A Theory of Geographic Variations in Medical Care

Pierre Thomas Léger[1] Robert J. Town[2] Jiashan Wu[1]

[1]University of Illinois at Chicago

[2]University of Texas at Austin, NBER

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Introduction

- U.S. health care system is inordinately inefficient.
- Central piece of evidence: wide geographic variations in medical care utilization and spending not explained by variations in underlying population health, prices or outcomes.
- Modern analysis of geographic variation comes from the *Dartmouth Atlas of Health Care Project* (DAHCP).
- Data from DAHCP show that the highest-spending counties spend twice as much, per Medicare beneficiary, as the lowest-spending ones (adjusted for price, sex and age). map
- Often suggested, that variations in physician culture is driving these variations in healthcare spending and utilization (Gawande).

Introduction

- A different picture of geographic variations in health spending and utilization emerges from the analysis of commercially insured data.
- In fact, results from DAHCP and IOM reports (Medicare/commercial) suggest:
  1. Geographic variation in spending and utilization are potentially very different for Medicare and commercially insured populations, &
  2. These 2 sectors might be linked.
- So, analyzing geographic variations in one sector in isolation might miss an important part of the story.

Introduction

- A thorough reading of the literature yields many stylized “facts" about the nature and patterns of geographic healthcare variation within and across Medicare and commercial populatons.
- These “facts" provide important clues into the underlying mechanisms and a set of predictions that a theory of geographic variations should match.

Introduction

Stylized Facts:

SF1 Significant across-region variation in Medicare and commercially insured spending (Fisher et al., 2003a,b; MedPAC, 2011; Chernew et al., 2010; Philipson et al., Finkelstein et al., 2016; Cutler et al., 2017 etc...). variation

SF2 Across-region variation in Medicare spending is driven by a.r. variation in utilization while a.r. variation in commercial spending is driven by a.r. variation in the price of care (IOM report, Gottlieb et al., 2010).

SF3 Commercial prices are positively correlated a.r. with commercially insured spending and negatively correlated with Medicare spending (Romley et al., 2014). corr

Introduction

SF4 Medicare and commercially insured utilization is positively *correlated* across regions.

SF5 Medicare and commercially insured spending is positively but weakly *correlated* across regions (Chernew et al., 2010; Cooper et al., 2018). ▸ correlation

Introduction

SF6 Increases in Medicare payments *cause* commercially insured reimbursements to rise (Frakt, 2011; Clemens and Gottlieb, 2017).

SF7 Across-region variations in Medicare and commercially insured utilization (and spending) do not translate into important corresponding variations in outcomes (Finkelstein et al, 2018; Hussey et al., 2013; Fisher et al., 2003a, b; Fuchs, 2004).

Introduction

- Although these “facts" have inspired many policy makers and commentators to make broad welfare pronouncements and policy recommendations, they have:
  - Generally focused on the SF1 (i.e., across-region variation in utilization and spending), and
  - Have been made without much rigorous, theoretical guidance as to the underlying causes and implications of these variations.
- In this paper, we provide a testable theory of geographic variation in healthcare expenditures and utilization that reconciles the stylized facts listed above.

Introduction

- Unlike Gawande's hypothesis that geographic differences are driven by differences in provider culture, our model focuses on differences in provider incentives.
- Variations in healthcare utilization and spending come from underlying geographic variation in the model's primitives of provider market structure and productivity.
- These differences, in turn, lead to different incentives for physicians to treat based on the patient's insurance type.
- Our model emphasizes that understanding geographic variation requires accounting for provider incentives that lead to linkages and spillovers between the administered price environment of Medicare, and commercially insured price sectors.

Introduction

- In our model, partially altruistic physicians:
  1. Treat Medicare and commercially insured patients where Medicare reimbursements rate are given while commercial ones are negotiated and reflect the physician's bargaining leverage,
  2. Are capacity constrained, and
  3. Face cost controls in the commercial markets.

Introduction

- In our model, each physician's capacity constraint and bargaining leverage is drawn from a region-specific distribution.
- We solve for each physician's supply curve for both Medicare and commercial care patients.
- We then aggregate over physicians within regions and consider each of the (within and across region) stylized facts enumerated above.
- We derive the conditions under which SF1 through SF7 are satisfied.

Introduction

- We next consider a series of theoretical policy experiments to derive their predicted effects.
- Finally, we calibrate the model to fit data from both the Medicare and commercial markets to solve for the proper values of the all of the model's parameters and run policy simulations.

Model

- Let physician j's utility of providing q^M units of care to a Medicare patient i who suffers from illness severity θ_i^M in region s be given by:

$$U_{j,i,s}^M = h(\theta_i^M, q_i^M) + F^M q_i^M - c(q_i^M), \tag{1}$$

- Similarly, let physician j's utility of providing q^P units to a commercial patient k who suffers from illness severity θ_k^P in region s be given by:

$$U_{j,k,s}^P = h(\theta_k^P, q_k^P) + F_{j,k,s}^P q_k^P - c(q_k^P). \tag{2}$$

Model

- We assume that each physician faces a physician-region specific capacity constraint in total quantity which is increasing in physician *j*'s productivity α_j where:

  $\sum_{k=1}^{K} q_k^P + \sum_{i=1}^{I} q_i^M \leq \overline{Q}(\alpha_j)$, where $\overline{Q'}(\alpha_j) > 0$

- Denote physician *j*'s bargaining leverage as μ_j and let the reduced-form relationship between the private fee and bargaining leverage be given as:
  $F_{j,k,s}^P(\mu_j)$, where $F_{j,k,s}^{\prime P}(\mu_j) \geq 0$. bargaining

- Commercial insurers engage in cost controls:
  $f(F_{j,k,s}^P(\mu_j) q_k^P)$ where $f'_{F^P} > 0$ and $f'_{q^P} > 0$

Model

- Assuming that: (i) each physician treats one Medicare and one commercial patient, (ii) capacity constraints are binding, and (iii) physicians value their 2 patients equally, physician *j*'s maximization problem is given by:

$$\begin{aligned} max \mathcal{L}_{q^M, q^P, \lambda} = & \; h(\theta_i^M, q_i^M) + F^M q_i^M + h(\theta_k^P, q_k^P) + F^P_{j,k,s}(\mu_j) q_k^P \\ & - c(q_i^M + q_k^P) - f(F^P_{j,k,s}(\mu_j) q_k^P) \\ & + \lambda(\overline{Q}(\alpha_j) - q_i^M - q_k^P). \end{aligned} \tag{3}$$

Model

- The supply curve for q_k^P, is given (implicitly) by :

$$h_2'(\theta_i^M, \overline{Q}(\alpha_j) - q_k^P) + F^M = \\ h_2'(\theta_k^P, q_k^P) + F_{j,k,s}^P(\mu_j) - f_{q^P}'(F_{j,k,s}^P(\mu_j) q_k^P). \tag{4}$$

- With the capacity constraint, the above solution yields the supply curve for q_i^M and q_k^P which we express as:

$$q_{j,i,s}^M = \mathcal{Q}(F^M, F_{j,k,s}^P, \theta_k^P, \theta_i^M; \mu_j, \alpha_j) \tag{5}$$

$$q_{j,k,s}^P = \mathcal{Q}(F^M, F_{j,k,s}^P, \theta_k^P, \theta_i^M; \mu_j, \alpha_j) \tag{6}$$

Model

- Finally, we assume that:
  - Physician j's productivity α_j and bargaining μ_j parameters are drawn from a region-s distribution Γ where $\Gamma(\alpha, \mu; \omega_s) = \Gamma(\alpha, \mu; \omega'_s)$ iff $\omega_s = \omega'_s$, and
  - The hyper-parameter ω_s is drawn from a non-degenerate distribution $K(\omega_s)$.
- Thus, the distribution of two of the primitives of the model (α and μ) vary by geographic regions s.

Proposition 1

P1 Significant across-region variation in mean Medicare and commercially insured spending not explained by variation in health status or outcomes.

- In our model, variations in Medicare spending can come:
  1. *directly* from across-region variation in productivity (i.e., capacity constraints), or
  2. *indirectly* from across-region variation in commercial fees (i.e., mean bargaining leverage).
- Across-region variations in commercial utilization can come from in productivity or bargaining leverage.

Proposition 2

P2 Across-region variation in mean Medicare spending is driven principally by across-region variation in utilization, while commercial spending variation is driven principally by across-region in commercial fees.

- First part is obvious given Medicare fees are administered.
- Our model generates variation in commercial spending driven by variation in commercial fees (not utilization) if:
    1. Greater bargaining leverage translates into greater fees but utilization variation is limited by cost controls, and/or
    2. Across-region productivity is negatively correlated with bargaining leverage (consistent with bargaining framework).

Propositions 3 & 4

P3 Across-region commercial provider prices are positively correlated with commercial spending and negatively correlated with Medicare spending.

P4 Across-region Medicare and commercially insured utilization is positively correlated.

- In order for P3 and P4 to both hold simultaneously, $corr(\mu, \alpha) < 0$.

Proposition 5

P5 Medicare and commercially insured spending is positively but *weakly* correlated across regions.

- The correlation between commercial spending and Medicare spending is weaker than commercial utilization and Medicare utilization if commercial prices and commercial utilization are negatively correlated across regions (which was established in Proposition 3).

Proposition 6

P6 Increases in Medicare payments *cause* commercially insured reimbursement to rise.

- Unlike P1 through P5, this stylized fact concerns a *within-region* relationship.
- Our bargaining framework is consistent with this prediction.

Proposition 7

P7 Variations in utilization (and spending) do not translate into corresponding variations in health outcomes.

- Simply requires that across-region mean equilibria utilization are on the flat part of the health production curve.

Policy Changes

- We next introduce a series of policy changes and derive their implications within our model, including:
  1. A ceteris paribus increase in provider bargaining power ▸ μ
  2. The introduction of a P4P bonus scheme for Medicare
  3. The introduction of a Capitation payment system in the commercial market ▸ Capitation
  4. An increase in the cost control in the commercial market ▸ Cost Control
  5. A ceteris paribus increase in a physician's capacity constraint & an across-the-board one. ▸ α

Specification of physician's maximization problem

To calibrate the model, we specify the following functional forms:

$$h(\theta_i, q_i^M) = \ln\left(q_i^M - \theta_i\right)$$
$$h(\theta_k, q_k^P) = \ln\left(q_k^P - \theta_k\right)$$
$$\underline{Q}(\alpha_j) = \alpha_j \underline{Q}$$
$$F^P(\mu_j) = \mu_j F^M$$
$$f(F^P(\mu_j) q_k^P) = \gamma \mu_j q_k^P$$
$$c(q_i^M + q_k^P) = \delta (q_i^M + q_k^P)^2$$

The physician's maximization problem

Under these specification, the physician's maximization problem is given by:

$$\begin{gathered}\max_{q_i^M, q_k^P} U = \beta \ln\left(q_i^M - \theta\right) + F^M q_i^M \\ +\beta \ln\left(q_k^P - \theta\right) + (1-\gamma)\mu_j F^M q_k^P \\ -\delta\left(q_i^M + q_k^P\right)^2 \\ s.t. q_i^M + q_k^P = \alpha_j \overline{Q}\end{gathered} \tag{7}$$

Calibration results

- From our model, we obtain a set of moment conditions which we calibrate to match IOM data.
- The calibration yields the following parameter values:

parameter	β	γ	θ
value	1.95	0.71	0.55

Stimulation result (benchmark case)

Below we present the moments from the IOM data with the stimulation result in parentheses:

$E(\alpha)$	$E(\mu)$	$E(q_p)$	$E(q_m)$	$\sigma(\alpha)$	$\sigma(\mu)$	$\sigma(q_p)$	$\sigma(q_m)$
1	1.56	2.82	7.05	0.11	0.3	0.38	0.85
(1)	(1.56)	(2.82)	(7.06)	(0.14)	(0.3)	(0.42)	(0.84)

	α	μ	q_p	q_m
α	1			
	(1)			
μ	-0.58	1		
	(-0.56)	(1)		
q_p	0.73	-0.12	1	
	(0.76)	(0.05)	(1)	
q_m	0.54	0.31	0.53	1
	(0.96)	(-0.76)	(0.54)	(1)

Counterfactual experiments:

We generate a 1% positive shock to $E(\alpha)$ (i.e., capacity constraint):

E(α)	E(μ)	E(q_p)	E(q_m)	$\sigma(\alpha)$	$\sigma(\mu)$	$\sigma(q_p)$	$\sigma(q_m)$
1	1.56	2.84	7.14	0.11	0.3	0.38	0.86
(1% ↑)	(0.00%)	(0.7% ↑)	(1.1% ↑)	(0.00%)	(0.00%)	(10.5% ↓)	(2.3% ↑)

Counterfactual experiments

We generate a 1% negative shock to $E(\mu)$ (i.e., bargaining leverage):

E(α)	E(μ)	E(q_p)	E(q_m)	$\sigma(\alpha)$	$\sigma(\mu)$	$\sigma(q_p)$	$\sigma(q_m)$
1	1.54	2.81	7.07	0.11	0.3	0.38	0.85
(0.00%)	(1% $\downarrow$)	(0.4% $\downarrow$)	(0.3% $\uparrow$)	(0.00%)	(0.00%)	(10.05% $\downarrow$)	(1.2% $\uparrow$)

Counterfactual experiment

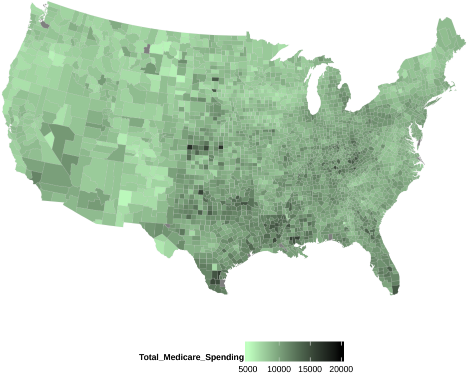
We generate a 1% positive shock to γ (cost control in commercial market):

$E(\alpha)$	$E(\mu)$	$E(q_p)$	$E(q_m)$	$\sigma(\alpha)$	$\sigma(\mu)$	$\sigma(q_p)$	$\sigma(q_m)$
1.01	1.56	2.8	7.08	0.11	0.3	0.37	0.85
(0.00%)	(0.00%)	(0.7% $\downarrow$)	(0.3% $\uparrow$)	(0.00%)	(0.00%)	(12% $\downarrow$)	(1.2% $\uparrow$)

Conclusions

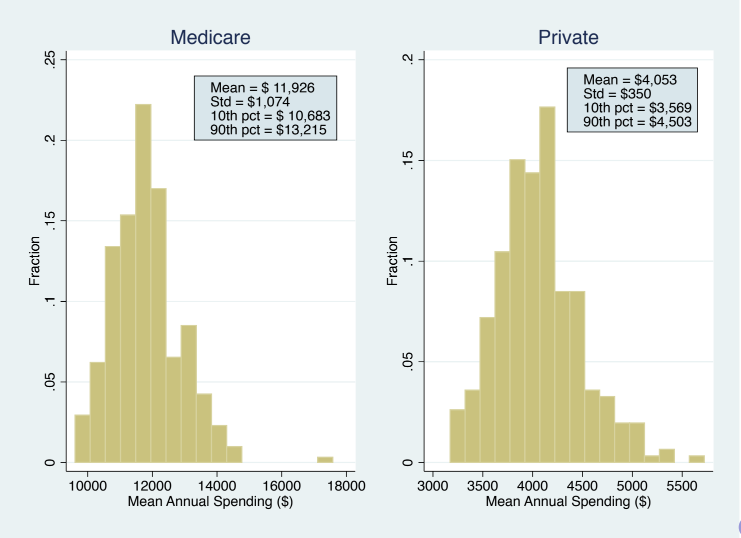
- In this paper, we provide a testable theory of geographic variations in healthcare expenditures and utilization that reconciles a series of stylized facts on geographic variations.
- Our model focuses on differences in provider incentives that lead to differences in the care that is delivered & leads to linkages and spillovers between these markets.
- We calibrate the model to IOM data and run a series of counterfactual policy experiments.
- This allows us to quantity the effect that policy changes will not only have on “own" market but also to what extent they may spill over into the other.

Age, Sex, Price Adjusted Per-Capita Spending by County



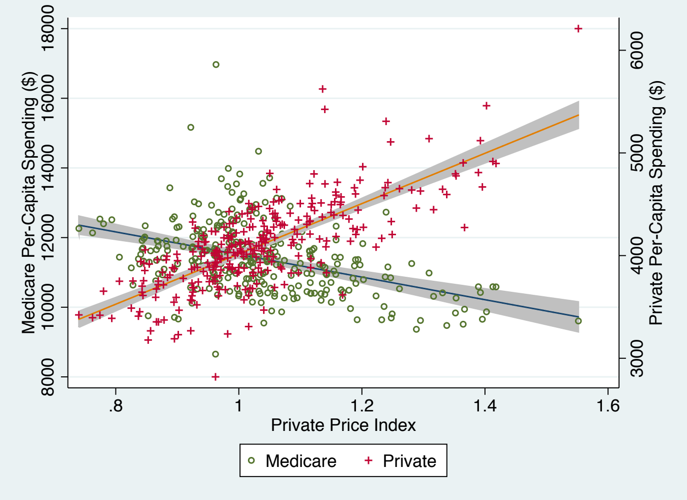
▸ return

Variation in Medicare and Commercial Spending



return

Private Price and Spending Correlations



return

Correlations in Medicare and Commercial Spending and Utilization

return

Commercial Fees

The physician j's problem:

- Consider a physician j endowed with patients i and k.
- Physician j's utility of treating patients i and k optimally is given by:

$$U^A_{j,k,i} \equiv h(\theta^M_i, q^{*M}_i) + F^M q^{*M}_i + h(\theta^P_k, q^{*P}_k) + F^P_{j,k} q^{*P}_k - c(\overline{Q}(\alpha_j)) - f(F^P_{j,k} q^{*P}_k), \tag{8}$$

return

Commercial Fees

- Assume that if the physician refuses to treat her commercial patient k, she can replace him with another commercial patient k' or another Medicare patient i' with probabilities μ_j and $(1 - \mu_j)$, respectively, and where $F^P_{j,k'} > F^P_{j,k}$.

Comercial Fees

- If the physician refuses to treat patient k, her expected utility becomes:

$$\begin{aligned} U^D_{j,k'/i',i} \equiv \mu_j[h(\theta_i^M, q_i^{**M}) + F^M q_i^{**M} + h(\theta_{k'}^P, q_{k'}^{**P}) + \\ F^P_{j,k'} q_{k'}^{**P} - f(F^P_{j,k'} q_{k'}^{**P})] \\ +(1-\mu_j)[h(\theta_i^M, q_i^{***M}) + F^M q_i^{***M} \\ +h(\theta_{i'}^M, q_{i'}^{***M}) + F^M q_{i'}^{***M}] - c(\overline{Q}(\alpha_j)) \end{aligned} \tag{9}$$

Commercial Fees

- Two things are worth noting:
  1. There exists a minimum fee $F^P_{min,j}$ such that the physician is willing to continue to treat her patient k rather than try her luck on a new patient i' or k', and
  2. The minimum fee is increasing in the physician's bargaining leverage μ_j.

Commercial Fees

The commercial insurer's k's problem:

- Similarly, the commercial insurer's agreement utility is given by:

$$V_k^A \equiv V(h(\theta^P, q_k^{*P}), F_j^P q_k^{*P}) \tag{10}$$

- And disagreement utility: $V_k^D \equiv 0$.

Commercial Fees

Insurer-Physician reimbursement setting process:

- We assume that commercial insurance provider makes a take-it-or-leave-it offer of $F^P_{j,k}$ to physician j.
- Can show that the fee offered to the physician is weakly increasing in physician j's minimum fee $F^P_{min,j}$ which is itself strictly increasing in probability μ_j.
- The bargaining framework yields a negative relationship between α_j and μ_j.
- Whether this relationship is consistent with the SFs will be addressed below.

Increase in bargaining power

- Commercial utilization and spending increase while Medicare utilization and spending decrease with a c.p. increase in provider bargaining power.
- Under basic conditions, an increase in μ leads to an increase in F_k^P which leads to an increase in q_k^p and crowding out of q_i^M.

return

P4P

- Under sufficiently large bonus payments, the introduction of a Pay-for-Performance (P4P) scheme in the Medicare system will lead to an increase in Medicare utilization and spending, and a corresponding decrease in commercial utilization and spending.

return

Capitation

- The introduction of a capitation payment scheme for commercially insured individuals leads to a decrease in commercial utilization (and potentially, commercial spending) and a corresponding increase in Medicare utilization and spending.

return

Cost Control

- An increase in cost controls will lead to a decrease in commercial utilization (with corresponding decrease in commercial spending) and an increase in Medicare utilization (with corresponding increase in Medicare spending).

▸ return

Capacity Constraint

- An increase in physician capacity constraint will lead to a ceteris paribus increase in Medicare and private utilization and spending.
- When considering an across-the-board increase in physicians' capacity constraints (within a given region), the net effect will depend on strength of the negative relationship between capacity constraints and bargaining power (i.e., $\Gamma(\alpha, \mu; \omega_s)$).

return