Approaches to Addressing MD Shortages

Victoria Angelova
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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?
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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

1Thanks to Elena for letting me use some of her slides.
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 $\rightarrow 1.2\% \uparrow$ of physicians in rural areas
  - $\uparrow$ salary incentives would result in $\uparrow$ higher-quality physicians to rural areas
Contribution to the Literature

1. Physician location and geographical distribution
   → Structural model that accounts for additional considerations
     e.g. specialty, training quality and net income

2. Labor literature on location choice of skilled workers
   → 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]
    - Skill, $q_i$ (proxied by quality of residency program)
    - 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]
    - 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 $\xi_j$
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

\[
\max_j u_{ij} = \delta_{j,k}^{k,\ell} x_j + \xi_{j,k}^{k,\ell} + \alpha_{k,\ell}^{k,\ell} y_{ij} + \beta_{j,k}^{k,\ell} x_{ij} + \epsilon_{ij}
\]

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

**Data:** \(x_j, y_{ij}, x_{ij}\)

**Unobserved:** \(\xi_{j,k}^{k,\ell}, \epsilon_{ij}\)

**Parameters:** \(\beta_{k,\ell}^{k,\ell}, \alpha_{k,\ell}^{k,\ell}, \beta_{j,k}^{k,\ell}\)
Choice Probabilities

Implied choice probabilities:

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

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

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

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

\[ \theta_{jt}^{PC} = f_{PC} (N_{jt}^{PC}, N_{jt}^{SP}) \exp (\epsilon_{jt}^{PC}) \]

\[ \theta_{jt}^{SP} = f_{SP} (N_{jt}^{PC}, N_{jt}^{SP}) \exp (\epsilon_{jt}^{SP}) \]

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

Elasticity of substitution\(=\frac{1}{1-\rho}\); \(\theta_{jt}^{PC}, \theta_{jt}^{SP}\) are the physician-type productivities
Suppose capital is frictionless, solve problem, log-linearize:

\[
\begin{align*}
\text{comp}^{PC}_{jt} &= \beta_{0,pc} + \gamma_{pc}^{PC} n^{PC}_{jt} + \gamma_{sp}^{PC} n^{SP}_{jt} + \epsilon^{PC}_{jt} \\
\text{comp}^{SP}_{jt} &= \beta_{0,sp} + \gamma_{pc}^{SP} n^{PC}_{jt} + \gamma_{sp}^{SP} n^{SP}_{jt} + \epsilon^{SP}_{jt}
\end{align*}
\]

where lowercase letters denote logs

**Data:** \(\text{comp}^{PC}_{jt}, \text{comp}^{SP}_{jt}, n^{PC}_{jt}, n^{SP}_{jt}\)

**Unobserved:** \(\epsilon^{PC}_{jt}, \epsilon^{SP}_{jt}\)

**Parameters:** \(\gamma_{pc}^{PC}, \gamma_{sp}^{PC}, \gamma_{pc}^{SP}, \gamma_{sp}^{SP}\) as well as \(\rho\) for the simpler models
Equilibrium

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

$$
\begin{align*}
N_{jt}^{PC*} &= \sum_{\ell \in q,f} \sum_{i=1}^{N_{\ell t}^{PC}} \frac{\exp\{\delta_{jt,\ell} + \mu_{ijt}\}}{\sum_{m=1}^{M} \exp\{\delta_{mt,\ell} + \mu_{imt}\}} N_{\ell t}^{PC} \\
\text{comp}_{jt}^{PC} &= \beta_{0,pc} + \gamma_{pc} n_{jt}^{PC*} + \gamma_{sp} n_{jt}^{SP} + \epsilon_{jt}^{PC} \\
n_{jt}^{PC*} &= \log N_{jt}^{PC*}
\end{align*}
$$
(2) Demand for specialists equals supply of specialists in each location $j$:

\[
\begin{aligned}
N^{SP*}_{jt} &= \sum_{\ell \in q, f} \sum_{i=1}^{N^L_t} \frac{\exp\left\{ \delta^{SP, \ell}_{jt} + \mu_{ijt} \right\}}{\sum_{m=1}^{M} \exp\left\{ \delta^{SP, \ell}_{mt} + \mu_{imt} \right\}} N^{SP}_{\ell t} \\
\text{comp}^{SP}_{jt} &= \beta_{0,sp} + \gamma^{sp}_{pc} n^{PC}_{jt} + \gamma^{sp}_{sp} n^{SP*}_{jt} + \epsilon^{SP}_{jt} \\
n^{SP*}_{jt} &= \log N^{SP*}_{jt}
\end{aligned}
\]
Estimation

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

2. Simultaneous equation non-linear GMM
   - Uses moments implied from the choice-function and shift-share instrument → 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.

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

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

$$\Delta Z_{jt} \in \begin{cases} 
\Delta Z_{jt}^k \\
\Delta \text{Patient Rates}_{j,t-1} \\
\Delta N_{j,t-1}^{\text{pat}} \\
\Delta M_{jt}^{\text{PC}} \\
\Delta M_{jt}^{\text{SP}} \\
\forall k, \ k' = \text{PC, SP}
\end{cases}$$
Results: Physician Supply ($\beta^{k,\ell}, \alpha^{k,\ell}, \beta^{k,\ell}_{state}, \beta^{k,\ell}_{HRR}$)

<table>
<thead>
<tr>
<th></th>
<th>Amenities</th>
<th>Amenities, Top 50</th>
<th>Amenities, Foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PC</td>
<td>SP</td>
<td>PC</td>
</tr>
<tr>
<td>$\beta^{k,\ell}$</td>
<td>0.39</td>
<td>0.59</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.020)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>$\alpha^{k,\ell}$</td>
<td>0.03</td>
<td>0.15</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(1.18e-06)</td>
<td>(7.57e-06)</td>
<td>(2.58e-06)</td>
</tr>
<tr>
<td>$\beta^{k,\ell}_{state}$</td>
<td>2.77</td>
<td>1.75</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.035)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>$\beta^{k,\ell}_{HRR}$</td>
<td>2.35</td>
<td>2.57</td>
<td>-1.48</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.042)</td>
<td>(0.008)</td>
</tr>
</tbody>
</table>

Notes: Magnitude of the $\alpha$ 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.
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
   → ↑ 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

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

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