Approaches to Addressing MD Shortages

Victoria Angelova

February 28, 2024

Motivation

- 99M people live in areas with 1 primary care provider per 3,500 people
  [BHW, 2023]

Motivation

- 99M people live in areas with 1 primary care provider per 3,500 people
  [BHW, 2023]

- Shortage projected to reach up to 124,000 physicians within 10 years
  [AAMC, 2021]

Motivation

- 99M people live in areas with 1 primary care provider per 3,500 people
  [BHW, 2023]

- Shortage projected to reach up to 124,000 physicians within 10 years
  [AAMC, 2021]

- Medically-underserved communities have worse health outcomes on average
  [Marshall et al., 2017]

Motivation

- 99M people live in areas with 1 primary care provider per 3,500 people
  [BHW, 2023]

- Shortage projected to reach up to 124,000 physicians within 10 years
  [AAMC, 2021]

- Medically-underserved communities have worse health outcomes on average
  [Marshall et al., 2017]

- Key policy questions:
  - ▶ How to increase the supply of medical professionals in medical deserts?
  - ▶ Can an additional doctor influence health outcomes in underserved areas?

Programs Incentivizing Practice in Health Professional Shortage Areas (HPSAs)

- **National Health Service Corps (NHSC)**:
  scholarships/loan repayments to U.S.-citizen providers if work in a HPSA

- **J-1 Waiver Programs**:
  immigration benefit to foreign doctors if work in HPSAs for 3 years

  ▶ Conrad 30, HHS J-1 Waiver Program, Appalachian J-1 program, etc

- **CMS HPSA Bonus Repayment Program**
  bonus payments if providing medical services in HPSAs

The Determinants of Physicians' Location Choice: Understanding the Rural Shortage

Elena Falcettoni[1]

Paper in a Slide

- Develops rich structural model on physicians' location choices
  - ▶ Focuses on location choice for first job after residency
  - ▶ Novel data on physicians' medical school, residency, and first-job choices
- Estimates elasticities of location choices w.r.t net income + amenities
- Finds that specialists are more elastic to net income and amenities
  - ▶ Top-50 residents are more responsive than lower-ranked residents
  - ▶ No systematic differences between foreign and U.S. physicians
  - ▶ PCPs display same persistence in location choices as unskilled workers
- Loan forgiveness + salary incentives → 1.2% ↑ of physicians in rural areas
  - ▶ ↑ salary incentives would result in ↑ higher-quality physicians to rural areas

Contribution to the Literature

1. Physician location and geographical distribution

   $\rightarrow$ Structural model that accounts for additional considerations
     e.g. specialty, training quality and net income

2. Labor literature on location choice of skilled workers

   $\rightarrow$ Studies within-occupation differences across specialty type

Model Overview

Physician Supply

- Static discrete choice model of physician i among locations (HHRs) j
- Heterogeneous physician preferences by:
  - ▶ Specialty, k [Physician Work History Panel]
  - ▶ Demographics, l [Physician Work History Panel]
    - $\rightarrow$ Skill, q_i (proxied by quality of residency program)
    - $\rightarrow$ Foreign status, f_i
- Physician-specific net income, y_{ij}:
  - ✓ Salary [BLS]
  - ✓ Procedure Revenue $= \sum_t p_t \times N_t$ [CMS Medicare Part B Data]
    - $\rightarrow$ incentive for PCPs to substitute to specialty services in rural areas
  - ✗ Housing costs [ACS]
  - ✗ Malpractice insurance
  - ✗ Student loans

Physician Supply

- Location-specific amenity index as proxy for amenity bundle (x_j)
  - ▶ Retail, education, environment, health, crime, transportation, long commute, and traffic characteristics
  - ▶ Highest ranked HHRs: New York, Chicago, DC, San Francisco, Seattle
- Location-specific unobservable ξ_j

Physician Supply

- Higher-ranked physicians have more options in their choice set
  → "First dibs" on jobs with higher amenity and higher pay

- Allow for home-bias toward place where physician completed residency x_{ij}

- New physicians pick a location within the whole nation,
  compete with other graduates who are picking a location that year

Physician Preferences

$$\max_j u_{ij} = \overbrace{\beta^{k,\ell} x_j + \xi_j^{k,\ell}}^{\delta_j^{k,\ell}} + \overbrace{\alpha^{k,\ell} y_{ij} + \beta_j^{k,\ell} x_{ij}}^{\mu_{ij}} + \epsilon_{ij}$$

- k = specialty group (PC vs. SP)
- ℓ = quality ranking (q) and foreign status (f)
- $\delta_j^{k,\ell}$ = mean utility
- μ_{ij} = individual utility

Data: x_j, y_{ij}, x_{ij}
Unobserved: $\xi_j^{k,\ell}$, ϵ_{ij}
Parameters: $\beta^{k,\ell}$, $\alpha^{k,\ell} \beta_j^{k,\ell}$

Choice Probabilities

Implied choice probabilities:

$$
N_{jt}^{PC} = \sum_{\ell \in q,f} \sum_{i=1}^{N_{\ell t}^{PC}} \frac{\exp\left\{\delta_{jt}^{PC,\ell} + \mu_{ijt}\right\}}{\sum_{m=1}^{M} \exp\left\{\delta_{mt}^{PC,\ell} + \mu_{imt}\right\}} N_{\ell t}^{PC}
$$

$$
N_{jt}^{SP} = \sum_{\ell \in q,f} \sum_{i=1}^{N_{\ell t}^{SP}} \frac{\exp\left\{\delta_{jt}^{SP,\ell} + \mu_{ijt}\right\}}{\sum_{m=1}^{M} \exp\left\{\delta_{mt}^{SP,\ell} + \mu_{imt}\right\}} N_{\ell t}^{SP}
$$

Demand for Physicians

- Each HRR j produces a medical good (M) through a high number of homogeneous firms

- Production $\approx$ CD function, with PCPs, specialists and machinery (K)

  ▶ K may be obtained anywhere at p_t

- Number of physicians $\approx$ CES function

- Allow for PCPs and specialists to have different productivities

Demand for Physicians

$$M_{jt} = D_{jt}^{\alpha} K_{jt}^{1-\alpha}$$

$$D_{jt} = \left(\theta_{jt}^{PC} \left(N_{jt}^{PC} \right)^{\rho} + \theta_{jt}^{SP} \left(N_{jt}^{SP} \right)^{\rho} \right)^{\frac{1}{\rho}}$$

$$\theta_{jt}^{PC} = f_{PC} \left(N_{jt}^{PC}, N_{jt}^{SP} \right) \exp \left(\epsilon_{jt}^{PC} \right)$$

$$\theta_{jt}^{SP} = f_{SP} \left(N_{jt}^{PC}, N_{jt}^{SP} \right) \exp \left(\epsilon_{jt}^{SP} \right)$$

Cobb-Douglas function that uses labor $\left(N_{jt}^{PC}, N_{jt}^{SP} \right)$ and capital K_{jt}

Elasticity of substitution$=\frac{1}{1-\rho}$; $\theta_{jt}^{PC}, \theta_{jt}^{SP}$ are the physician-type productivities

Log-Linear Approximation of Compensation Equation

Suppose capital is frictionless, solve problem, log-linearize:

$$
\begin{aligned}
\text{comp}_{jt}^{PC} &= \beta_{0,pc} + \gamma_{pc}^{pc} n_{jt}^{PC} + \gamma_{sp}^{pc} n_{jt}^{SP} + \epsilon_{jt}^{PC} \\
\text{comp}_{jt}^{SP} &= \beta_{0,sp} + \gamma_{pc}^{sp} n_{jt}^{PC} + \gamma_{sp}^{sp} n_{jt}^{SP} + \epsilon_{jt}^{SP}
\end{aligned}
$$

where lowercase letters denote logs

Data: comp_{jt}^{PC}, comp_{jt}^{SP}, n_{jt}^{PC}, n_{jt}^{SP}
Unobserved: ϵ_{jt}^{PC}, ϵ_{jt}^{SP}
Parameters: γ_{pc}^{pc}, γ_{sp}^{pc}, γ_{pc}^{sp}, γ_{sp}^{sp} as well as ρ for the simpler models

Equilibrium

(1) Demand for primary care physicians equals supply of primary care physicians in each location j:

$$\begin{cases} N_{jt}^{PC*} & = \sum_{\ell \in q, f} \sum_{i=1}^{N_{\ell t}^{PC}} \frac{\exp\left\{\delta_{jt}^{PC,\,\ell} + \mu_{ijt}\right\}}{\sum_{m=1}^{M} \exp\left\{\delta_{mt}^{PC,\,\ell} + \mu_{imt}\right\}} N_{\ell t}^{PC} \\[2ex] \text{comp}_{jt}^{PC} & = \beta_{0,pc} + \gamma_{pc}^{pc} n_{jt}^{PC*} + \gamma_{sp}^{pc} n_{jt}^{SP} + \epsilon_{jt}^{PC} \\[2ex] n_{jt}^{PC*} & = \log N_{jt}^{PC*} \end{cases}$$

Equilibrium

(2) Demand for specialists equals supply of specialists in each location j:

$$
\begin{cases}
N_{jt}^{SP*} & = \sum_{\ell \in q, f} \sum_{i=1}^{N_{\ell t}^{SP}} \dfrac{\exp\left\{\delta_{jt}^{SP,\ell} + \mu_{ijt}\right\}}{\sum_{m=1}^{M} \exp\left\{\delta_{mt}^{SP,\ell} + \mu_{imt}\right\}} N_{\ell t}^{SP} \\[2ex]
\text{comp}_{jt}^{SP} & = \beta_{0,sp} + \gamma_{pc}^{sp} n_{jt}^{PC} + \gamma_{sp}^{sp} n_{jt}^{SP*} + \epsilon_{jt}^{SP} \\[2ex]
n_{jt}^{SP*} & = \log N_{jt}^{SP*}
\end{cases}
$$

Estimation

1. Use MLE to match model-implied shares $\hat{s}_{j,t}^{k,l}$ to observed shares $s_{j,t}^{k,l}$ (BLP)
   $\rightarrow$ mean utility ($\delta_j^{k,l}$) and coefficients $\alpha^{k,l}$ and $\beta_j^{k,l}$

2. Simultaneous equation non-linear GMM
   ▶ Uses moments implied from the choice-function and shift-share instrument
   $\rightarrow$ unobservable amenity, $\xi_{j,t}^{k,l}$

IV Strategy

- I exploit changes in policy-set reimbursement rates, by procedure, weighing them by how much the procedure is carried out

$$\Delta Z_{jt}^k = \sum_{r \in treatments} \frac{S_{j,2012}^r}{S_{j,2012}} \left(\overline{reimb}_{m \neq j,t}^{k,r} - \overline{reimb}_{m \neq j,2012}^{k,r} \right)$$

- Well correlated with compensation as physicians gain a substantial part of their income from procedure revenues
- Patient-area level characteristic lags from Dartmouth Atlas (on readmission rates, discharge rates, etc.)
- Interact with malpractice insurance costs to identify demand parameters

Procedure Mix Variation

Estimation

1. First stage: MLE to separate the mean utility levels $\delta_j^{k,\ell}(\beta)$ from the parameters $\alpha^{k,\ell}$, $\beta_j^{k,\ell}$

2. Second stage: GMM using moments from choice function

3. $\mathbb{E}\left(\Delta \xi_{jt} \Delta Z_{jt}\right) = 0$ is the moment restriction,

$$
\Delta Z_{jt} \in
\begin{cases}
\Delta Z_{jt}^k & \Delta Z_{jt}^k \Delta MP_{jt}^k \\
\Delta \text{Patient Rates}_{j,t-1} & \Delta N_{j,t-1}^{pat}
\end{cases}
\forall k,\, k' = PC,\, SP
$$

Results: Physician Supply ($\beta^{k,\ell}$, $\alpha^{k,\ell}$, $\beta^{k,\ell}_{state}$, $\beta^{k,\ell}_{HRR}$)

	Amenities		Amenities, Top 50		Amenities, Foreign	
	PC	SP	PC	SP	PC	SP
$\beta^{k,\ell}$	0.39	0.59	0.20	0.25	0.01	0.04
	(0.018)	(0.020)	(0.014)	(0.012)	(0.008)	(0.006)
	Income		Income, Top 50		Income, Foreign	
	PC	SP	PC	SP	PC	SP
$\alpha^{k,\ell}$	0.03	0.15	-0.005	-0.023	-0.001	0.001
	(1.18e-06)	(7.57e-06)	(2.58e-06)	(1e-05)	(0.001)	(0.001)
	State		State, Top 50			
	PC	SP	PC	SP		
$\beta^{k,\ell}_{state}$	2.77	1.75	0.42	-0.38		
	(0.012)	(0.035)	(0.018)	(0.053)		
	HRR		HRR, Top 50			
	PC	SP	PC	SP		
$\beta^{k,\ell}_{HRR}$	2.35	2.57	-1.48	-0.29		
	(0.005)	(0.042)	(0.008)	(0.063)		

Notes: Magnitude of the α represents the elasticity of demand of a location with respect to income. Magnitude of the state and HRR coefficients represent the semielasticity of demand with respect to whether the choice is within the same state or area (HRR) of residency, respectively.

Density of Amenities, by Location Type
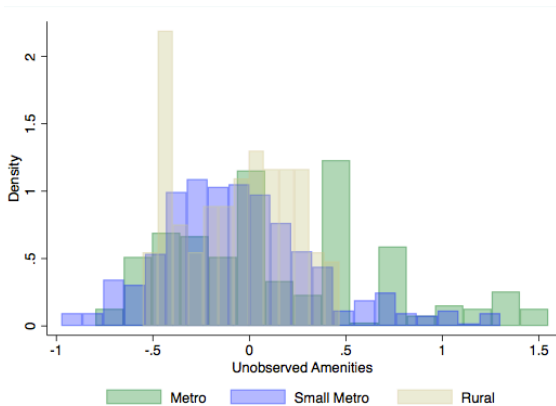
Notes: This figure shows the density distribution of the recovered amenities (observed and unobserved), by location type. As expected, cities have higher amenity levels than rural areas.

Counterfactual Analysis

1. Current policies (loan forgiveness + salary incentives) vs. no incentives

   - $\rightarrow$ ↑ 1.2% in number of physicians picking rural areas
   - ▶ Specialists respond *more* to current policies (driven by loan forgiveness)
   - ▶ Loan forgiveness attracts bottom 25% of residents

2. ↑ salary incentives to all physicians and no loan forgiveness

   - ▶ $35k more a year

3. ↑ salary incentives to PCPs only and no loan forgiveness

New Rural Physicians: Model & Data - Annual Count

Policy Environment	PC	SP
Data: New Rural Physicians	1,039	1,060
Model		
Current Policies	1,039	1,060
Remove All Incentives	971	773
Effect of Current Policies	+68	+287
Effect of Alternative Policy 1 - Target All	+407	+132
Effect of Alternative Policy 2 - Target Primary Care Only	+1,029	-22

Notes: The table reports the impact of current and alternative policies on the physician population, by specialty type.