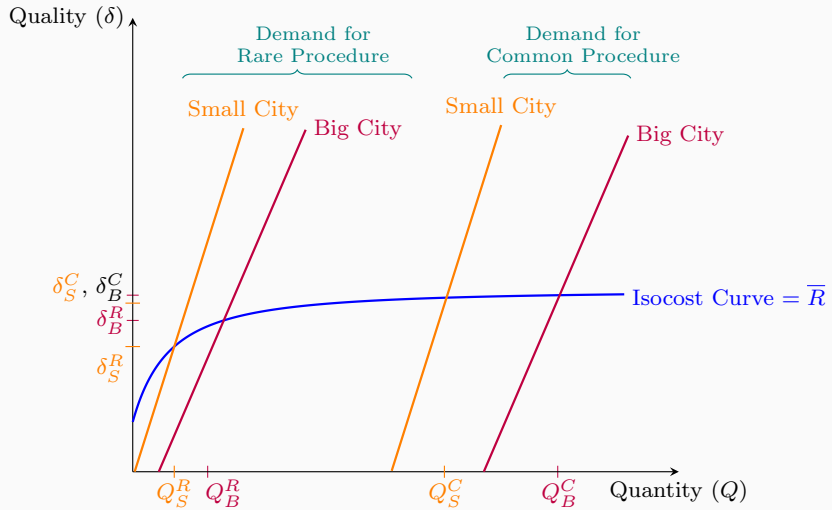
◂ Back

Lipsey: "Measuring International Trade in Services" (2009)

- "Unlike trade in goods, for trade in services there is no package crossing the customs frontier with an internationally recognized commodity code, a description of the contents, information on quantity, origin, and destination, an invoice and an administrative system based on customs duty collection, that is practiced at assembling these data"
- "Exports or imports of services often involve no crossing of an international boundary by the service, but only a crossing of a border by the consumer of the service."
- "The measurement difficulties are exacerbated by the deliberate manipulation of the apparent location of production; for the avoidance or reduction of corporate taxes by appearing to move production to low-tax locations."

Back

Rare vs common procedures: Non-zero small-city autarkic output



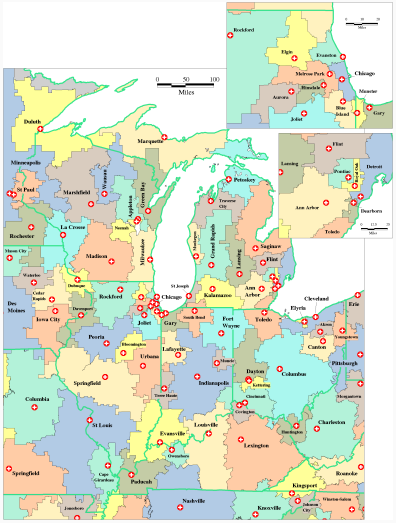
Back

Geographic units: Hospital referral regions

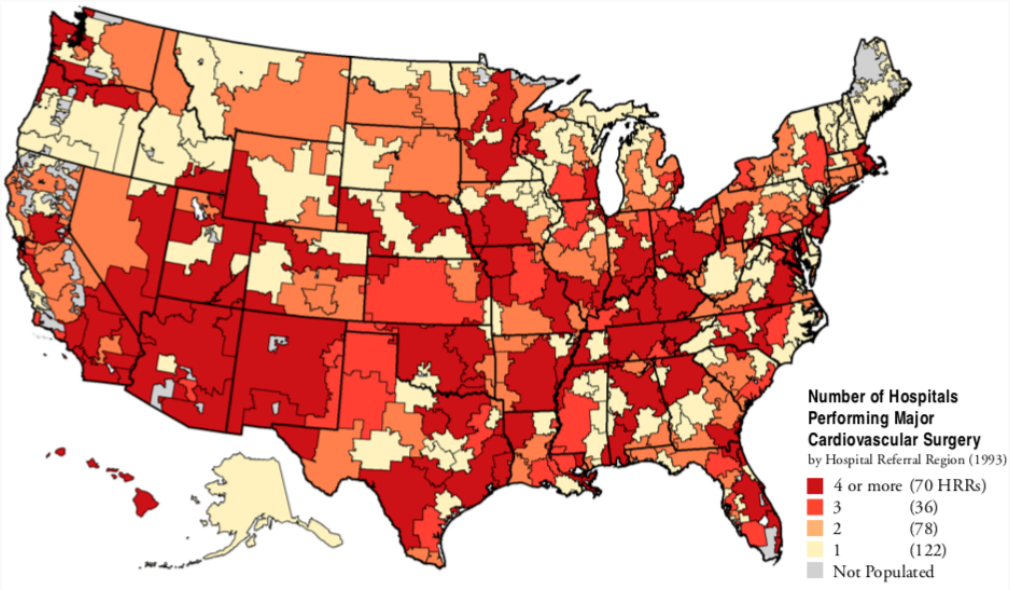
Our benchmark unit is a hospital referral region

- 306 HRRs defined by 1996 *Dartmouth Atlas*
- Aggregate patient ZIP codes based on major cardiovascular surgical procedures & neurosurgery in 1992-93 Medicare claims
- Each HRR has ≥ 1 city where both performed
- Most common unit used in health econ
- Definition could mechanically minimize trade

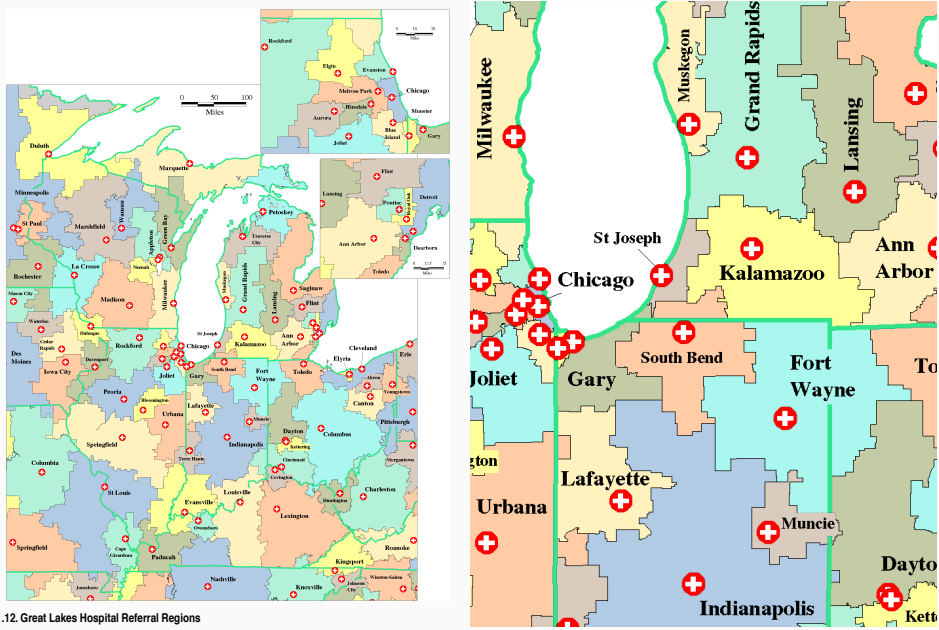
◂ Claims data ▸ National ▸ Bay Area ▸ South Bend ▸ Metro examples ▸ vs CBSA



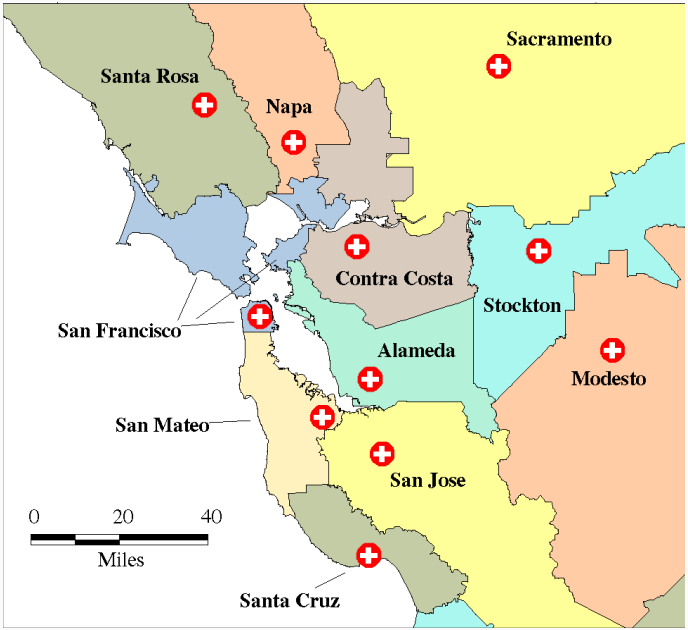
Map 1.12. Great Lakes Hospital Referral Regions


Number of Hospitals
Performing Major
Cardiovascular Surgery
by Hospital Referral Region (1993)
4 or more (70 HRRs)
3 (36)
2 (78)
1 (122)
Not Populated

◂ Data: Units



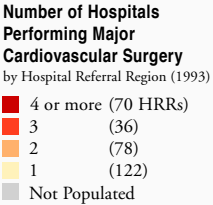
Map 1.12. Great Lakes Hospital Referral Regions

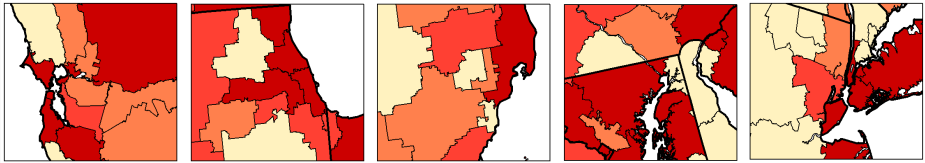

Sacramento
Santa Rosa
Napa
Contra Costa
Stockton
San Francisco
Alameda
Modesto
San Mateo
San Jose
0
20
40
Miles
Santa Cruz

Hospital referral regions: Metropolitan examples

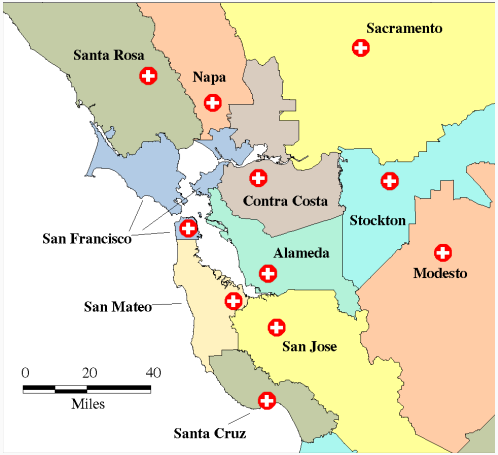
Map 1.5. Hospital Referral Regions According to the Number of Hospitals Performing Major Cardiovascular Surgery

Seventeen percent of the population of the United States lived in hospital referral regions with one hospital offering major cardiovascular surgery (buff), 18% in areas with two (light orange), 11% in regions with three (bright orange), and 54% in regions with four or more (red).



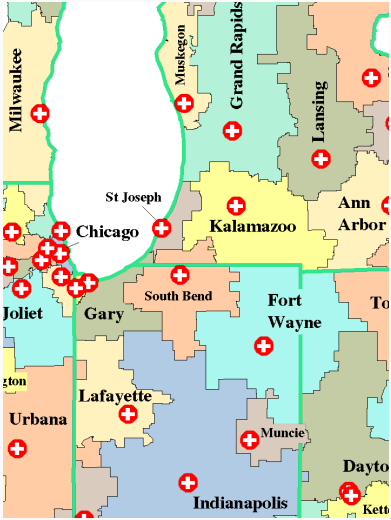


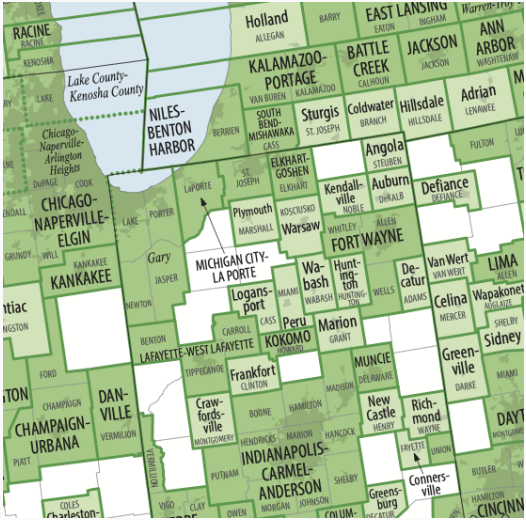
HRRs vs CBSAs



Back

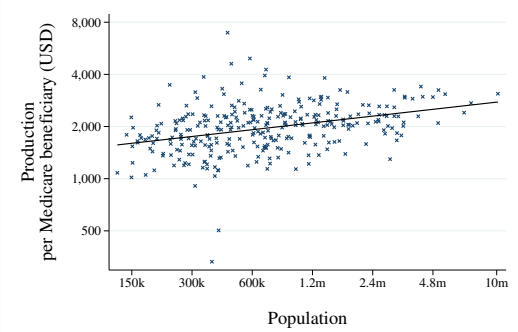
HRRs vs CBSAs



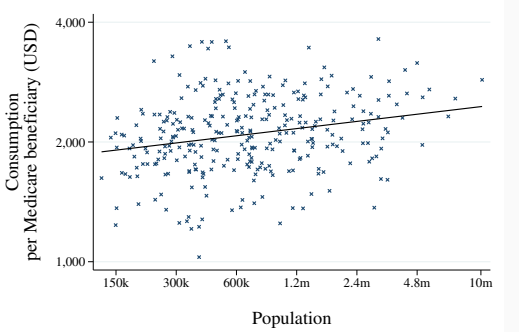


Back

Production and consumption by HRR size



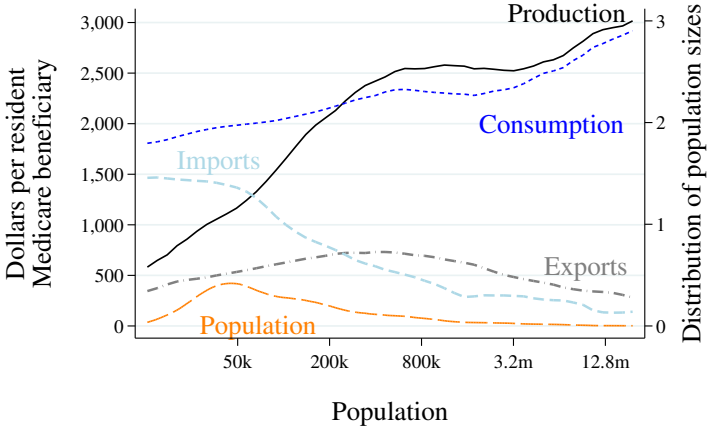
R−squared level−log: 0.10. R−squared log−log: 0.13.
Fitted line: ln(y) = 0.130 (0.020) * ln(x) + 5.827 (0.266).



R−squared level−log: 0.05. R−squared log−log: 0.06.
Fitted line: ln(y) = 0.060 (0.014) * ln(x) + 6.839 (0.189).

◂ Back

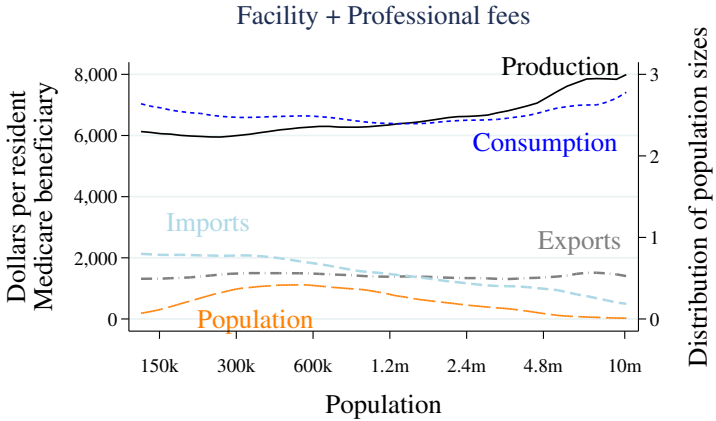
Production, consumption, trade, and CBSA size



Population elasticity (log–log regression slope) of transactions per resident Medicare beneficiary:
Production: 0.44 (0.02), Consumption: 0.06 (0.01)
Exports: 0.37 (0.03), Imports: −0.39 (0.01)

Back

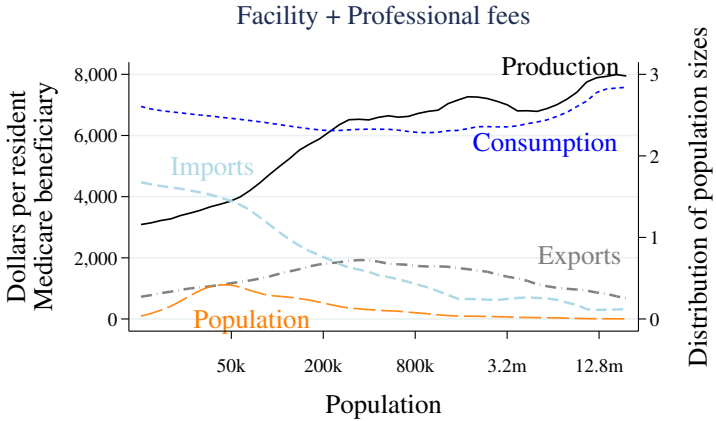
Production, consumption, trade, and HRR size w/ facility fees



Population elasticity (log–log regression slope) of transactions per resident Medicare beneficiary:
Production: 0.06 (0.01), Consumption: −0.01 (0.01)
Exports: −0.02 (0.04), Imports: −0.31 (0.03)

Back

Production, consumption, trade, and CBSA size w/ facility fees



Population elasticity (log–log regression slope) of transactions per resident Medicare beneficiary:
Production: 0.22 (0.01), Consumption: −0.02 (0.00)
Exports: 0.24 (0.02), Imports: −0.44 (0.01)

Back

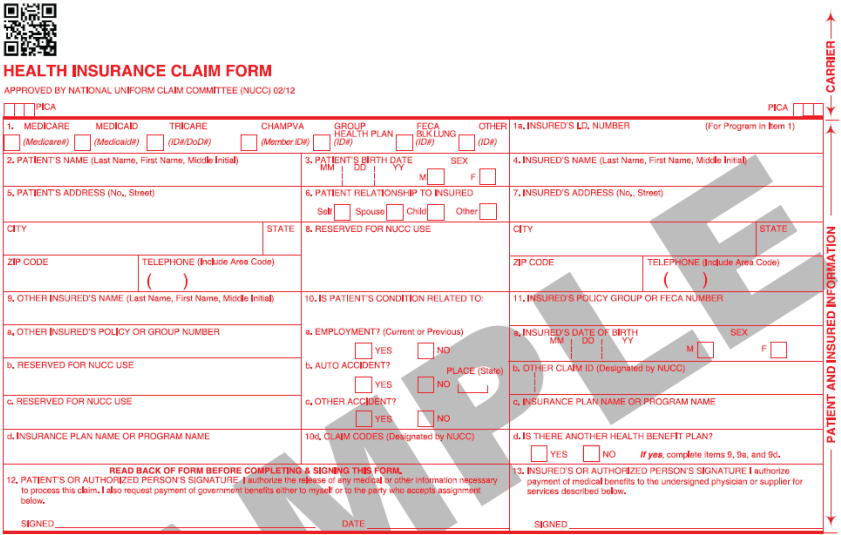
HCPCS code examples

Procedure	Total Service Count	Number of Providers
Established patient office or other outpatient, visit typically 25 minutes	87,942,824	309,239
Injection, ferric carboxymaltose, 1 mg	49,651,104	1,346
Routine electrocardiogram (EKG) using at least 12 leads with interpretation and report	18,859,406	48,308
Biopsy of large bowel using an endoscope	992,190	14,650
Anesthesia for open or endoscopic total knee joint replacement	178,065	7,569
Removal of stone from bile or pancreatic duct using an endoscope	35,432	1,299
Assessment of balance and postural instability	35,034	493
Insertion of lower heart chamber blood flow assist device	544	34
Suture of abdominal cavity tissue	24	2
Removal of multiple wrist bones	11	1
Fusion of spine bones for correction of deformity, posterior approach, 13 or more vertebral segments	11	1
Removal (5 centimeters or greater) tissue growth of leg or ankle	11	1
Lengthening of esophagus	11	1

Counts in public-use file tally procedures performed by an NPI ≥ 11 times

◂ Back

Claim form (top half)



HEALTH INSURANCE CLAIM FORM

APPROVED BY NATIONAL UNIFORM CLAIM COMMITTEE (NUCC) 02/12

PICA

1. MEDICARE (Medicare#) MEDICAID (Medicaid#) TRICARE (ID#/DoD#) CHAMPVA (Member ID#) GROUP HEALTH PLAN (ID#) FECA BLK LUNG (ID#) OTHER (ID#)

1a. INSURED'S I.D. NUMBER (For Program in Item 1)

2. PATIENT'S NAME (Last Name, First Name, Middle Initial)

3. PATIENT'S BIRTH DATE MM DD YY SEX M F

4. INSURED'S NAME (Last Name, First Name, Middle Initial)

5. PATIENT'S ADDRESS (No., Street)

6. PATIENT RELATIONSHIP TO INSURED Self Spouse Child Other

7. INSURED'S ADDRESS (No., Street)

CITY STATE

8. RESERVED FOR NUCC USE

CITY STATE

ZIP CODE TELEPHONE (Include Area Code) ( )

ZIP CODE TELEPHONE (Include Area Code) ( )

9. OTHER INSURED'S NAME (Last Name, First Name, Middle Initial)

10. IS PATIENT'S CONDITION RELATED TO:

11. INSURED'S POLICY GROUP OR FECA NUMBER

a. OTHER INSURED'S POLICY OR GROUP NUMBER

a. EMPLOYMENT? (Current or Previous) YES NO

a. INSURED'S DATE OF BIRTH MM DD YY SEX M F

b. RESERVED FOR NUCC USE

b. AUTO ACCIDENT? YES NO PLACE (State)

b. OTHER CLAIM ID (Designated by NUCC)

c. RESERVED FOR NUCC USE

c. OTHER ACCIDENT? YES NO

c. INSURANCE PLAN NAME OR PROGRAM NAME

d. INSURANCE PLAN NAME OR PROGRAM NAME

10d. CLAIM CODES (Designated by NUCC)

d. IS THERE ANOTHER HEALTH BENEFIT PLAN? YES NO *If yes*, complete items 9, 9a, and 9d.

READ BACK OF FORM BEFORE COMPLETING & SIGNING THIS FORM.

12. PATIENT'S OR AUTHORIZED PERSON'S SIGNATURE I authorize the release of any medical or other information necessary to process this claim. I also request payment of government benefits either to myself or to the party who accepts assignment below.

SIGNED _____ DATE _____

13. INSURED'S OR AUTHORIZED PERSON'S SIGNATURE I authorize payment of medical benefits to the undersigned physician or supplier for services described below.

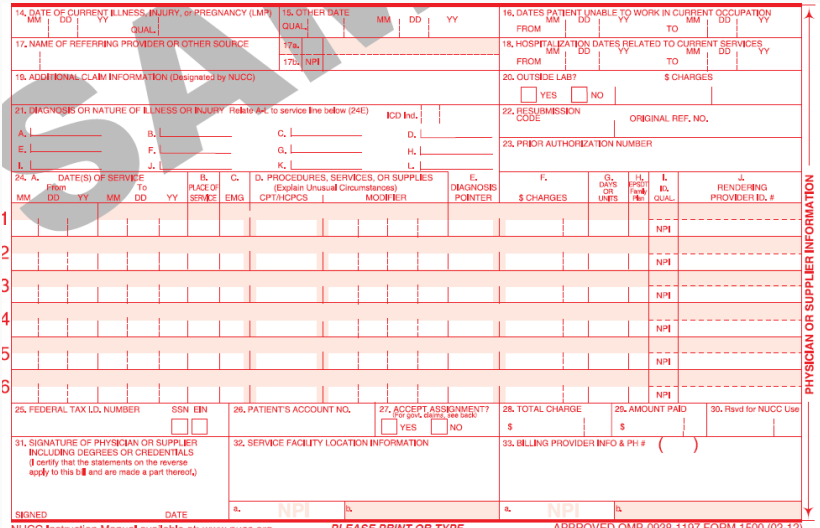
SIGNED _____

CARRIER

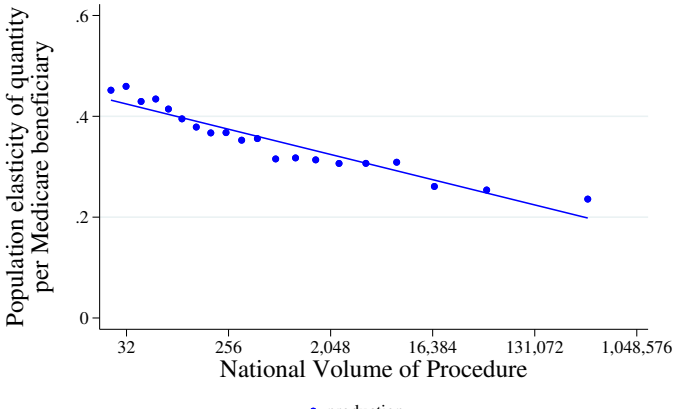
PATIENT AND INSURED INFORMATION

SAMPLE

Claim form (bottom half)



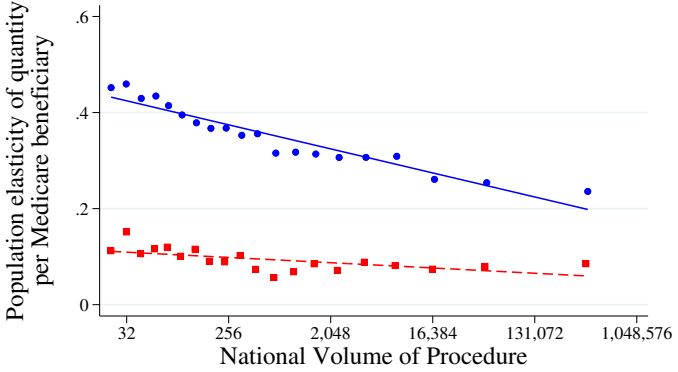
Population elasticity of production (CBSAs) vs frequency



Production fitted line: y = −0.024 (0.001) * x + 0.506 (0.010)
This plot depicts estimated population elasticities per Medicare beneficiary for 8,220 procedures produced at least 20 times nationally.

Back

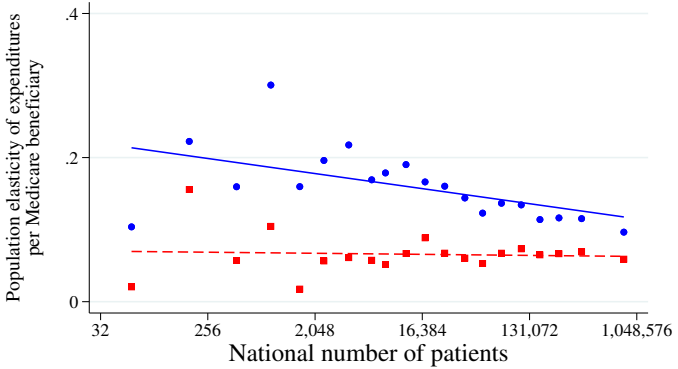
Population elasticity of consumption (CBSAs) vs frequency



Production fitted line: y = −0.024 (0.001) * x + 0.506 (0.010)
Consumption fitted line: y = −0.005 (0.001) * x + 0.126 (0.010)
This plot depicts estimated population elasticities per Medicare beneficiary for 8,220 procedures produced at least 20 times nationally.

Back

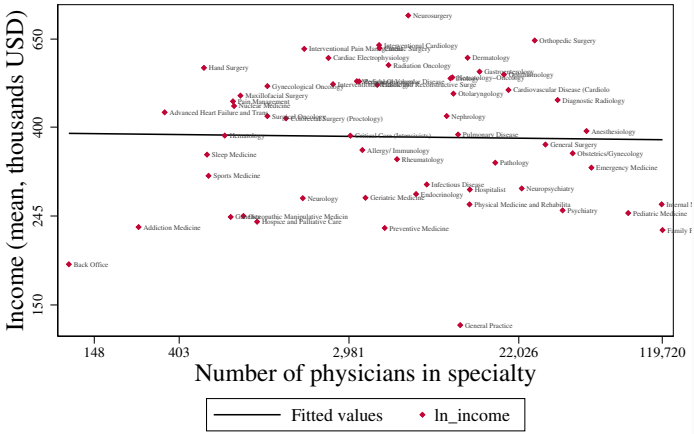
Population elasticities (HRRs) vs frequency, CCSR diagnoses



Production fitted line: y = −0.010 (0.003) * x + 0.252 (0.032)
Consumption fitted line: y = −0.000 (0.003) * x + 0.070 (0.028)
This plot depicts estimated population elasticities per Medicare beneficiary for 482 diagnoses billed for at least 20 patients nationally.

Back

Specialization earnings and frequency



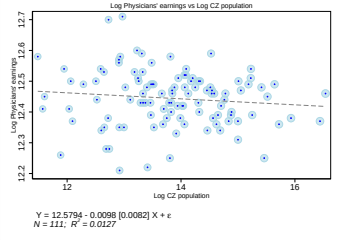
Pearson correlation: −0.022.
Fitted line: y = −0.005 (0.030) * x + 5.981 (0.261)

Back

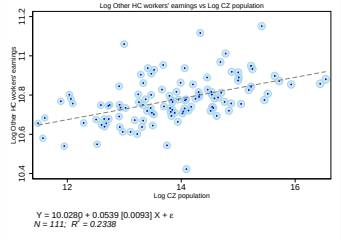
Labor costs rise with population size (commuting zones)

Population elasticities of earnings/value:

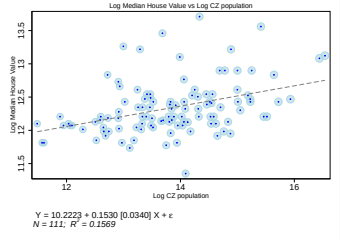
Physicians: -1%



Other healthcare occupations: +5%



Housing: +15%



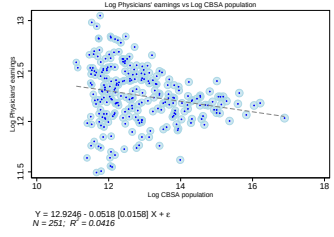
Category	Number of Workers	Average Earnings ($)	Total Spending ($ Millions)
Other HC Workers	6,553,901	59,847	392,229
Physicians	576,050	360,512	207,673

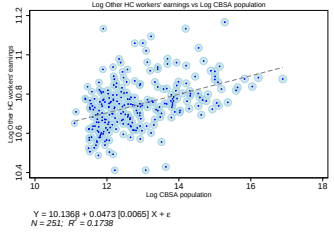
◂ HME regression ◂ Specialization ▸ CBSAs

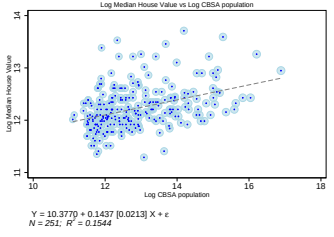
Labor costs rise with population size (CBSAs)

Population elasticities of earnings/value:

Physicians: -5% Other healthcare occupations: +5% Housing: +15%



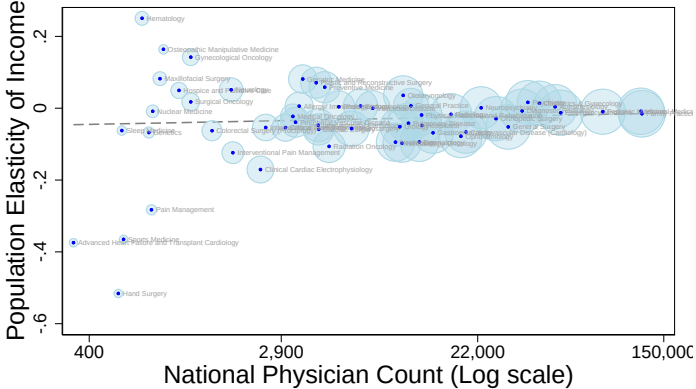




Category	Number of Workers	Average Earnings ($)	Total Spending ($ Millions)
Other HC Workers	7,260,806	58,056	421,531
Physicians	505,788	277,596	140,405

◂ HME regression ◂ Specialization

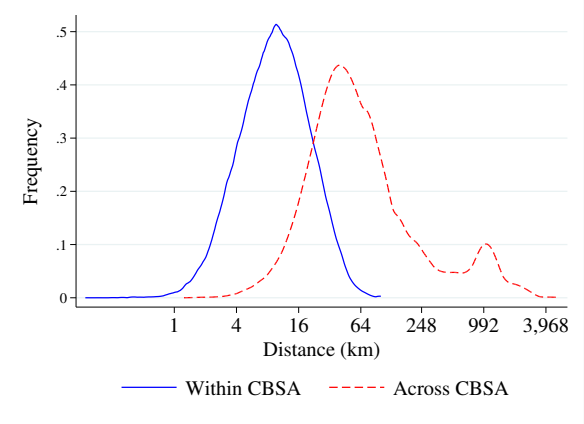
Population elasticities of earnings by specialty

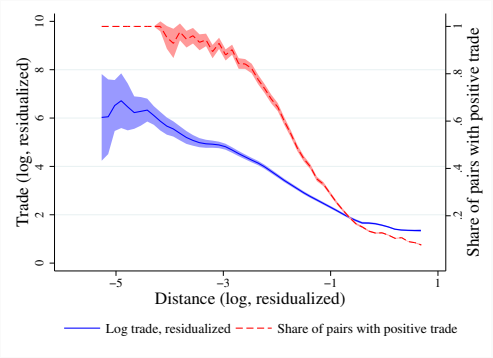


Both the regression and scatter markers are weighted by number of underlying observations for specialty's elasticity estimate
Pearson correlation: 0.113.
Fitted line: y = 0.005 (0.006) * x + -0.077 (0.061)
N = 56
Physician income and count data from Gottlieb et al. (2020)

Back

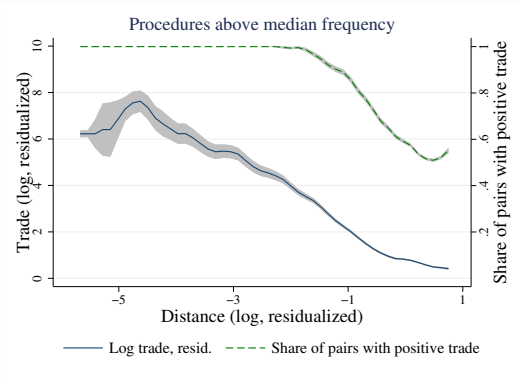
Bilateral distance and trade, CBSAs

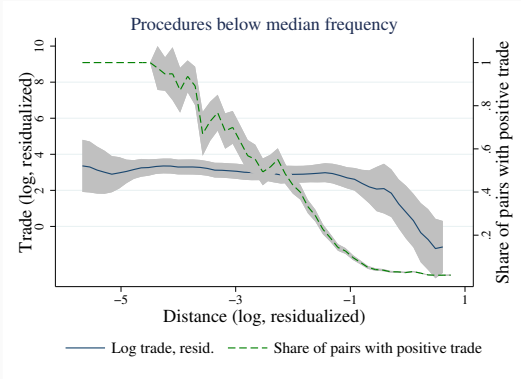




Back

Bilateral trade declines with bilateral distance





◂ Back

Consistent with gravity/logit, there is intra-procedure trade

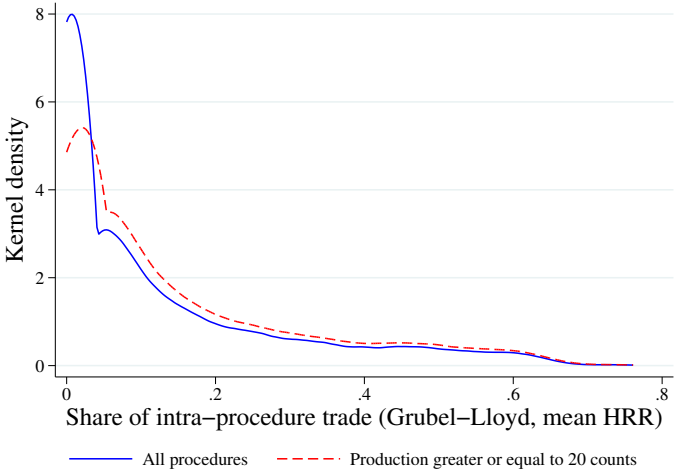
Grubel-Lloyd (1971) index:

$$\mathrm{GL}_{ph} = 1 - \frac{|X_{ph} - M_{ph}|}{X_{ph} + M_{ph}}$$

where X_{ph} and M_{ph} are exports and imports of procedure p in geography h.

$$\overline{\mathrm{GL}_{ph}} = 0.619$$

▸ Top surgical procedures ◂ Back



Gravity regression: Strong HME for aggregate services (CBSAs)

	(1)	(2)	(3)
$\lambda_{\mathbf{X}}$ Provider-market population (log)	0.734	0.739	0.703
	(0.0231)	(0.0233)	(0.0205)
$\lambda_{\mathbf{M}}$ Patient-market population (log)	0.398	0.396	0.419
	(0.0289)	(0.0291)	(0.0263)
Distance (log)	-2.302	-3.508	
	(0.0494)	(0.320)	
Distance (log, squared)		0.114	
		(0.0319)	
Observations	857,476	857,476	857,476
Distance deciles			Yes

Two-way clustered standard errors in parentheses

Back

Strong HME for aggregate services (HRRs, more FEs)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Provider-market population (log)	0.638	0.707			0.643	0.693			0.645	0.667	
	(0.0634)	(0.0558)			(0.0610)	(0.0546)			(0.0455)	(0.0451)	
Patient-market population (log)	0.377		0.427		0.376		0.414		0.406		0.418
	(0.0615)		(0.0539)		(0.0587)		(0.0520)		(0.0423)		(0.0424)
Distance (log)	-1.664	-1.834	-1.785	-1.894	0.0996	-0.515	-0.280	-0.555			
	(0.0501)	(0.0582)	(0.0588)	(0.0575)	(0.307)	(0.338)	(0.309)	(0.335)			
Distance (log, squared)					-0.178	-0.130	-0.150	-0.132			
					(0.0299)	(0.0327)	(0.0302)	(0.0332)			
Observations	93,636	93,636	93,636	93,636	93,636	93,636	93,636	93,636	93,636	93,636	93,636
Patient market FE		Yes		Yes		Yes		Yes		Yes	
Distance deciles									Yes	Yes	Yes
Provider market FE			Yes	Yes			Yes	Yes			Yes

Two-way clustered standard errors in parentheses

Back

Strong HME for aggregate services (CBSAs, more FEs)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Provider-market population (log)	0.734	0.781			0.739	0.795			0.703	0.733	
	(0.0232)	(0.0285)			(0.0234)	(0.0290)			(0.0205)	(0.0235)	
Patient-market population (log)	0.395		0.446		0.393		0.449		0.417		0.448
	(0.0290)		(0.0254)		(0.0292)		(0.0264)		(0.0264)		(0.0239)
Distance (log)	-2.311	-2.417	-2.371	-2.488	-3.464	-4.343	-4.116	-4.702			
	(0.0493)	(0.0617)	(0.0557)	(0.0674)	(0.324)	(0.312)	(0.328)	(0.310)			
Distance (log, squared)					0.110	0.180	0.164	0.206			
					(0.0323)	(0.0303)	(0.0321)	(0.0310)			
Observations	857,476	857,476	857,476	857,476	857,476	857,476	857,476	857,476	857,476	857,476	857,476
Patient market FE		Yes		Yes		Yes		Yes		Yes	
Distance deciles									Yes	Yes	Yes
Provider market FE			Yes	Yes			Yes	Yes			Yes

Two-way clustered standard errors in parentheses

Back

Strong HME for aggregate services (facility fees, HRRs)

	(1)	(2)	(3)
Provider-market population (log)	0.674	0.681	0.672
	(0.0563)	(0.0517)	(0.0400)
Patient-market population (log)	0.254	0.250	0.284
	(0.0532)	(0.0476)	(0.0330)
Distance (log)	-1.646	0.457	
	(0.0465)	(0.281)	
Distance (log, squared)		-0.212	
		(0.0284)	
Same hrr	0.479	1.625	4.775
	(0.165)	(0.214)	(0.0641)
Observations	93,636	93,636	93,636
Distance deciles			Yes

Two-way clustered standard errors in parentheses

Back

Strong HME for aggregate services (facility fees, CBSAs)

	(1)	(2)	(3)
Provider-market population (log)	0.789	0.794	0.742
	(0.0228)	(0.0222)	(0.0208)
Patient-market population (log)	0.263	0.260	0.303
	(0.0328)	(0.0324)	(0.0306)
Distance (log)	-2.338	-3.246	
	(0.0472)	(0.331)	
Distance (log, squared)		0.0866	
		(0.0331)	
Same cbsa	-1.337	-1.990	5.342
	(0.0946)	(0.229)	(0.0699)
Observations	857,476	857,476	857,476
Distance deciles			Yes

Two-way clustered standard errors in parentheses

Back

Strong HME for specific common & rare services (CBSAs)

	(1)	(2)	(3)	(4)	(5)	(6)
Procedure:	Colonoscopy	Cataract surgery	Brain radiosurgery	Brain tumor	LVAD	Colon removal
HCPCS code:	G0121	66982	61798	61510	33979	44155
$\lambda_{\mathbf{X}}$ Provider-market population (log)	0.639	0.682	1.017	0.976	1.043	1.005
	(0.0263)	(0.0230)	(0.0503)	(0.0447)	(0.0805)	(0.0932)
$\lambda_{\mathbf{M}}$ Patient-market population (log)	0.322	0.424	0.391	0.329	0.466	0.106
	(0.0303)	(0.0355)	(0.0317)	(0.0438)	(0.0805)	(0.124)
Distance (log)	-4.180	-4.192	-1.514	-1.733	-0.251	0.987
	(0.357)	(0.432)	(1.008)	(0.704)	(1.986)	(3.630)
Distance (log, squared)	0.165	0.165	-0.0567	-0.0559	-0.178	-0.377
	(0.0358)	(0.0435)	(0.0971)	(0.0708)	(0.195)	(0.386)
Observations	857,476	857,476	857,476	857,476	857,476	857,476
Distance elasticity at mean	-1.83	-1.84	-2.32	-2.53	-2.78	-4.39
Total count	53,058	38,316	689	1,755	295	102

Two-way clustered standard errors in parentheses

Back

HME stronger for rarer procedures (full table)

	(1)	(2)	(3)	(4)	(5)	(6)
Provider-market population (log)	0.638	0.624	0.623		0.630	
	(0.0634)	(0.0613)	(0.0614)		(0.0598)	
Patient-market population (log)	0.377	0.379	0.380		0.379	
	(0.0615)	(0.0590)	(0.0591)		(0.0572)	
Distance (log)	-1.664	-1.599	-1.599		-0.146	
	(0.0501)	(0.0492)	(0.0492)		(0.295)	
Distance (log, squared)					-0.147	
					(0.0285)	
Same hrr	0.211	0.309	0.310		1.085	
	(0.180)	(0.175)	(0.175)		(0.249)	
Provider-market population (log) × rare			0.306	0.291	0.316	0.287
			(0.0472)	(0.0455)	(0.0480)	(0.0458)
Patient-market population (log) × rare			-0.229	-0.219	-0.232	-0.211
			(0.0698)	(0.0671)	(0.0704)	(0.0658)
Distance (log) × rare			0.0421	0.0488	0.883	0.768
			(0.0441)	(0.0497)	(0.379)	(0.180)
Distance (log, squared) × rare					-0.0835	-0.0682
					(0.0436)	(0.0191)
Same hrr × rare			-0.454	-0.441	0.0520	0.0521
			(0.179)	(0.194)	(0.128)	(0.180)
Observations	187,272	113,468	113,468	113,468	113,468	113,468
Patient-provider-market-pair FEs				Yes		Yes

Two-way clustered standard errors in parentheses

Back

HME stronger for rarer procedures (split by expenditure)

	(1)	(2)	(3)	(4)	(5)	(6)
Provider-market population (log)	0.638	0.624	0.608		0.614	
	(0.0634)	(0.0613)	(0.0600)		(0.0580)	
Patient-market population (log)	0.377	0.379	0.395		0.394	
	(0.0615)	(0.0590)	(0.0582)		(0.0560)	
Distance (log)	-1.664	-1.599	-1.620		-0.216	
	(0.0501)	(0.0492)	(0.0498)		(0.301)	
Distance (log, squared)					-0.143	
					(0.0294)	
Same hrr	0.211	0.309	0.332		1.066	
	(0.180)	(0.175)	(0.177)		(0.251)	
Provider-market population (log) × rare			0.0304	0.0281	0.0316	0.0280
			(0.0168)	(0.0149)	(0.0172)	(0.0148)
Patient-market population (log) × rare			-0.0307	-0.0300	-0.0306	-0.0292
			(0.0148)	(0.0131)	(0.0152)	(0.0129)
Distance (log) × rare			0.0385	0.0518	0.146	0.245
			(0.00779)	(0.0109)	(0.0758)	(0.0711)
Distance (log, squared) × rare					-0.00966	-0.0185
					(0.00765)	(0.00625)
Same hrr × rare			-0.0481	-0.0149	0.0357	0.112
			(0.0247)	(0.0308)	(0.0447)	(0.0580)
Observations	187,272	113,468	113,468	113,468	113,468	113,468
Patient-provider-market-pair FEs				Yes		Yes

Robust standard errors in parentheses

Back

HME stronger for rarer procedures (CBSAs)

	(1)	(2)	(3)	(4)	(5)	(6)
Provider-market population (log)	0.734	0.689	0.689		0.695	
	(0.0232)	(0.0205)	(0.0205)		(0.0204)	
Patient-market population (log)	0.395	0.413	0.413		0.411	
	(0.0290)	(0.0269)	(0.0270)		(0.0269)	
Distance (log)	-2.311	-2.017	-2.017		-3.570	
	(0.0493)	(0.0456)	(0.0457)		(0.288)	
Distance (log, squared)					0.146	
					(0.0269)	
Same cbsa	-1.574	-1.000	-0.999		-2.158	
	(0.0963)	(0.0938)	(0.0939)		(0.217)	
Provider-market population (log) × rare			0.151	0.180	0.143	0.163
			(0.0307)	(0.0316)	(0.0333)	(0.0339)
Patient-market population (log) × rare			-0.0448	-0.0794	-0.0417	-0.0713
			(0.0353)	(0.0360)	(0.0371)	(0.0364)
Distance (log) × rare			0.115	0.107	2.049	2.831
			(0.0367)	(0.0288)	(0.887)	(0.909)
Distance (log, squared) × rare					-0.182	-0.240
					(0.0824)	(0.0810)
Same cbsa × rare			-0.457	-0.426	1.005	1.973
			(0.188)	(0.194)	(0.552)	(0.652)
Observations	1,714,952	223,996	223,996	223,996	223,996	223,996
Patient-provider-market-pair FEs				Yes		Yes

Two-way clustered standard errors in parentheses

Back

HME stronger for rarer procedures (HRRs), CCSR diagnoses

	(1)	(2)	(3)	(4)	(5)	(6)
Provider-market population (log)	0.638	0.624	0.620		0.627	
	(0.0634)	(0.0613)	(0.0606)		(0.0590)	
Patient-market population (log)	0.377	0.379	0.382		0.380	
	(0.0615)	(0.0590)	(0.0585)		(0.0566)	
Provider-market population (log) × rare			0.110	0.103	0.115	0.102
			(0.0540)	(0.0499)	(0.0546)	(0.0482)
Patient-market population (log) × rare			-0.0630	-0.0603	-0.0627	-0.0549
			(0.0427)	(0.0399)	(0.0444)	(0.0391)
Observations	187,272	113,468	113,468	113,468	113,468	113,468
Distance controls	Yes	Yes	Yes	Yes		
Distance [quadratic] controls					Yes	Yes
Patient-provider-market-pair FEs				Yes		Yes

Two-way clustered standard errors in parentheses

Back

Top 10 surgical procedures - intra-procedure trade

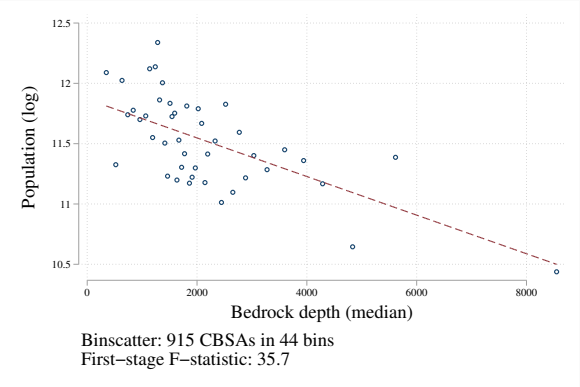
	GL index			
	Value	Count	Import to Consumption Ratio	Production (million USD)
Top 10 procedures (GL value)				
20610 - Aspiration and/or injection of large joint or joint capsule	0.69	0.69	0.19	60.2
45378 - Diagnostic examination of large bowel using an endoscope	0.68	0.69	0.18	16.2
43239 - Biopsy of the esophagus, stomach, and/or upper small bowel using an endoscope	0.67	0.68	0.19	31.9
69210 - Removal of impact ear wax, one ear	0.66	0.66	0.18	12.1
45385 - Removal of polyps or growths of large bowel using an endoscope	0.65	0.65	0.17	46.5
17000 - Destruction of skin growth	0.65	0.64	0.18	52.1
45380 - Biopsy of large bowel using an endoscope	0.64	0.65	0.18	31.9
10060 - Drainage of abscess	0.64	0.65	0.17	3.8
43235 - Diagnostic examination of esophagus, stomach, and/or upper small bowel using an endoscope	0.64	0.64	0.19	7.6
66821 - Removal of recurring cataract in lens capsule using laser	0.64	0.64	0.18	40.1
Selected procedure examples				
45380 - Biopsy of large bowel using an endoscope	0.64	0.65	0.18	31.9
33979 - Insertion of lower heart chamber blood flow assist device	0.07	0.07	0.53	0.4

Notes: The Grubel-Loyd index is averaged across HRRs. Procedures with at least 10,000 USD of production are displayed and are sorted based on the Grubel-Lloyd ratios and production amount (USD). Source data: 2017 Medicare Claims data, 20% Carrier Files and MBSF Files.

Back

Instrument population size using bedrock depth

- Levy & Moscona (2020): Shallower subterranean bedrock $\rightarrow$ easier to build $\rightarrow$ higher population density
- We use bedrock depth as an instrument for CBSA population
- HME results hold up when instrumented



▸ IV results

◂ Aggregate HME ◂ Stronger HME for rarer

Strong HME with bedrock-depth IV for population

	(1) IV sample	(2) IV: GMM	(3) GMM Common	(4) GMM Rare
Provider-market population (log)	0.739	1.161	1.157	1.753
	(0.0259)	(0.307)	(0.307)	(0.524)
Patient-market population (log)	0.394	0.178	0.182	-0.582
	(0.0311)	(0.373)	(0.373)	(0.580)
Distance (log)	-3.400	-4.677	-4.678	-4.631
	(0.347)	(1.056)	(1.049)	(2.520)
Distance (log, squared)	0.105	0.210	0.210	0.181
	(0.0346)	(0.0850)	(0.0845)	(0.199)
Observations	781,456	781,456	781,456	781,456

Two-way clustered standard errors in parentheses

◂ Aggregate HME ◂ Stronger HME for rarer ▸ Full common-rare table

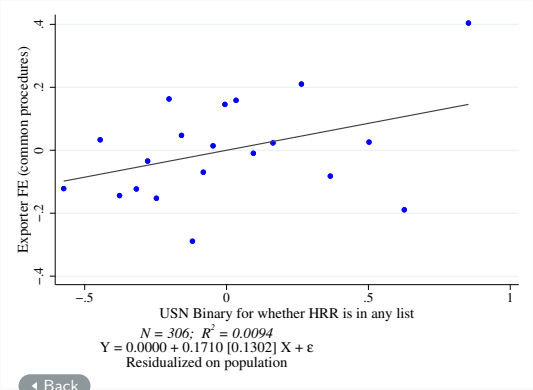
Stronger HME for rare procedures with IV for population

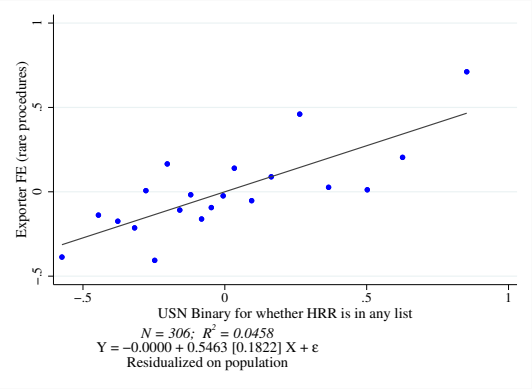
	(1)	(2)	(3)	(4)	(5)	(6)
Geography:	HRR	HRR	CBSA	CBSA	CBSA	CBSA
Instrument:	1940 pop	1940 pop	1940 pop	1940 pop	Bedrock	Bedrock
Procedure Sample:	Common	Rare	Common	Rare	Common	Rare
Provider-market population (log)	0.595	1.080	0.716	0.895	1.157	1.753
	(0.0733)	(0.0913)	(0.0249)	(0.0388)	(0.307)	(0.524)
Patient-market population (log)	0.361	0.0476	0.396	0.328	0.182	-0.582
	(0.0522)	(0.114)	(0.0261)	(0.0344)	(0.373)	(0.580)
Distance (log)	0.0756	0.973	-3.412	-1.378	-4.678	-4.631
	(0.270)	(0.449)	(0.294)	(0.989)	(1.049)	(2.520)
Distance (log, squared)	-0.177	-0.261	0.105	-0.0742	0.210	0.181
	(0.0265)	(0.0503)	(0.0287)	(0.0935)	(0.0845)	(0.199)
Observations	93,636	93,636	857,476	857,476	781,456	781,456
Distance elasticity at mean	-2.45	-2.76	-1.91	-2.43	-1.68	-2.05

Two-way clustered standard errors in parentheses

◂ Aggregate HME ◂ Stronger HME for rarer

Exporter Fixed Effects and Hospital Quality





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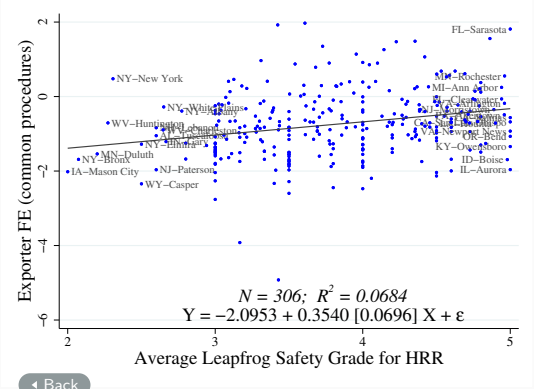
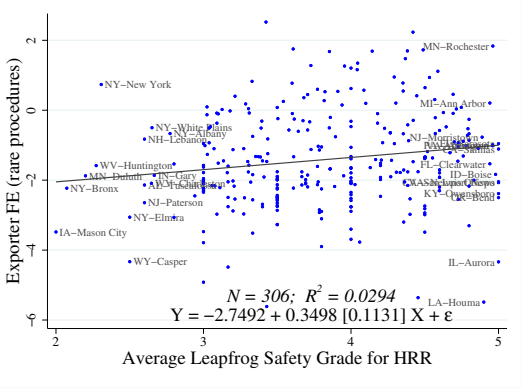
Exporter Fixed Effects and Hospital Quality





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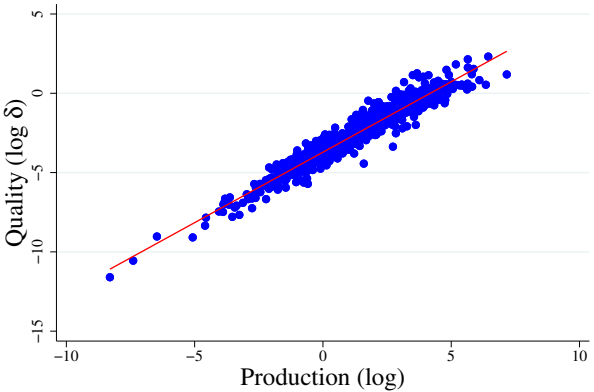
Scale elasticity of quality (CBSAs)



The estimated elasticity is 0.888.

	No Controls		Controls	
	No Diag	Diag	No Diag	Diag
OLS	1.052	0.888	1.063	0.908
	(0.017)	(0.009)	(0.023)	(0.011)
2SLS: *pop*	1.023	0.845	1.016	0.847
	(0.016)	(0.010)	(0.024)	(0.014)
2SLS: *pop1940*	0.928	0.848	0.900	0.843
	(0.025)	(0.014)	(0.036)	(0.020)
2SLS: *bedrock*	0.762	0.810	0.700	0.815
	(0.099)	(0.038)	(0.116)	(0.043)

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Scale elasticity of quality by procedure (HRRs)

Procedure:	Colonoscopy	Cataract surgery	Total knee arthroplasty	Office visit (25 min)	Stent (PCI)	Imaging optic nerve
HCPCS code:	G0121	66982	27447	99214	92928	92133
OLS	0.792	0.643	0.900	0.800	0.879	0.755
	(0.053)	(0.052)	(0.039)	(0.033)	(0.041)	(0.036)
2SLS: *pop*	0.652	0.601	0.823	0.708	0.719	0.625
	(0.056)	(0.064)	(0.054)	(0.035)	(0.055)	(0.040)
2SLS: *pop1940*	0.883	0.360	0.508	0.507	0.450	0.698
	(0.082)	(0.087)	(0.096)	(0.077)	(0.101)	(0.074)
N	306	304	304	306	306	304
Total count	58,798	43,604	65,985	18,010,036	53,615	410,875

Note: Standard errors are heteroskedasticity-robust.

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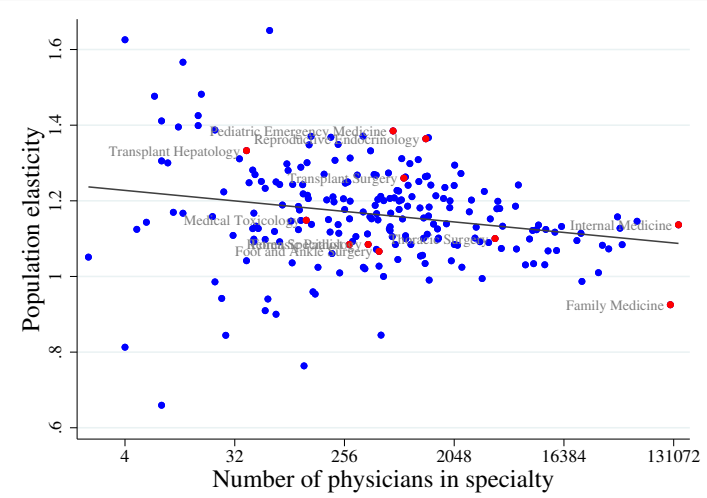
Population elasticities of physician specializations (CBSAs)



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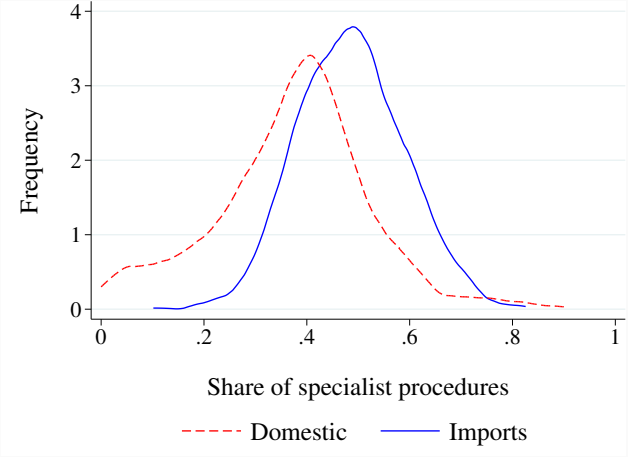
Traded procedures are specialist-intensive (CBSAs)

Imports are more likely to be specialty care than locally produced consumption



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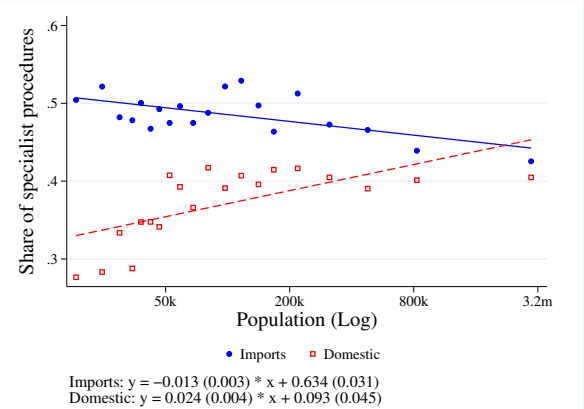
Small places more likely to import specialty procedures (CBSAs)

Smaller regions more likely to import specialty procedures, while larger places more likely to consume specialty procedures produced locally



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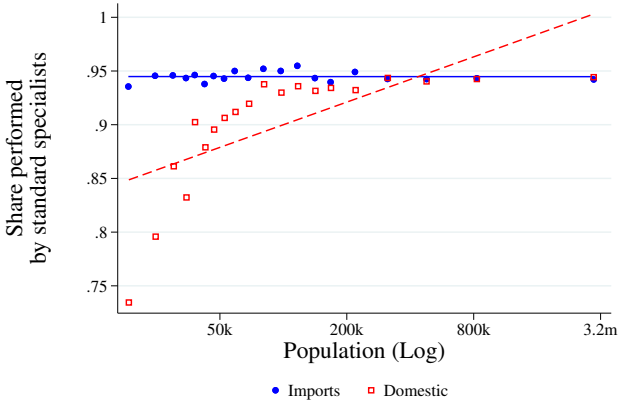
Care provided by "wrong" specialties in smaller places (CBSAs)



Smaller places less likely to get domestically produced specialty care performed by the "correct" specialty, and more likely to import specialty procedures performed by the "correct" specialties

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Income heterogeneity in willingness to travel by procedure

	(1) 25min visit	(2) cataract removal	(3) knee joint repair	(4) heart artery bypass	(5) gallblader removal	(6) repair conjunctiva	(7) repair finger tendon
Distance (log)	-2.047	-2.224	-2.207	-2.237	-2.101	-2.229	-2.562
	(0.0764)	(0.0798)	(0.0896)	(0.0872)	(0.0873)	(0.217)	(0.305)
Distance (log) × income tercile 2	0.0860	0.154	0.136	0.114	0.201	-0.106	0.451
	(0.0611)	(0.0681)	(0.0722)	(0.0839)	(0.0722)	(0.269)	(0.387)
Distance (log) × income tercile 3	0.193	0.293	0.194	0.395	0.300	0.186	0.502
	(0.0754)	(0.0830)	(0.0908)	(0.0929)	(0.0915)	(0.247)	(0.386)
Observations	271,728	268,705	262,352	240,352	250,800	36,250	45,584
Patient market-income FE & Provider market FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Two-way clustered standard errors in parentheses

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