Should Physicians Choose Their Reimbursement Rate? Menu Design for Physician Payment Contracts

Jori Barash

UT Austin

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Central challenge in healthcare: asymmetric info between physicians and patients/insurers

- How should physicians be reimbursed for treatment?

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Theory: A physician's **choice of contract** can convey private information

Research question

Should a regulator offer a menu of reimbursement contracts instead of a uniform contract?

Two Contracts **Sometimes** Better Than One

Uniform (Mixed) Contract

Contract 1

$45 per hour
("Fee-for-Service Rate")

$4 per patient
("Base Payment")

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Menu of (Two) Contracts

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- Fewer hours at \$45 rate → large health impact, small spending impact

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- Fewer hours at $45 rate → large health impact, small spending impact
- Do these physicians have the largest **private gain** from rate increase?

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Empirical Setting: Norwegian primary care physicians, 2008-2017

- Regulated single-payer system with uniform contract
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- Test for physician heterogeneity with DiD and quasi-random assignment
- Estimate structural model of treatment $\rightarrow$ distribution of physician parameters
- Derive **budget-neutral** menu of contracts to maximize **perceived** health

Main Empirical Findings

Physicians drive meaningful variation in treatment

- Reduced-form: physician-specific effects span 0.38 standard deviations
- Structural: **correlated** heterogeneity in physician parameters

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- Less under-utilization: low-hours physicians choose high fee-for-service rates
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Asymmetric information remains quite costly: \$350M per year for full population

- Limited gains from further increasing contract flexibility

Contribution

Contract Design: **(Theory)** Ellis and McGuire, 1986; Jack, 2005; Choné and Ma, 2011; Naegelen and Mougeot, 2011; Barham and Milliken, 2014; Allard, Jelovac and Léger, 2014; Ji, 2021; Wu, Chen and Li, 2017; Fang and Wu, 2018; Wu, 2020. **(Empirical)** Fortin et al., 2021; Gaynor et al., 2023. **(Insurance Menus)** Azevedo and Gottlieb, 2017; Marone and Sabety, 2022; Ho and Lee, 2023. **(Other Menus)** Bellemare and Shearer, 2013; D'Haultfœuille and Février, 2020; Taburet et al., 2024

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Physician response to financial incentives: Gaynor, Rebitzer and Taylor, 2004; Clemens and Gottlieb, 2014; Brekke et al., 2017, 2020; Einav, Finkelstein and Mahoney, 2018; Eliason et al., 2018; Song et al., 2019; Xiang, 2021

- Measure **health** impact of physician response without health outcome data

Toy Model: Two Physicians Vary in Altruism

Physician j chooses treatment hours m: $V_j(p) \equiv \max_m (p-c)\,m + \alpha_j h(m)$

- Altruism α_j is weight on **patient** health $h(m)$ relative to **private** profit $(p-c)\,m$

[1] The full-information rate, equal to marginal health production, **decreases** in altruism: $\alpha_1 < \alpha_2,\ h'' < 0 \Rightarrow p_2^* < p_1^*$.

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- Physicians may under-value patient health: $\alpha_R > \alpha_j > 0, \forall j$

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Best uniform rate p_U lies between efficient rates

- $p_U \equiv \alpha_R E[h'(m_j(p_U))]$, so if $\alpha_1 < \alpha_2$, then $p_2^* < p_U < p_1^*$

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One-Dimensional Heterogeneity: a Menu is Not Preferable

Offer two contracts: (p_L, b_L) and $(p_H, 0)$ where rate $p_L < p_H$

Contract 1
\$45 per hour
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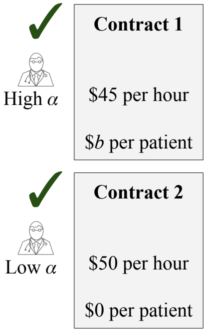

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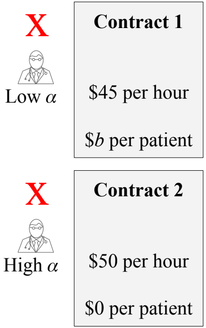
No, they don't value the health increase as much

- $\frac{d}{d\alpha}(V(p_H) - V(p_L)) = h(m(p_H)) - h(m(p_L)) > 0$



$\alpha_1 < \alpha_2, h'' < 0 \Rightarrow m_1(p) < m_2(p)$
Only the low-altruism physician will choose p_H when only her private gain exceeds base payment: $b_L = V_2(p_H) - V_2(p_L) + \epsilon$.
The first equality is from the envelope theorem and the second is from $h' > 0$.

Multidimensional Heterogeneity: a Menu may be Preferable

Let physicians also vary by cost of effort (c_j): $\max_m (p - c_j)\, m + \alpha_j h(m)$

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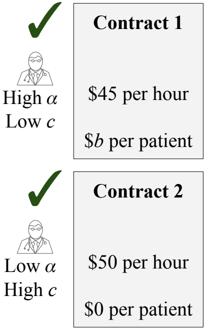

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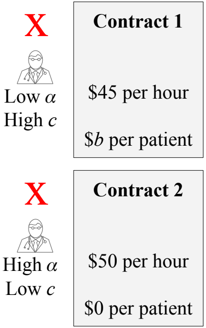

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Correlation helps mitigate tension, e.g., high cost **and** high altruism

- High cost $\rightarrow$ large marginal returns to health
- High altruism $\rightarrow$ accepts lower profit (greater cost of effort)
- Revenue-neutral: Lower base payment offsets higher fee-for-service

✓

Low α
Low c

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✓

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Later: Same Intuition in Empirical Model

In the paper and today's empirical section, I extend this toy model

- Patient need varies with observed X_i, **unobserved** shock, and physician **productivity**
- Effort is non-negative (some patients excluded, others don't arrive)
- Regulator is constrained by budget and physician participation

Intuition for **correlated physician heterogeneity** remains the same

- Estimated correlation structure for a continuum of physician parameters
- Menu doesn't necessarily require $\rho(c, \alpha) > 0$

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Two other factors matter in both the toy model and full empirical model

- **Dispersion** in full-information rates p_j^* ($\uparrow$ in cost, $\downarrow$ in altruism)
- **Social tradeoff** between health and expenditure (α_R)

Empirical Setting

Data from Norwegian Health Ministry, 2008-2017

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- Patients: revenue, hours, demographics, diagnoses
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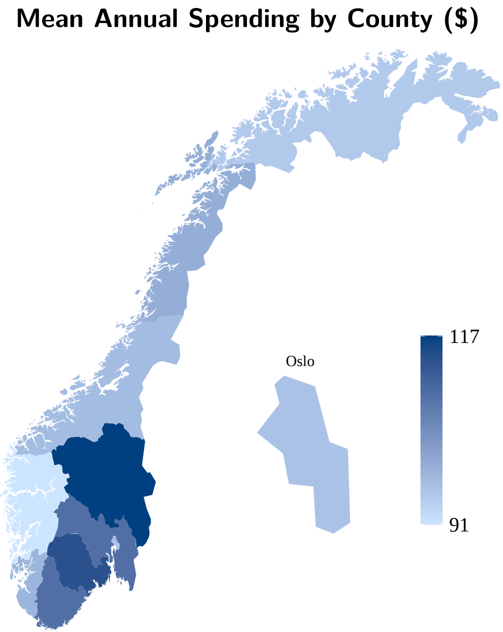
Key Features: Highly regulated single-payer system

- Regulated uniform payments per service and patient
- Across-time variation in payment rates
- Sometimes PCP exit leads to quasi-random patient assignment

Mean Spending Varies Across Place



PCPs Mostly Spend Time Speaking with Patients

Reasons for office visits:

- Screen for illness and manage chronic conditions
- Referral for specialist and non-emergency hospital services
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Average PCP spends 27 hours per week with patients (90^{th} pctl. $= 37$)

- Typical workday: consult with 21 of 1225 patients
- Typical visit: 17 minutes per visit, 1.5 services
- Includes 0.2 procedures and 0.6 diagnostic tests

Norway vs. United States

Identifying Variation: Fee-for-Service Rate Increase

Intermediate Research Question

How does the fee-for-service rate affect treatment?

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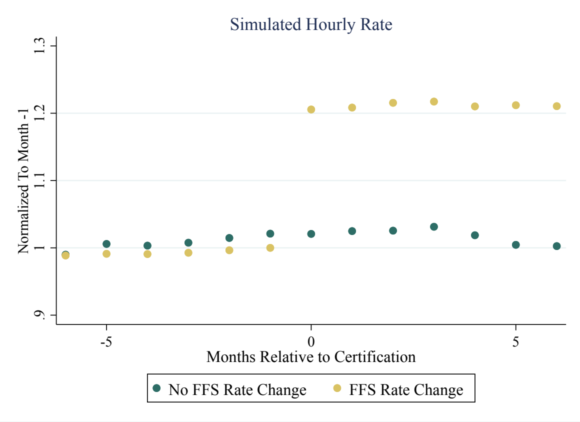

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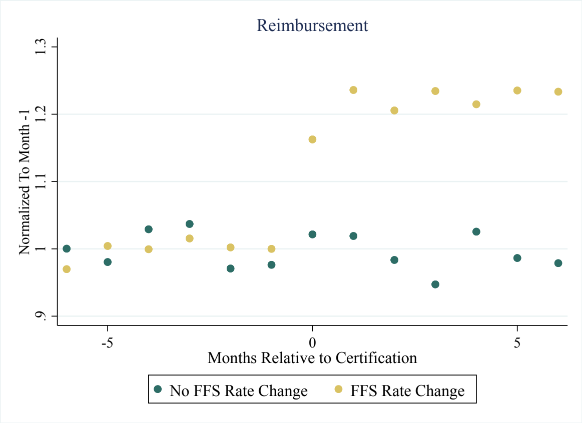

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- vs. counterfactual menus: large fixed cost, no difference in base payment

Long-Lasting PCP-Patient Relationships | Screenshot: Patient Info | Data Details | Sample Selection

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Estimation sample: fixed composition of patients over 13 months

- Long-term residents with consistent registration to active PCP in one location

Key measure of treatment: fee-for-service revenue divided by wage index

- Wage calculated using average bundle of services and time use for full population

Long-Lasting PCP-Patient Relationships | Screenshot: Patient Info | Data Details | Sample Selection

Summary Statistics for Estimation Sample

	Mean	Std. Dev.	10th	50th	90th
Patient Variables					
[1] Reimbursement ($)	8	25	0	0	31
[2] Hourly Rate ($)	44	7	32	45	51
[3] Minutes ([1] $\div$ [2])	11	34	0	0	41
[4] Base Payment ($)	4	0	4	4	4
Physician Variables					
[5] Enrollment	1,225	300	867	1,197	1,589
[6] Physician Hours/Week	27	9	13	27	37
[7] Patients Age 60+ (%)	19	10	7	18	32
[8] Physician Age	40	6	34	39	49
Patients	643,363				
Physicians	619				

More Summary Statistics | Norwegian Population | Summary Stats by Patient Bin

Physicians Vary in Multiple Ways

What patterns of physician heterogeneity should be in the empirical model?

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1. When fee-for-service rate increases, PCPs increase treatment hours
   - Stacked differences-in-differences with patient fixed effects
   - Some more than others Figure Details Estimates Mechanisms Treatment Types

$$Y_{ijt} = \beta_j \left(Post_{jt} \times Certified_j \right) + \boldsymbol{\beta}_x \mathbf{X}_{jt} + \gamma_i + \gamma_{y(t)} + \gamma_{m(t)} + \epsilon_{ijt}$$

Physicians Vary in Multiple Ways

What patterns of physician heterogeneity should be in the empirical model?

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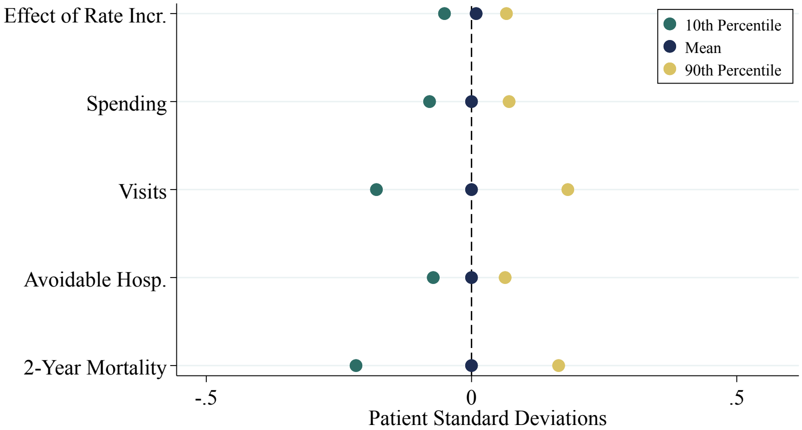
3. PCPs causally affect treatment and adverse outcomes, e.g., two-year mortality
   - Random patient assignment after nearby PCP exits (Ginja et al., 2022)
   - New evidence: dispersed effects on spending and avoidable hospitalizations

   $$Y_{ij} = \beta_j + \beta_{j_0(i)} + \beta_x X_j + \epsilon_{ij}$$ Details Figure

Dispersion in Physician-Specific Effects

Moving from the 10th to 90th percentile of physicians

- Equivalent to 12-38 percent of a standard deviation across patients
- Bayesian shrinkage adjusts for estimation error



Correlation in Raw Data

Limited Evidence for Workload Constraints

Alternative explanations for low responsiveness to the fee-for-service rate:

- Income effects: increasing value of leisure $\rightarrow$ small (expensive) increase
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Later: Use linear cost of effort for baseline model

- Test whether PCPs have an increasing distaste for workload
- Robustness: Impose shadow cost of capacity

How do Patients Choose Physicians?

In Norway, patients tend to choose PCPs based on star ratings (Bensnes and Huitfeldt, 2021)

- Choice uncorrelated with treatment amount (Iversen and Lurås, 2011) and causal effect of PCP on mortality (Ginja et al., 2022)
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Endogenous versus exogenous patient registration

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Later: compare E[Health] (projected from structural model estimates)

- Uncorrelated with patients switching to new PCPs
- Correlated with lower avoidable hospitalizations and mortality

Model Timing

Regulator designs menu of contracts to maximize patient health ▸ Details

- Uncertainty over **physician parameters** and **patient severity**
- Subject to **budget** and physician participation constraints

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Patient i gets random draw of illness severity: $\log \lambda_i \sim N(\vec{\beta} X_i, \sigma) \mid \lambda_i > 0$

- Sick patients accept recommended treatment

Heterogeneous Physicians Choose Hours of Treatment

Physicians have additive preferences (e.g., Ellis and McGuire, 1986)

- **Observed**: treatment hours m_{ij}, fee-for-service rate p_{ij}, patient characteristics X_i

$$\max_{m \geq 0} \underbrace{\qquad\qquad}_{\text{Profit}} + {\color{red}\alpha} \underbrace{\qquad\qquad\qquad}_{\text{Health}}$$

Decision involves three physician-specific **parameters**

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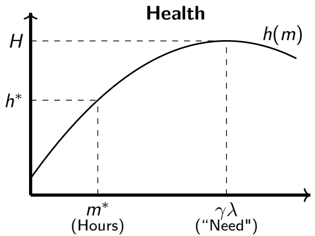

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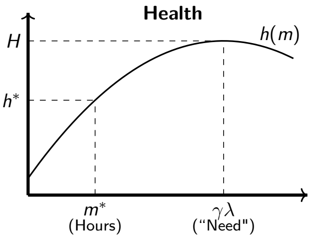

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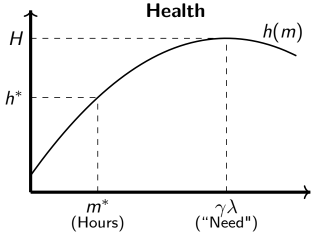


Robustness: relax linear cost of effort, quadratic health

First-Order Condition

$$m^*_{ij}(p, \lambda) = \max\{0, \frac{p_{ij} - c_j}{\alpha_j} + \gamma_j\, \lambda(X_i, \epsilon_{ij})\}$$

Measuring Physician Heterogeneity

Data: Hours m_{ijt}, Fee-for-Service Rate p_{it}, and X_{it}, for patient i, physician j, month t

- X_{it} includes chronic illness, gender, disability, income, tenure, month, age, and lags

Parameters to estimate:

- Altruism α_j: physicians' responsiveness to increased fee-for-service rate

Estimating Equation

$$m_{ijt} = \max\{0, \frac{p_{it} - c_j}{\alpha_j} + \gamma_j \exp\left(\vec{\beta} X_{it} + \sigma \epsilon_{ijt}\right)\} \mid \lambda > 0$$

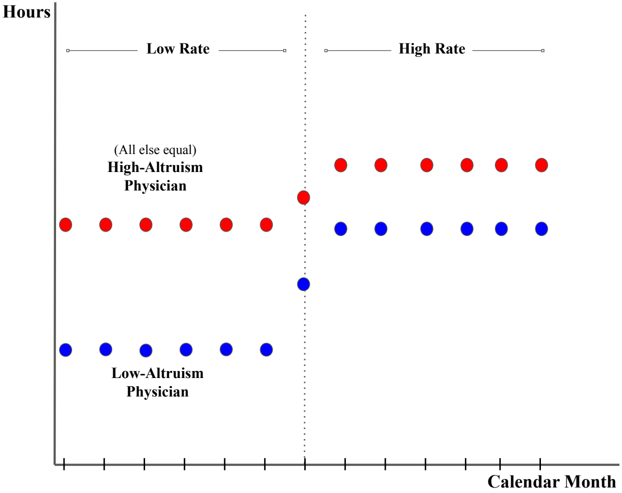
Estimated parameters maximize the likelihood of observed treatment hours

Measuring Physician Heterogeneity

$$\max_{m \equiv \text{Hours}} \ \text{Profit}(m) + \ \textbf{Altruism} \times \text{Health}(m) \quad \Rightarrow \quad \frac{dm}{d\,\text{Rate}} \approx \frac{1}{\text{Altruism}}$$

High-Altruism PCPs Respond Less to Increased Fee-for-Service Rate

Stylized Example with All Else Equal



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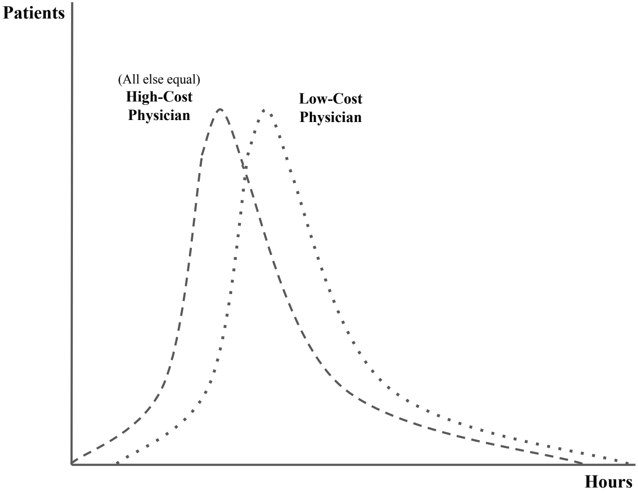
High-Cost PCPs Persistently Treat Additively Less

Stylized Example with All Else Equal



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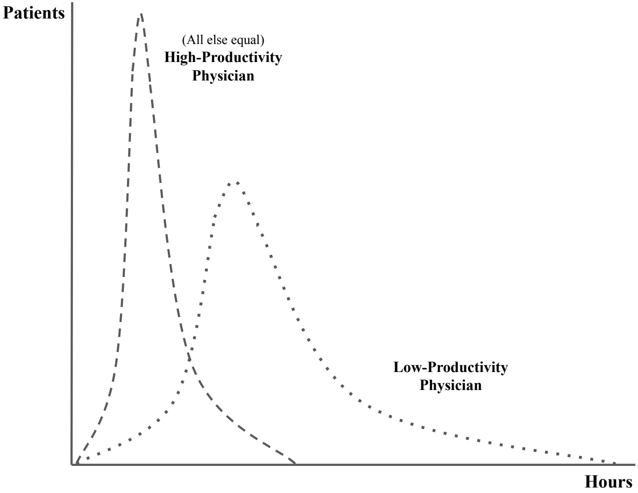
Measuring Physician Heterogeneity

$$\max_{m \equiv \text{Hours}} \ \text{Profit}(m) + \quad \text{Altruism} \times \textbf{Health(m)} \quad \Rightarrow \quad \frac{d\ \text{Health}}{d\ \text{Productivity}} > 0$$

High-Productivity PCPs Persistently Treat Multiplicatively Less

Stylized Example with All Else Equal



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- Patient Severity $\lambda \sim F(\vec{\beta}, \sigma)$: correlations and variance of residual treatment

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Estimated parameters maximize the likelihood of observed treatment hours

Estimation Assumptions

Key assumption: patient severity λ is **conditionally random**

- Same treatment hours, patient severity, and productivity $\rightarrow$ same **perceived** health
- No fifth dimension influences physicians' treatment decisions
- Health **outcomes** could be determined by perceived health and **ex-post** shock

Implicit assumptions

- Physicians fully observe patient severity λ
- Perceived health $h(m, \gamma\lambda)$ matters to the regulator
- Physician parameters do not vary in the short run

Measuring Perceived Health as Welfare

Perceived health production h is a function of data and parameter estimates

- Similar to how demand estimation studies can measure consumer surplus

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- Parameters: Cost c_j, Productivity γ_j, Altruism α_j, Patient Severity $\lambda \sim F(\vec{\beta}, \sigma)$

$$E[h(m, \gamma\lambda) \mid p_{it}, X_{it}, \hat{\theta}, \lambda > 0] \equiv \sum_{\epsilon'} -\tfrac{1}{2}\, w(\epsilon')\left(m_{ijt}(\epsilon') - \gamma_j \lambda_{ijt}(\epsilon')\right)^2$$

$$m_{ijt}(\epsilon') \equiv \max\{0, \frac{p_{it} - c_j}{\alpha_j} + \gamma_j \underbrace{e^{\vec{\beta} X_{it} + \sigma\epsilon'}}_{\lambda_{ijt}(\epsilon')}\}$$

Measuring Perceived Health as Welfare

Perceived health production h is a function of estimated parameters

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Alternative approaches to measuring treatment benefits have limitations

- Adverse health outcomes: rare, highly random; effects of primary care are long-term
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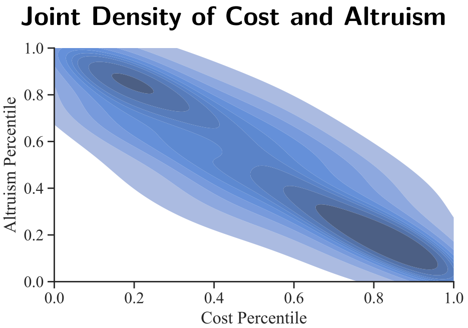
Later: estimates imply regulator is $\geq$ 3.1 times as altruistic (α_R) as the median physician

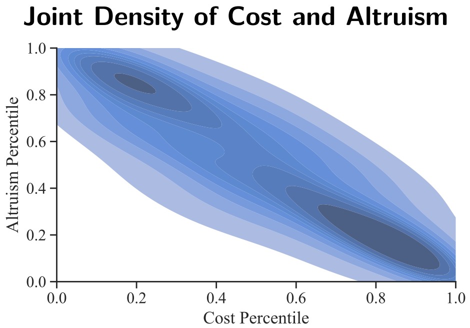
- Gaynor et al. (2024) calibrated comparable ratio at 52.6 using VSLY

Correlated Cost of Effort and Altruism[1]



[1] Darker colors indicate greater density.

Correlated Cost of Effort and Altruism[1]



PCPs with high cost and low altruism:

- Female, young, more patients
- Fewer diagnostic tests

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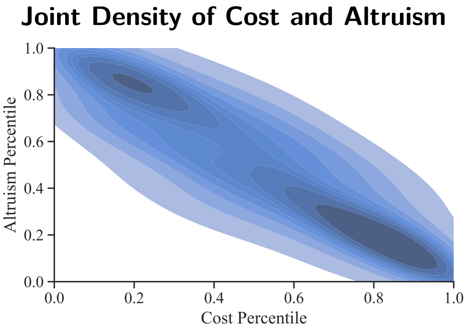

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Rural-urban health disparity: $32

- 10% due to physicians
- 5% cost, 4% altruism

▸ Correlates of Physician Heterogeneity ▸ Model Fit ▸ Health Outcomes

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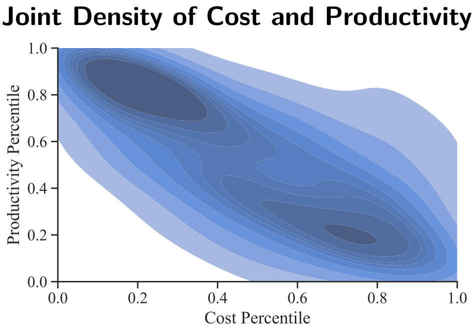
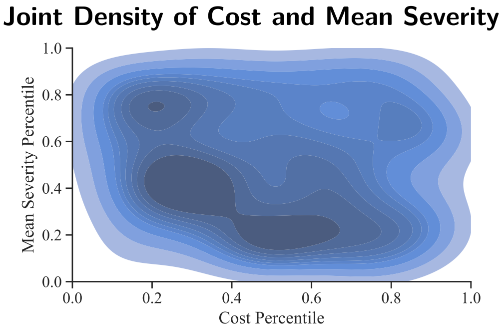
Correlated Cost of Effort and Productivity[1]





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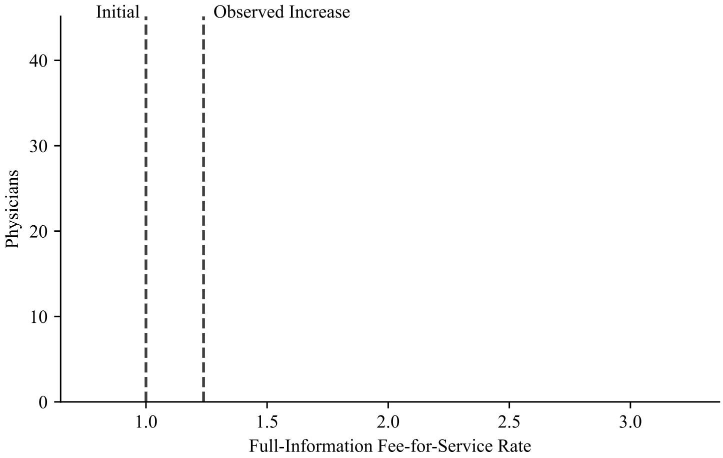
Full Information: First-Best Contracts are Dispersed



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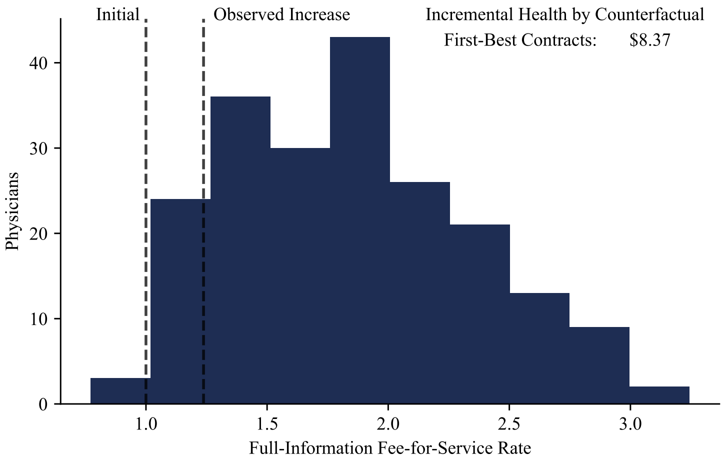

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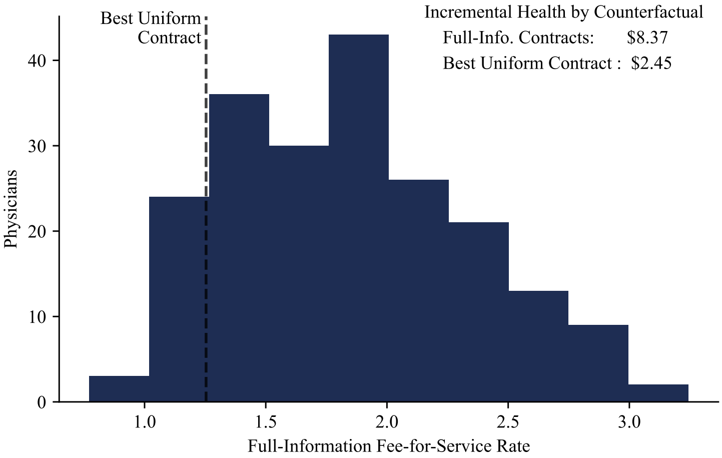

Imperfect Information: a Two-Contract Menu **May** be Preferable

Reference Contract:
Best Uniform $2.12 + $55 × m

Imperfect Information: a Two-Contract Menu **May** be Preferable

Fix both fee-for-service rates	(x_L, "Low Rate")	(x_H, "High Rate")
	\$2.12 + \$55 × m	\$2.12 + **Δb** + **\$56** × m

Imperfect Information: a Two-Contract Menu **May** be Preferable

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Δb = $0 *Vary the incremental base payment*		

Imperfect Information: a Two-Contract Menu **May** be Preferable

	(x_L, "Low Rate") $2.12 + $55 × m	(x_H, "High Rate") $2.12 + **Δb** + $56 × m
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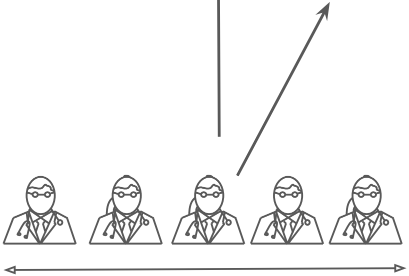

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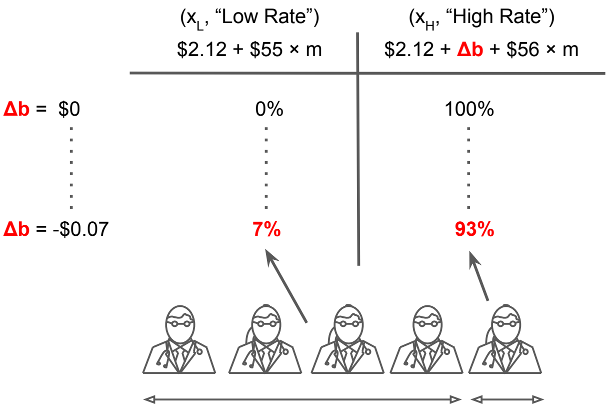

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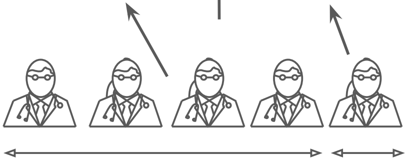
⋮	⋮	⋮
Δb = -$0.07	7%	93%



What drives choice? (Private Gain)

Low Patient Severity High Patient Severity

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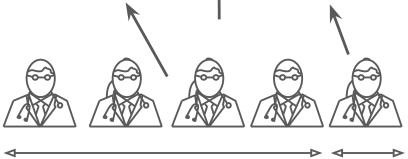


What drives choice?
(Private Gain)

Low Patient Severity — High Patient Severity

Is it efficient? Yes!
(Health - Expenditure)

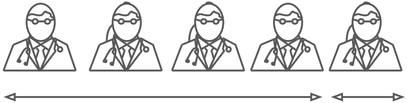
Low Cost — High Cost

Two Contracts: Menu Separates Physicians by Private Gain

	(x_L, “Low Rate”) \$2.12 + \$55 × m	(x_H, “High Rate”) \$2.12 + **Δb** + \$56 × m
Δb = \$0	0%	100%
Δb = -\$0.07	7%	93%

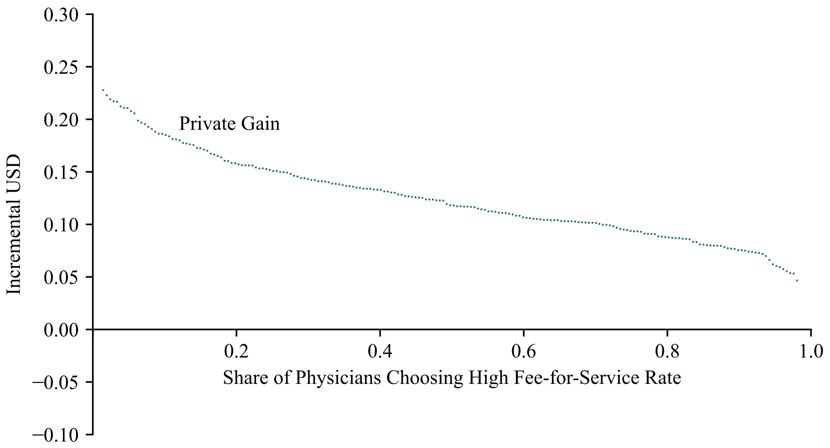
Next slide: y-axis

x-axis



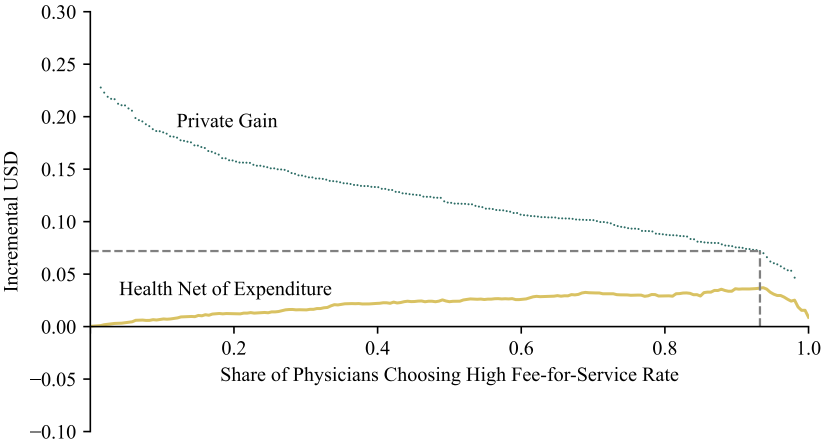
What drives choice? *(Private Gain)*	Low Patient Severity	High Patient Severity
Is it efficient? Yes! *(Health - Expenditure)*	Low Cost	High Cost

Two Contracts: Menu Separates Physicians by Private Gain



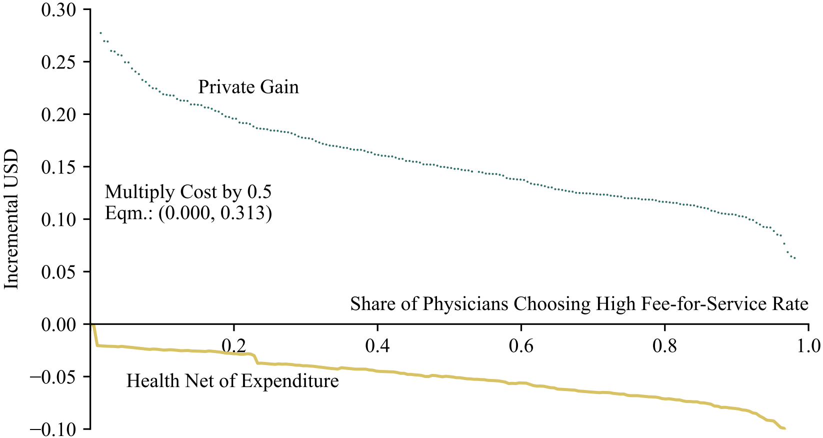
▸ Correlations with Type

Two Contracts: Menu Separates Physicians by Private Gain



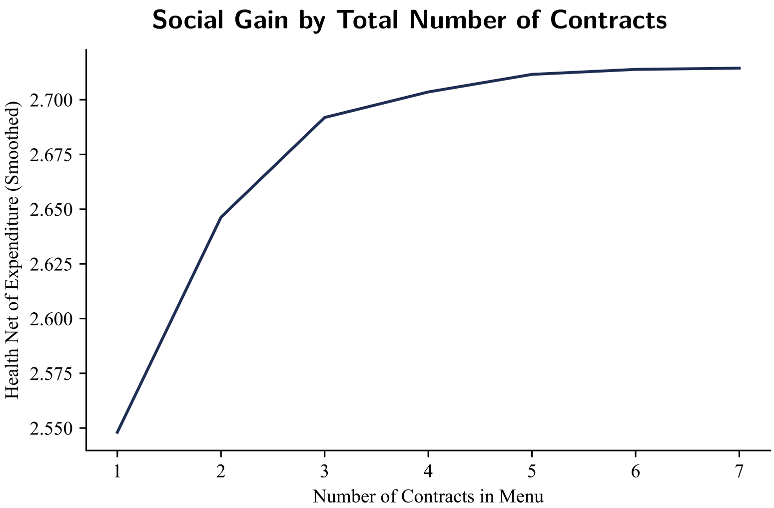
Correlations with Type

Counterexample: Uniform Contract is Sufficient



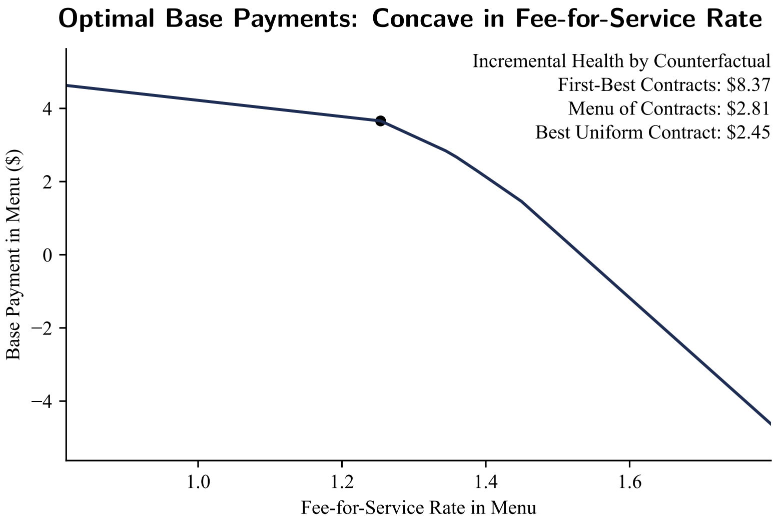
▸ Correlations with Type

More Than Two Contracts is Even Better



▸ Physicians Sort into Seven Contracts
▸ Similar Menu Across Bootstraps

More Than Two Contracts is Even Better



▸ Physicians Sort into Seven Contracts ▸ Similar Menu Across Bootstraps

Who Benefits Most?

Aggregate physicians into 4 bins, e.g., a combination of:

c_H Above-median cost of effort

α_L Below-median altruism

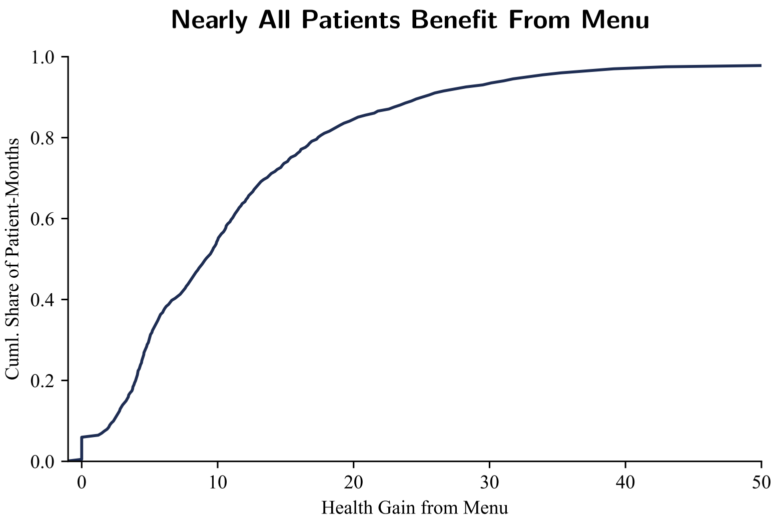
Who Benefits Most? High Cost, Low Altruism[1]

Physicians		Menu of Contracts			Efficient Contracts	
Bin	Share	WTP	Health	Spend	Health	Spend
c_L, α_H	0.40	1.75	1.17	2.23	1.64	0.68
c_H, α_L	**0.38**	1.64	**4.31**	2.23	**17.04**	3.96
c_H, α_H	0.11	1.83	2.26	2.35	6.11	2.16
c_L, α_L	0.10	1.92	4.31	2.85	4.76	1.45

Further Decomposition
By Rurality
Summary of Counterfactuals

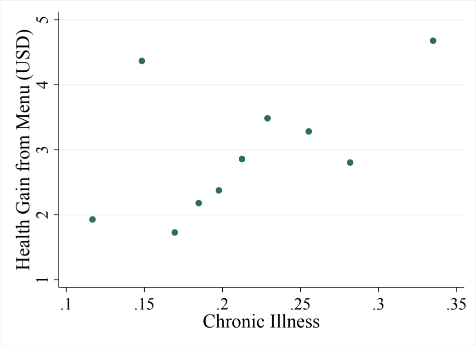
[1] All outcomes are measured in USD per patient per month. WTP is the net private gain.

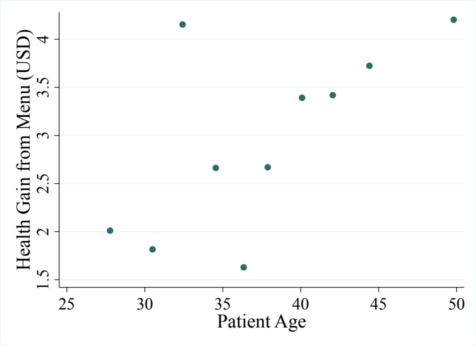
Which Patients Benefit Most?



Which Patients Benefit Most?

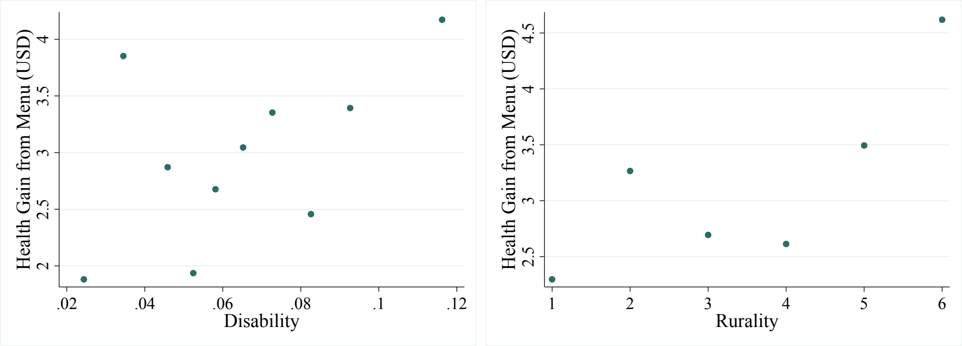
Gains are Largest for Sicker, Older Patients





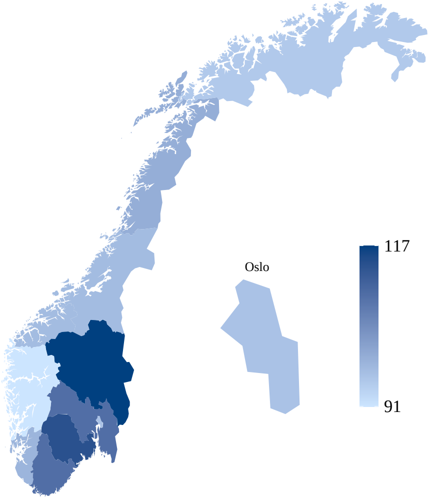
Which Patients Benefit Most?

Gains are Largest for Disabled, Rural Patients

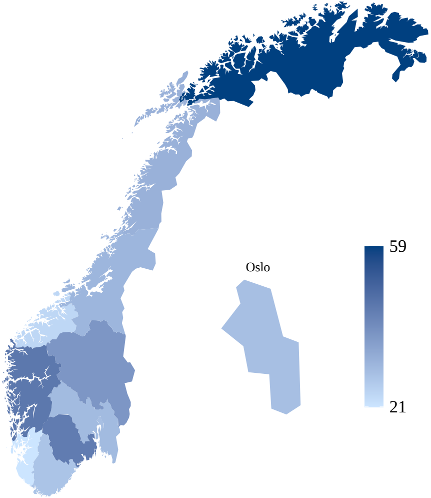


Which Patients Benefit Most?

Mean Annual Spending ($)



Annual Health Gain from Menu ($)



Summary of Robustness

External validity

- (within Norway) Include out-of-sample PCPs, same $E[\alpha_j \mid X_j]$
- (outside Norway) Large perturbations to estimated parameters Details

Descriptive evidence on exclusion assumption (limited patient sorting)

- No correlation with patient switches Details
- No sudden change to number or composition of patients Details
- Dispersion in PCP FEs Overall Quasi-Random Assignment

Alternative specifications

- Income effects (distaste for total workload) Unobserved Constraints
- Health production parameterization
- Relax budget or participation constraints

Summary of Extensions

Can the regulator further close the gap between a menu and perfect information?

Allow reimbursement rate to also vary with:

- Patient observed characteristics
- Rural vs. urban location
- Treatment hours

Other policies might complement menu design

- Steering, e.g, low-cost physicians towards high-severity patients
- Long-run investments to change the distribution of physicians

Conclusion

Physicians hold **private information** about their heterogeneity and patients' needs

- Asymmetric information is costly $\rightarrow$ contract choice can **sometimes** help
- **Correlated** heterogeneity helps align private and social gains

Policy implication: a simple, voluntary, budget-neutral menu can improve health

- Recent reform: higher base payments for high-need patients

Other settings might benefit from menu design

- Testable with panel variation in incentives
- Implications for U.S. reforms: value-based care and site-neutral payment Details
- Uniform flat-fee contracts common in public service

Thank you!

Suggestions are Appreciated (joribarash@utexas.edu)

Gaynor et al. (2023)

Estimates distributions of cost and altruism of dialysis clinics to derive optimal non-linear uniform contract for an anti-anemia drug

I extend this framework for related menu design question

- Uncertainty in patient severity from the regulator's perspective, heterogeneity in productivity, and bottom-censored treatment intensity
- In my setting, the optimal menu of contracts would otherwise be substantially different

Aligning incentives through differentiated contracts can improve welfare relative to contracting on quantity

- e.g., primary care, dermatology, and dentistry and inducing a specific level of effort
- Regulator cannot observe the socially efficient level of effort
- Partially altruistic agents exercise discretion in allocating effort across clients

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Regulator's Choice of Menu

Regulator chooses a menu of contracts (potentially a uniform contract)

Key friction: imperfect information about physician type θ

- Physicians endogenously choose contract $x^*_\theta(m)$ and treatment intensity $m^*(x, \theta)$

$$\max_X \int_{\theta'} E[h(m^*(x^*_\theta; \theta'), \lambda; \theta') \mid \lambda \sim F] \, dG(\theta') \tag{1}$$

$$\text{s.t.} \int_{\theta'} E[x^*_\theta(m^*; \theta'), \lambda) \mid \lambda \sim F] \, dG(\theta') \leq R \qquad [\mu_B, \text{Budget}]$$

$$\text{and} \int_{\theta'} E[V(x^*_\theta; \theta') \mid \lambda \sim F] \, dG(\theta') \geq \bar{v} \qquad [\mu_P, \text{Participation}]$$

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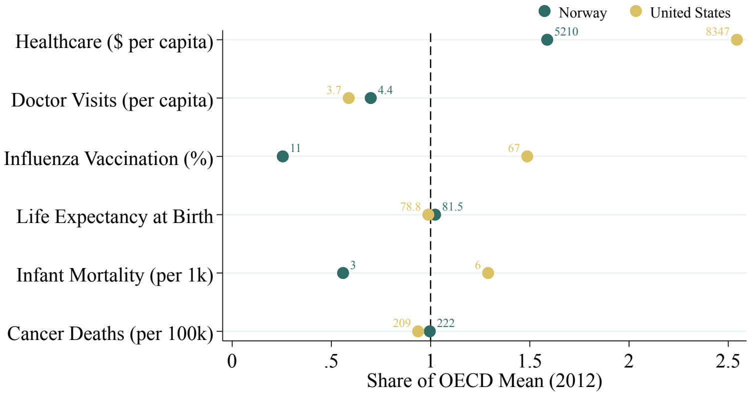
Norway vs. United States

Back



Norway vs. United States

Back

Gate-keeping and central registration

- Norway: patients need to register and visit for referrals
- U.S.: patients often switch, directly visit specialists

Government reimbursement to physicians

- Norway: combines rates per service (100s) and per patient
- U.S.: rates per services (1000s), with exceptions

Multi-payer incentives

- Norway: all physicians have same incentives
- U.S.: physicians often also treat privately insured, negotiate rates

Patient Choice Portal

Back

	GP	GP office	Free seats	Number on the waiting list
^	**Abureya, Ibrahim** 56 years old , male	Brugata Medical office Brugata 4 , 2212 Kongsvinger	22 av 1300	*No waiting list*

Ibrahim Abureya

Approved as a doctor in 2001
Specialist in general medicine
Started as GP in Kongsvinger: 1 May 2009

GP list ?

Maximum number of places on the doctor's list: 1,300
Number of vacant places on the doctor's list: 22
Number of people on the waiting list: 1

Contact information and facilities at the doctor's office

visiting address

Brugata Medical office
Brugata 4, 2212 Kongsvinger

Long-Lasting Patient-PCP Relationships

Using a centralized system, patients can request to join the panel of any physician with fewer patients than the contracted maximum

- Limited to 2 switches/year; few reach that limit
- Most patients choose a nearby PCP
- National licensing system fixes the total number of local physicians in the short term

Once registered, primary care largely occurs with a patient's registered physician

- Exceptions: treatment at stand-alone urgent care centers, e.g., outside regular opening hours, and second opinions from other PCPs

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Data

Construct balanced patient panel $\rightarrow$ isolate variation from reimbursement rate change

- Long-term residents with consistent registration to active PCP in one location
- Includes 6 months before and after certification
- Similar placebo sample: 10% of never-certified PCPs

Data

Construct balanced patient panel → isolate variation from reimbursement rate change

- Long-term residents with consistent registration to active PCP in one location
- Includes 6 months before and after certification
- Similar placebo sample: 10% of never-certified PCPs

Treatment intensity measure: simulated hours

- Revenue divided by simulated reimbursement per hour
- Bin patients into 10 types based on age, sex, and diagnoses Patient-Type Summary Stats
- For each type, calculate average bundle of services and apply current rates
- Divide by average hours per type → simulated reimbursement per hour

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Sample Selection

	Physicians	Patients
Total Personnel	12,677	
Registered to Patient List	8,928	
Linkable to Utilization	7,956	
Overlapping Certification	1,288	
Fixed and Present Physician	1,269	
Balanced 13-Month Spell	714	799,083
Balanced Patient Panel	619	643,363

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Patient-Type Summary Statistics

	Patients	Share	Age	Chronic Illness	Reimbursement	FFS Rate
1	154,560	0.229	10.503	0.000	2.510	32.922
2	93,670	0.139	34.332	0.027	4.794	50.321
3	94,920	0.141	37.481	0.191	5.435	44.055
4	56,639	0.084	38.036	0.055	8.275	45.737
5	67,959	0.101	41.282	0.000	8.869	46.597
6	54,147	0.080	44.248	0.035	9.649	46.509
7	47,809	0.071	58.283	0.441	10.688	47.308
8	43,579	0.065	66.043	0.791	14.376	46.178
9	33,689	0.050	59.553	1.000	17.489	48.015
10	26,837	0.040	71.314	1.000	24.116	50.706

Notes: Summary statistics reflect patients' monthly totals six months before certification in the estimation sample. Monetary measures are in USD.

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Summary Statistics

	Control Sample	Estimation Sample					
	Mean	Mean	Std. Dev.	% > 0	10th	50th	90th
Patient Characteristics							
Reimbursement	8.59	8.33	25.49	20.74	0.00	0.00	30.92
Simulated Hourly Rate	43.82	43.76	6.86	100.00	32.38	45.49	50.95
Simulated Hours	0.19	0.18	0.56	20.74	0.00	0.00	0.68
Base Payment	4.03	4.01	0.11	100.00	3.84	4.02	4.13
Visits	0.37	0.34	0.84	20.76	0.00	0.00	1.00
Hours	0.11	0.10	0.29	20.78	0.00	0.00	0.33
Reimbursement Lines	0.90	0.87	2.59	20.79	0.00	0.00	3.00
Procedures	0.06	0.07	0.57	3.55	0.00	0.00	0.00
Diagnostics	0.24	0.22	0.99	8.04	0.00	0.00	0.00
Extra Time	0.10	0.08	0.45	5.03	0.00	0.00	0.00
Patients	131800	643363					
Physicians	136	619					

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Summary Statistics

	Control Sample	Estimation Sample					
	Mean	Mean	Std. Dev.	% > 0	10th	50th	90th
Patient Characteristics							
Clinic Reimbursement	2.49	2.84	101.22	7.43	0.00	0.00	0.00
Specialist Reimbursement	19.84	19.24	86.66	22.88	0.00	0.00	59.67
Acute Hospitalizations	0.02	0.02	0.22	1.38	0.00	0.00	0.00
Age	40.54	37.57	22.78	100.00	6.67	36.58	69.00
Female	0.48	0.50	0.50	50.42	0.00	1.00	1.00
Chronic Illness	0.23	0.21	0.41	21.03	0.00	0.00	1.00
New Patient	0.20	0.10	0.29	9.59	0.00	0.00	0.00
Disability	0.07	0.06	0.25	6.42	0.00	0.00	0.00
Patients	131800	643363					
Physicians	136	619					

Back

Summary Statistics

	Control Sample	Estimation Sample					
	Mean	Mean	Std. Dev.	% > 0	10th	50th	90th
Physician Characteristics							
Enrollment	1201.99	1225.23	299.93	100.00	867.00	1197.00	1589.00
Max Enrollment	1268.60	1273.48	293.21	100.00	900.00	1220.00	1600.00
Physician Hours/Week	28.36	26.56	9.44	100.00	13.13	27.33	37.27
Female Physician	0.45	0.43	0.49	42.94	0.00	0.00	1.00
Physician Age	42.87	40.23	5.92	100.00	34.08	38.83	48.67
Migrant Physician	0.27	0.28	0.45	27.82	0.00	0.00	1.00
Pr(Diagnostic)	0.81	0.76	0.10	100.00	0.63	0.77	0.87
Ever Fixed-Salary	0.01	0.03	0.17	2.82	0.00	0.00	0.00
Patients Age 60+	0.23	0.19	0.10	100.00	0.07	0.18	0.32
Patients with Chronic Illness	0.23	0.21	0.06	100.00	0.14	0.20	0.29
Patients	131800	643363					
Physicians	136	619					

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Sample Resembles Norwegian Population

	Population	Estimation Sample					
	Mean	Mean	Std. Dev.	% > 0	10th	50th	90th
Patient Characteristics							
Age	38.436	37.225	22.684	1.000	6.417	36.250	68.417
Female	0.495	0.505	0.500	0.505	0.000	1.000	1.000
Chronic Illness	0.200	0.210	0.407	0.210	0.000	0.000	1.000
Disability	0.060	0.064	0.244	0.064	0.000	0.000	0.000
Physician Characteristics							
Enrollment	1297.232	1235.749	314.715	1.000	880.000	1197.000	1592.000
Female Physician	0.356	0.438	0.496	0.438	0.000	0.000	1.000
Physician Age	49.000	39.777	6.123	1.000	33.500	38.083	49.500
Migrant Physician	0.215	0.226	0.418	0.226	0.000	0.000	1.000
Patients	5525876	215529					
Physicians	4769	207					

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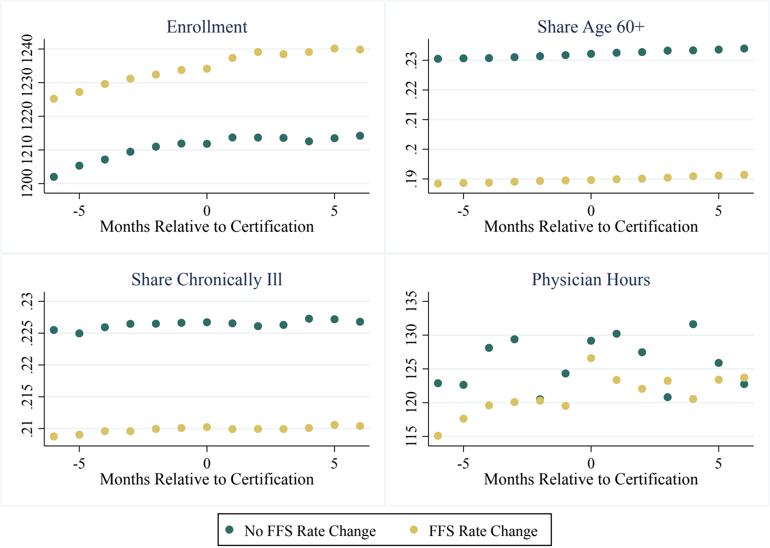
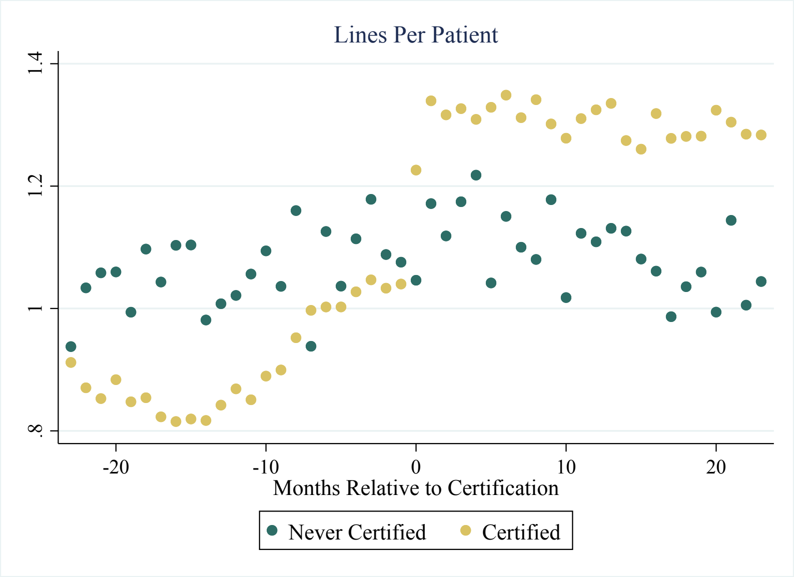
Raw Means of Characteristics Relative to Certification



Back: Robustness

Long-Run Means Relative to Certification



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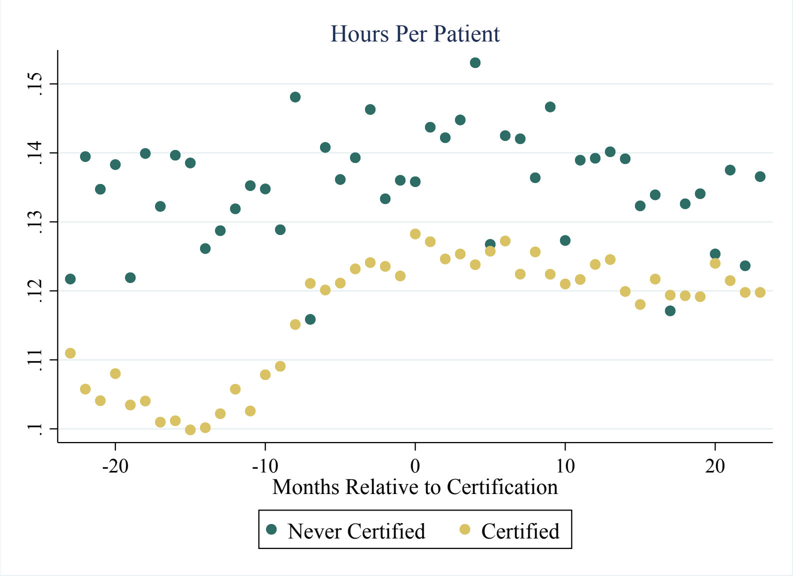

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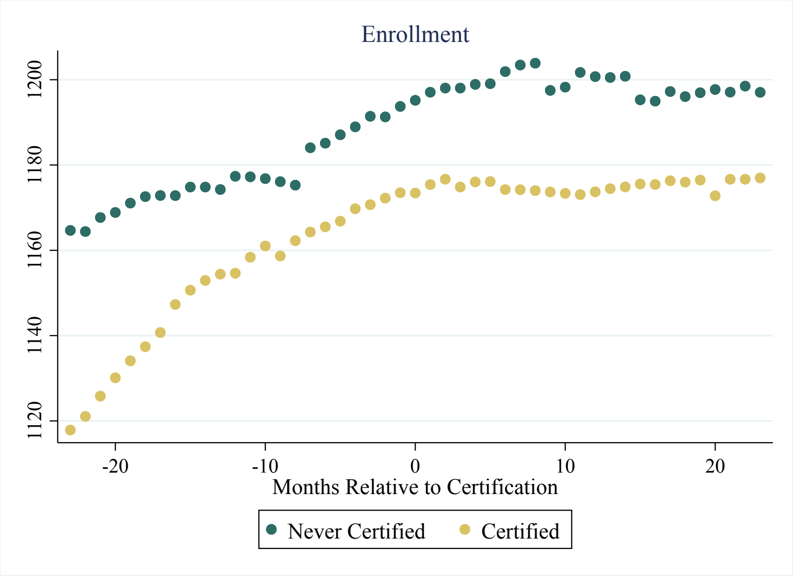

Back: Altruism

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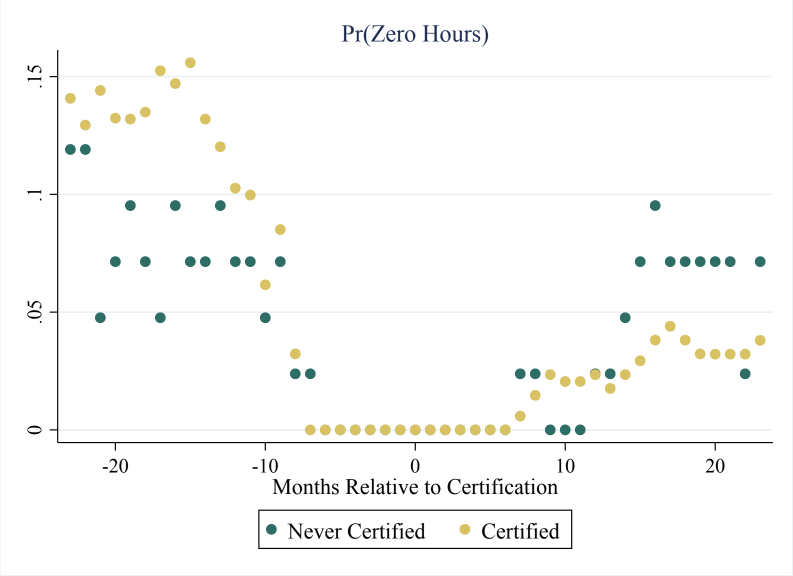
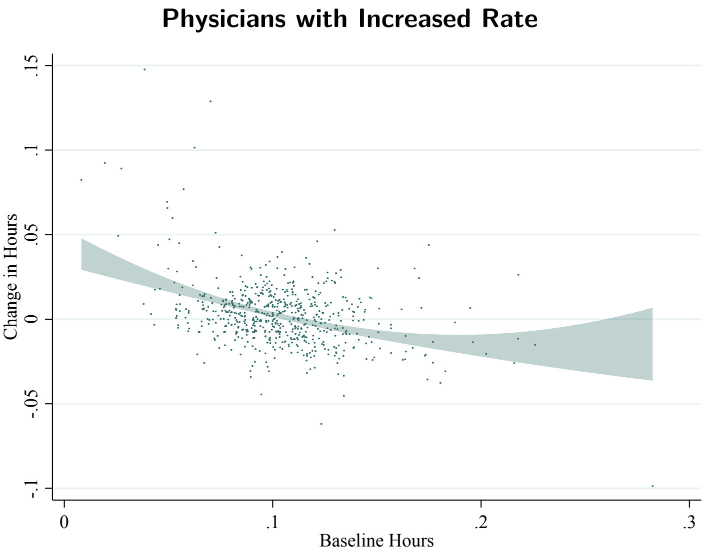


Back: Altruism

Raw Data Consistent with Correlated Cost and Altruism



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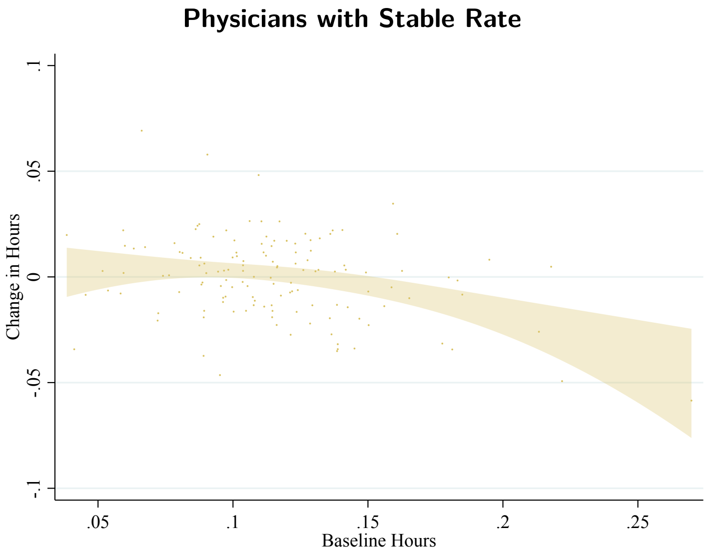

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How do PCPs respond to higher rates?

$$Y_{ijt} = \beta_1 Post_{jt} \times Certified_j + \boldsymbol{\beta}_x \boldsymbol{X}_{jt}$$
$$+ \gamma_i + \gamma_{y(t)} + \gamma_{m(t)} + \epsilon_{ijt}$$

Y_{ijt}: Outcome of interest for patient i at PCP j in relative month t

Stacked DiD: coefficient of interest β_1 compares post-certification relative to pre (for patients of certified PCPs relative to non-certified)

Patient fixed effects and short-term variation
$\rightarrow$ Weak assumptions on unobserved determinants of health

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PCPs Increase Treatment Intensity 3-4 Percent

	Post × Certified		Mean (Pre)	R^2	Obs.
Visits	0.015***	(0.001)	0.355	0.401	9,301,956
Reimbursement	2.093***	(0.106)	8.581	0.213	9,301,956
Simulated Hours	0.006**	(0.002)	0.187	0.186	9,301,956
Procedures	−0.001	(0.001)	0.071	0.237	9,301,956
Diagnostics	0.009***	(0.002)	0.229	0.266	9,301,956
Extra Time Codes	0.002***	(0.001)	0.086	0.230	9,301,956
Other Reimbursement	−0.303***	(0.076)	2.486	0.099	9,301,956
Specialist Reimbursement	0.245	(0.310)	19.702	0.190	9,301,956
Acute Hospitalizations	−0.000	(0.000)	0.019	0.153	9,301,956

Notes: This table estimates the stacked differences-in-differences using the estimation sample, showing the coefficient on the interaction of indicators for the main estimation sample and post-certification. The unit of analysis is a patient-month and the sample includes the six months before and after a PCP becomes certified for registered patients, among complete spells. Unless otherwise indicated, all outcomes are specific to a pair of physician and patient with registration numbers, and zeroes are included. Visits includes any in-person encounter. Reimbursement indicates fee-for-service revenue. Simulated Hours is reimbursement divided by a price index. Procedures, Diagnostics, and Extra Time Codes are counts of reimbursement codes grouped by the chapter of the reimbursement code. These categories are mutually exclusive but not exhaustive. Other-PCP Reimbursement includes treatment by any PCP other than the registered one, e.g., at community health clinics. Non-PCP reimbursement includes specialists, chiropractors, dentists, etc., that are eligible for public reimbursement. Acute Hospitalizations are unscheduled with admission within six hours. Mean (Pre) is an average of patient-months in the six months before certification, excluding the control sample.

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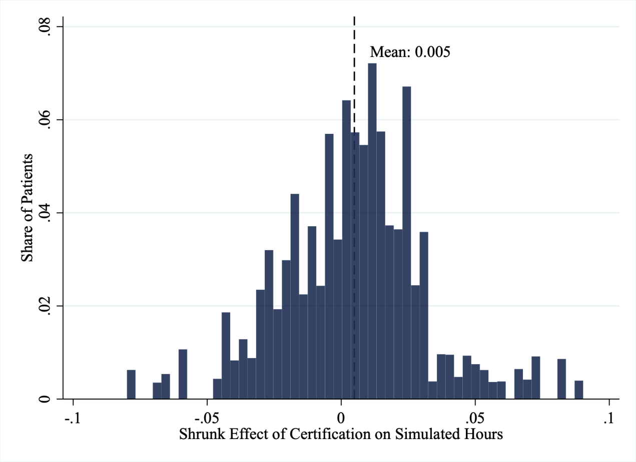
PCPs Heterogeneously Increase Treatment Intensity



Notes: This histogram shows estimates of β_{1j} from the stacked DiD specification where the effect of certification is allowed to vary by certified physician. Estimates are truncated at the 1st and 99th percentiles.

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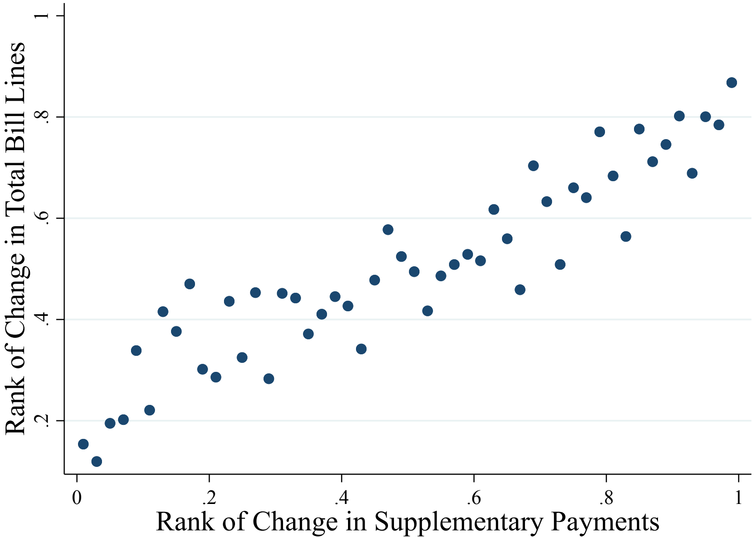
Correlated Response Across Treatments, Within Physician



Back: Altruism

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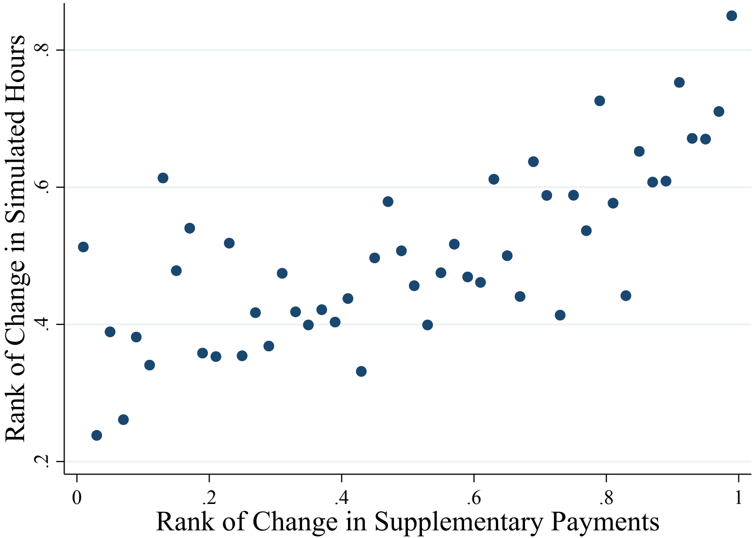

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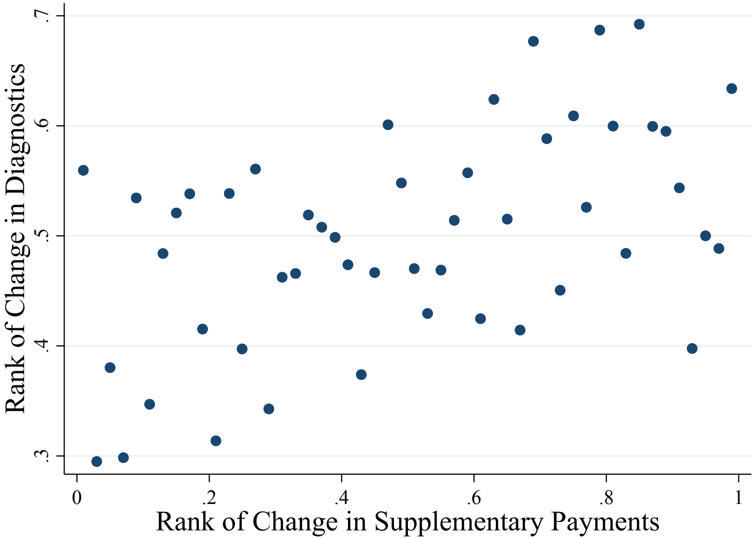

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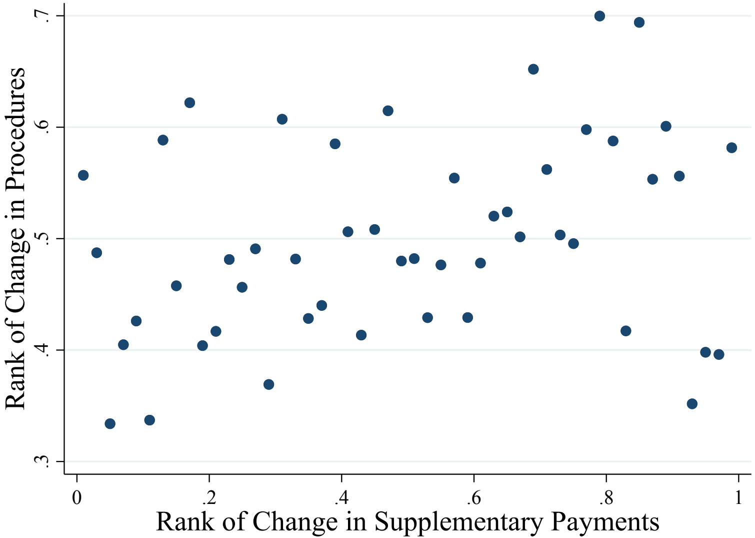

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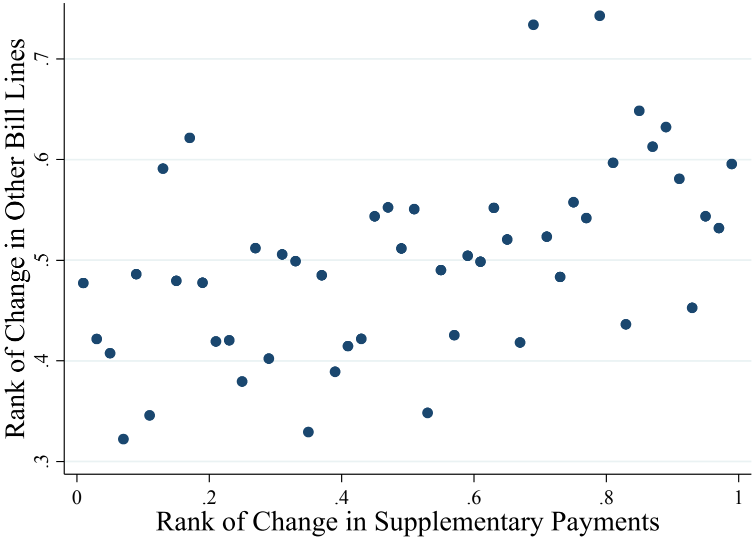

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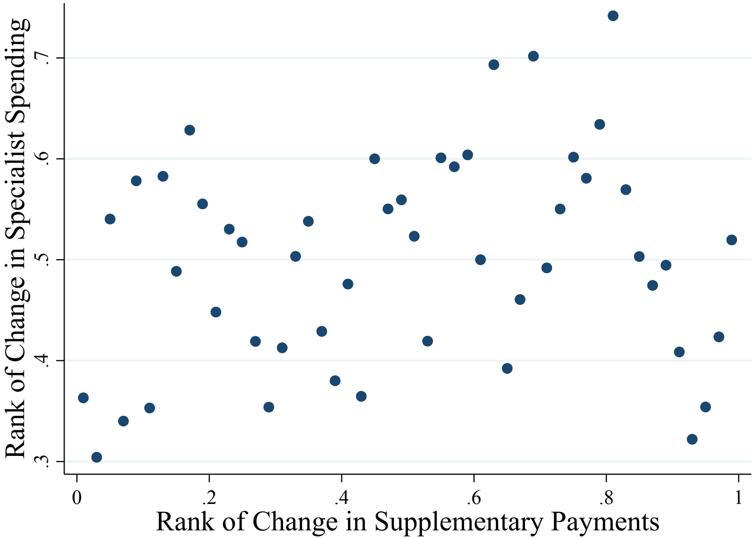

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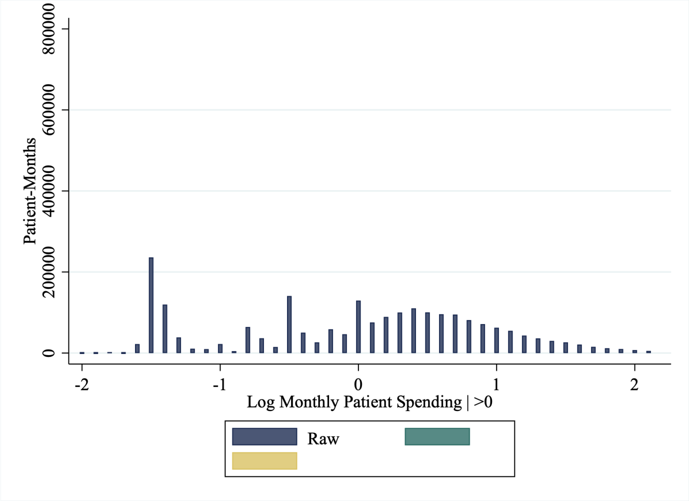
PCPs seem to drive dispersion in treatment intensity



Notes: Fixed effects are from regressing log reimbursement on an indicator for post-utilization, PCP fixed effects, high-resolution patient observed-type fixed effects, and a quadratic function of patient age. All measures subtract the sample mean of 5.71, and less than 1% of observations are excluded due to small frequencies.

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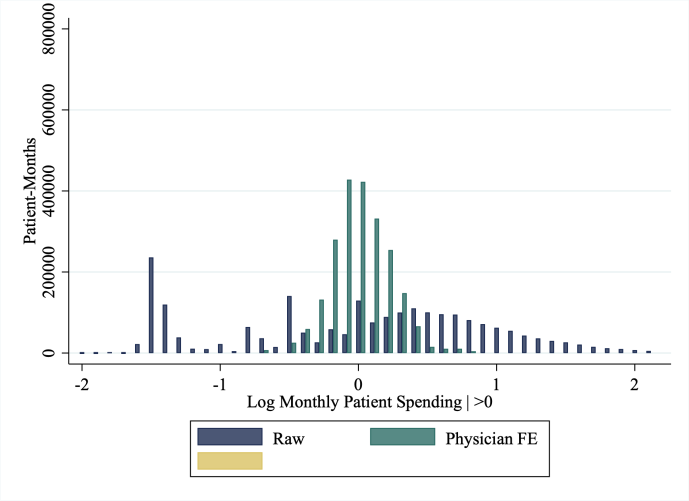

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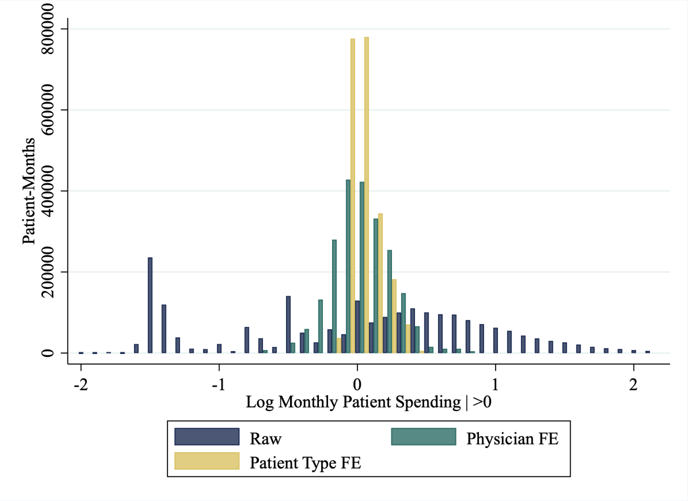

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Causal Effects of Assignment to Physician

$$Y_{ij} = \beta_j + \beta_{j_0(i)} + \beta_x X_j + \epsilon_{ij}$$

Y_{ij} Average outcome of interest for patient i conditionally randomly assigned to PCP j, over next 6 months

β_j Coefficient of interest ("value-added")

$\beta_{j_0(i)}$ Fixed effect for original exiting physician

$\beta_x X_j$ Availability and municipality, for conditional randomness

Shrink β_j to mean with weight $\frac{\sigma_w^2}{\sigma_w^2+\sigma_a^2}$, where within-variance and across-variance calculated using all patients

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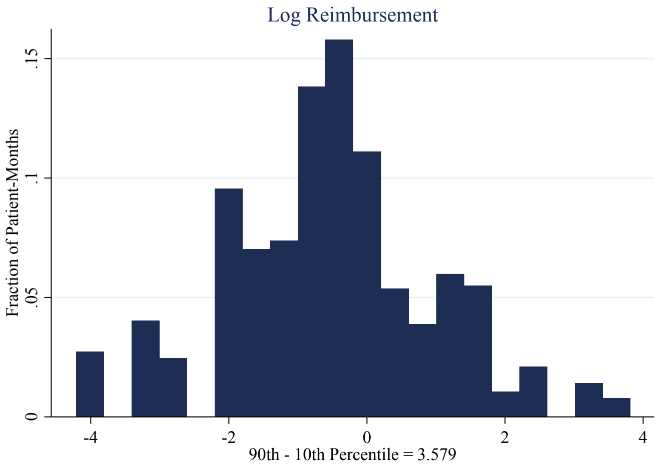
Shrunk Value-Added Estimates for Certified Physicians



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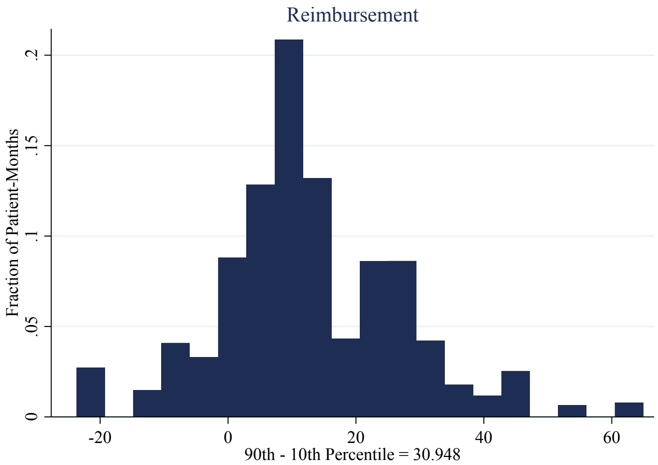
Shrunk Value-Added Estimates for Certified Physicians



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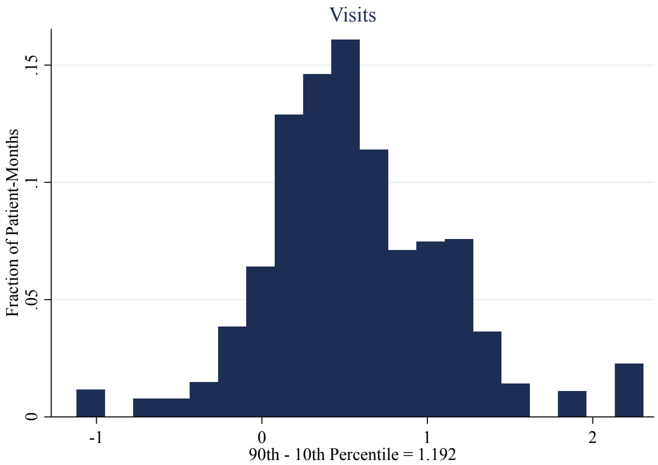
Shrunk Value-Added Estimates for Certified Physicians



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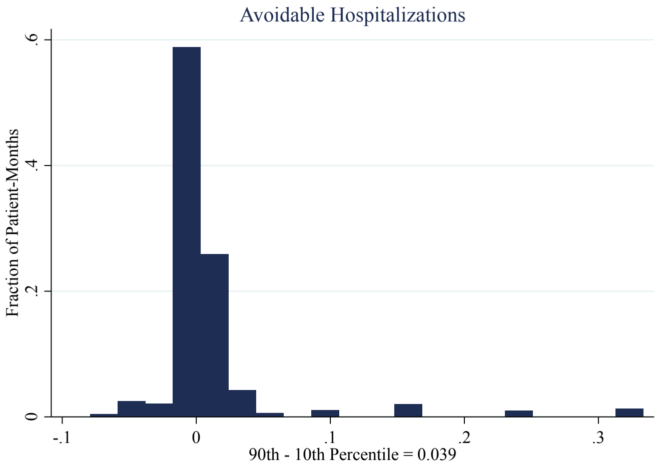

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Correlates of Physician Heterogeneity

	$\ln c$	$\ln \alpha$	$\ln \gamma$
Constant	0.902***	8.418***	−0.348***
	(0.168)	(0.280)	(0.011)
Age	0.031	0.024	0.035***
	(0.028)	(0.048)	(0.002)
Max Enrollment	−0.011	0.019	−0.015***
	(0.032)	(0.052)	(0.002)
Pr(Diagnostic)	−0.057*	0.023	−0.085***
	(0.030)	(0.049)	(0.002)
Ever Fixed-Salary	0.113	−0.050	0.113***
	(0.184)	(0.297)	(0.010)
Female	0.018	−0.049	−0.003
	(0.060)	(0.101)	(0.004)
Migrant	−0.104*	−0.022	−0.021***
	(0.063)	(0.110)	(0.004)
Rural Municipality	0.099	−0.091	0.003
	(0.077)	(0.127)	(0.004)
Trend	0.121	−0.639	−0.138***
	(0.304)	(0.517)	(0.018)
S.D. Residual	0.227***	0.318***	0.145***
	(0.031)	(0.029)	(0.002)

Back

Correlates of Physician Heterogeneity

$\rho(\ln c, \ln \alpha)$	-0.269^{*}
	(0.139)
$\rho(\ln c, \ln \gamma)$	0.561^{***}
	(0.101)
$\rho(\ln \alpha, \ln \gamma)$	-0.295^{**}
	(0.137)

Back

Correlates of Log Patient Severity

	Estimate	Std. Err.
$\log(1+m_{t-1})$	0.024	(0.000)
$m_{t-1}=0$	0.050	(0.001)
Cancer	0.010	(0.002)
Diabetes	0.028	(0.002)
COPD	0.031	(0.002)
Asthma	0.018	(0.002)
CVD	0.035	(0.002)
1+ Chronic Illness	0.014	(0.002)
2+ Chronic Illnesses	−0.005	(0.002)
Female	0.001	(0.000)
Disability Receipt	0.055	(0.001)
Income Percentile	−0.013	(0.001)

Back

Correlates of Log Patient Severity

	Estimate	Std. Err.
Recent Acute ER Visit	0.022	(0.001)
Recent Acute ER Visit 2+	0.032	(0.001)
Time Trend	0.009	(0.002)
New Patient	0.006	(0.001)
$\log \sigma_\lambda$	-0.389	(0.003)
$P(\lambda > 0) : d_0$	-3.389	(0.019)
$P(\lambda > 0) : d_1$	11.462	(0.132)

Back

Correlates of Log Patient Severity

	Estimate	Std. Err.
Patient Type 2	0.039	(0.001)
Patient Type 3	0.053	(0.001)
Patient Type 4	0.083	(0.001)
Patient Type 5	0.091	(0.001)
Patient Type 6	0.092	(0.001)
Patient Type 7	0.091	(0.001)
Patient Type 8	0.109	(0.001)
Patient Type 9	0.111	(0.001)
Patient Type 10	0.129	(0.002)

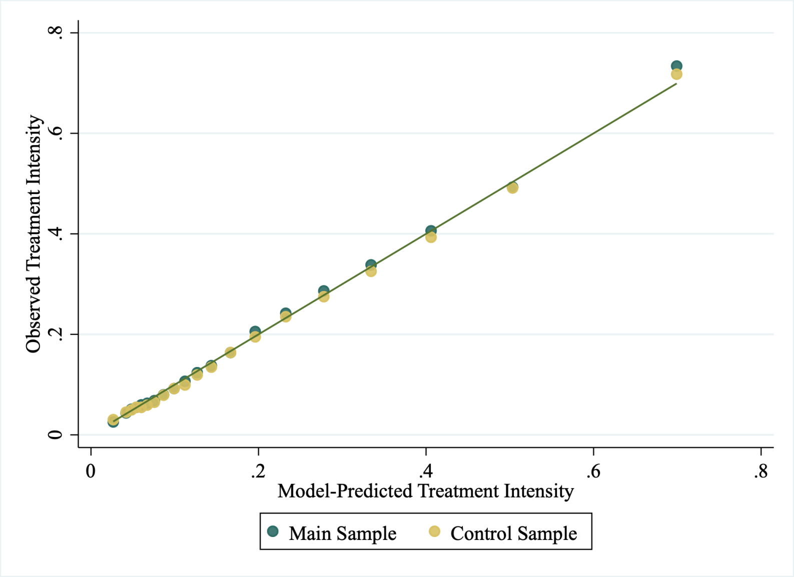
Back

Correlates of Log Patient Severity

	Estimate	Std. Err.
February	0.030	(0.001)
March	0.011	(0.001)
April	0.020	(0.001)
May	0.010	(0.001)
June	0.018	(0.001)
July	0.014	(0.001)
August	−0.059	(0.001)
September	0.013	(0.001)
October	0.017	(0.001)
November	0.017	(0.001)
December	0.018	(0.001)

Back

Model Fit: Ventiles of Predicted Treatment Intensity



Back Model Fit: Regression

Annual Counterfactual Outcomes for Norwegian Population ($M)

	Health Production	Share of Max	Expenditure	$E[V]$
Pre-Certification	0.0	0.000	0.0	0.0
Post-Certification	139.0	0.264	138.9	113.6
	(0.4)	(0.001)	(0.4)	(0.4)
Efficient Contracts	525.8	1.000	137.2	0.0
	(3.0)	(0.000)	(0.6)	(0.0)
Optimal Uniform Contract	153.7	0.292	132.5	103.6
	(2.1)	(0.003)	(0.5)	(0.5)
Optimal Menu of Contracts	176.5	0.336	144.9	109.1
	(1.9)	(0.003)	(0.4)	(0.6)

Notes: This table shows key outcomes from realized and counterfactual contract menus, scaled annually to the Norwegian population (5.24M).

Back

Two-Contracts: Correlates of Choice and Welfare

Figure: Patient severity drives willingness-to-pay

WTP R2: (cost) 0.043, (altruism) 0.002, (productivity) 0.031

Back

Two-Contracts: Correlates of Choice and Welfare

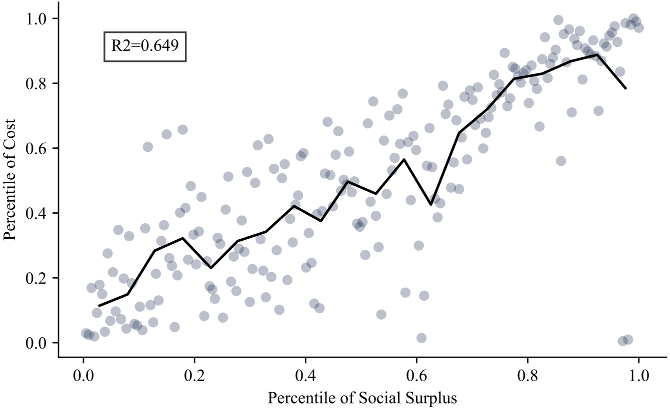
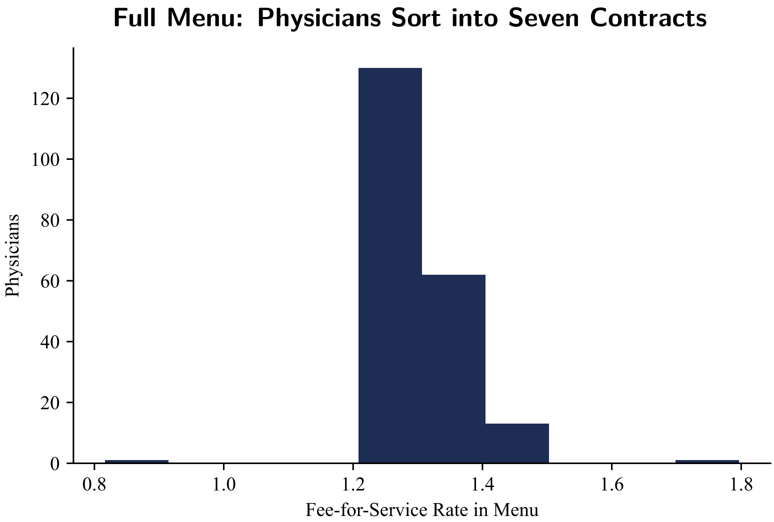


Figure: Cost drives incremental health production net of expenditure

SS R2: (altruism) 0.077, (productivity) 0.164, (severity) 0.112 Back

More Than Two Contracts is Even Better



Back

Who Benefits Most? High Cost, Low Altruism

Aggregate physicians into 16 bins, e.g., a combination of:

c_L Below-median cost of effort

α_L Below-median altruism

γ_L Above-median productivity

F_H Above-median (mean) patient severity

Who Benefits Most? High Cost, Low Altruism

Physicians		Menu of Contracts			Efficient Contracts	
Bin	Share	WTP	Health	Spend	Health	Spend
$c_L, \alpha_H, \gamma_L, F_L$	0.17	1.18	0.86	1.51	1.31	0.55
$c_H, \alpha_L, \gamma_H, F_L$	0.16	1.16	2.98	1.54	14.17	3.42
$c_H, \alpha_L, \gamma_H, F_H$	0.15	2.30	5.79	3.14	20.00	4.49
$c_L, \alpha_H, \gamma_L, F_H$	0.15	2.01	1.16	2.55	1.44	0.62
$c_L, \alpha_L, \gamma_H, F_L$	0.05	1.53	1.75	1.96	3.86	1.37
$c_H, \alpha_L, \gamma_L, F_H$	0.05	1.41	4.91	2.01	21.55	4.82
$c_L, \alpha_H, \gamma_H, F_H$	0.05	3.16	2.34	4.00	3.20	1.25
$c_H, \alpha_H, \gamma_L, F_L$	0.04	1.21	1.72	1.57	5.67	1.98
Other 8 Bins	0.18	1.94	3.44	2.71	5.47	1.79

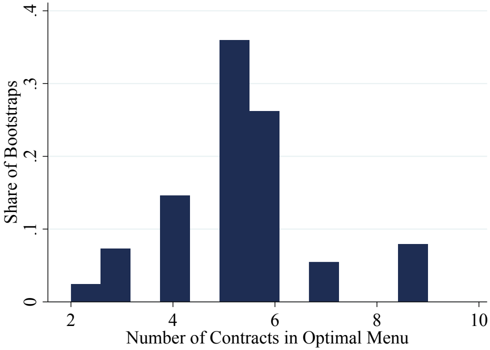
Back Summary of Counterfactuals

Rural Patients Benefit Most

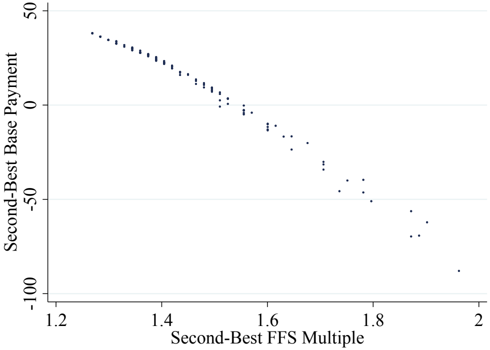
Physicians		Efficient Contracts		Menu of Contracts		
Type	Share	$\Delta E[h(m)]$	$\Delta E[p\,m+b]$	$\Delta E[h(m)]$	$\Delta E[p\,m+b]$	$\Delta E[V(p)]$
Most Urban: 1	0.11	6.09	1.72	2.10	2.18	1.68
2	0.31	8.90	2.30	3.08	2.42	1.80
3	0.34	7.32	1.99	2.65	2.23	1.68
4	0.16	9.22	2.46	2.57	2.15	1.65
5	0.04	11.11	2.58	3.43	2.51	1.88
Most Rural: 6	0.04	13.50	2.69	4.36	2.84	2.07

Back

Optimal Menu Across Bootstrap Samples



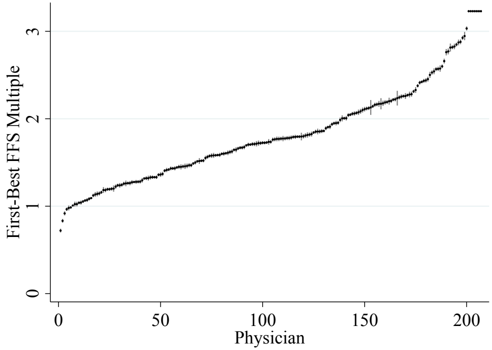
(a) Number of Contracts



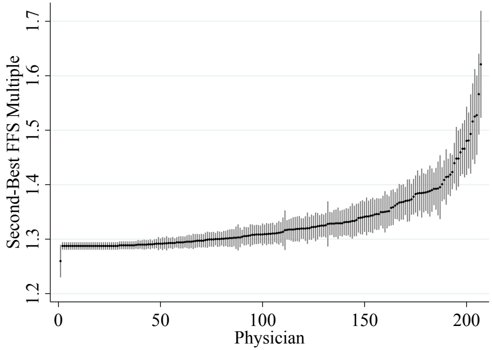
(b) Base Payment Schedule

Back Physician-Specific Contracts

Physician-Specific Contracts Across Bootstrap Samples



(a) Personalized Contracts



(b) Menu Self-Selected Contracts

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Test for Selection on Unobserved PCP Heterogeneity

	Certified	Non-Certified	Certified and Non-Certified		
	(1)	(2)	(3)	(4)	(5)
$E[m]$	1.041***	1.025***	1.032***	1.041***	1.087***
	(0.002)	(0.005)	(0.002)	(0.002)	(0.003)
$E[m] \times$ Control				−0.016***	−0.018***
				(0.005)	(0.005)
Control				−0.001	
				(0.001)	
Female					−0.013***
					(0.001)
Age					−0.000***
					(0.000)
Chronic Illnesses					−0.021***
					(0.001)
Intercept	−0.007***	−0.008***		−0.007***	
	(0.001)	(0.001)		(0.001)	
Physician FEs			✓		✓
Observations	2013672	385416	2399088	2399088	2399088
R^2	0.113	0.108	0.114	0.112	0.114

Back

Counterfactuals by Patient-Type

Table: Counterfactual Outcomes: Menu for each Patient Type

	$\Delta SS_{Efficient}$	$\Delta SS_{Uniform}$		ΔSS_{Menu}		Menu $\succ$ Uniform
	Level	Level	Share of Eff.	Level	Share of Eff.	
Baseline	8.396	2.548	0.303	2.714	0.323	✓
Patient Type 1	3.190	0.877	0.275	0.977	0.306	✓
Patient Type 2	4.560	1.264	0.277	1.332	0.292	✓
Patient Type 3	6.343	1.928	0.304	1.990	0.314	✓
Patient Type 4	7.810	2.447	0.313	2.520	0.323	✓
Patient Type 5	9.802	2.701	0.276	2.892	0.295	✓
Patient Type 6	11.868	3.389	0.286	3.554	0.299	✓
Patient Type 7	11.844	3.321	0.280	3.505	0.296	✓
Patient Type 8	15.291	4.328	0.283	4.511	0.295	✓
Patient Type 9	19.851	5.593	0.282	5.975	0.301	✓
Patient Type 10	25.702	6.842	0.266	7.185	0.280	✓
All Patient Types	8.586	2.433	0.283	2.569	0.299	✓

Back

Counterfactual Outcomes with Perturbations

Back

	$\Delta SS_{Efficient}$	$\Delta SS_{Uniform}$		ΔSS_{Menu}		Menu $\succ$ Uniform
	Level	Level	Share of Eff.	Level	Share of Eff.	
Baseline	8.396	2.548	0.303	2.714	0.323	✓
$0 \times Var(c)$	7.885	2.122	0.269	2.464	0.313	✓
$\frac{1}{2} \times c$	3.423	2.183	0.638	2.184	0.638	✓
$2 \times c$	5.560	1.194	0.215	1.332	0.240	✓
$2 \times Var(c)$	15.123	2.361	0.156	2.361	0.156	
$0 \times Var(\alpha)$	8.664	2.606	0.301	2.921	0.337	✓
$\frac{1}{2} \times \alpha$	5.838	2.005	0.343	2.040	0.349	✓
$2 \times \alpha$	11.188	2.791	0.249	3.178	0.284	✓
$2 \times Var(\alpha)$	9.978	2.327	0.233	2.327	0.233	
$0 \times Var(\gamma)$	8.645	2.564	0.297	2.652	0.307	✓
$\frac{1}{2} \times \gamma$	2.892	0.881	0.305	0.933	0.322	✓
$2 \times \gamma$	22.371	5.519	0.247	6.030	0.270	✓
$2 \times Var(\gamma)$	8.733	2.542	0.291	2.733	0.313	✓
Uncorrelated c, α, γ	10.215	2.117	0.207	2.176	0.213	✓
Drop Outliers of c, α, γ	8.993	2.576	0.286	2.802	0.312	✓
$\frac{1}{2} \times Var(\theta_k), \theta_k \in c, \alpha, \gamma$	8.416	2.721	0.323	2.998	0.356	✓
$0 \times Var(\gamma), 0 \times Var(\alpha)$	8.680	2.763	0.318	2.991	0.345	✓
$0 \times Var(c), 0 \times Var(\alpha)$	7.622	2.466	0.324	2.819	0.370	✓
$0 \times Var(c), 0 \times Var(\gamma)$	8.318	2.124	0.255	2.421	0.291	✓
$\frac{1}{2} \times \sigma_\lambda$	6.446	1.732	0.269	1.803	0.280	✓
$2 \times \sigma_\lambda$	23.791	5.530	0.232	6.456	0.271	✓

Counterfactual Outcomes with Perturbations

Back

	$\Delta SS_{Efficient}$	$\Delta SS_{Uniform}$		ΔSS_{Menu}		Menu $\succ$ Uniform
	Level	Level	Share of Eff.	Level	Share of Eff.	
Baseline	8.396	2.548	0.303	2.714	0.323	✓
$\frac{1}{2} \times \alpha_G$	4.449	1.324	0.298	1.310	0.294	
$2 \times \alpha_G$	16.599	4.991	0.301	5.667	0.341	✓
Add Control Sample	9.681	4.010	0.414	4.161	0.430	✓
Constrain Capacity	17.524	2.063	0.118	4.376	0.250	✓
Exclude Part-Time Physicians	8.781	2.559	0.291	2.730	0.311	✓
Only Urban Physicians	8.374	2.561	0.306	2.737	0.327	✓
Only Rural Physicians	9.360	2.644	0.282	2.788	0.298	✓
Alt. Health Parameterization	8.426	2.561	0.304	2.737	0.325	✓

Unobserved Constraints Don't Seem to Bias Altruism

Altruism estimates are identified by responsiveness to rate change

- Unobserved factors like capacity constraints could bias estimates upwards
- Problematic if physicians can still adjust treatment intensity down

Workload does not bunch near ten-year maximum Capacity

High- and low-altruism physicians are similar

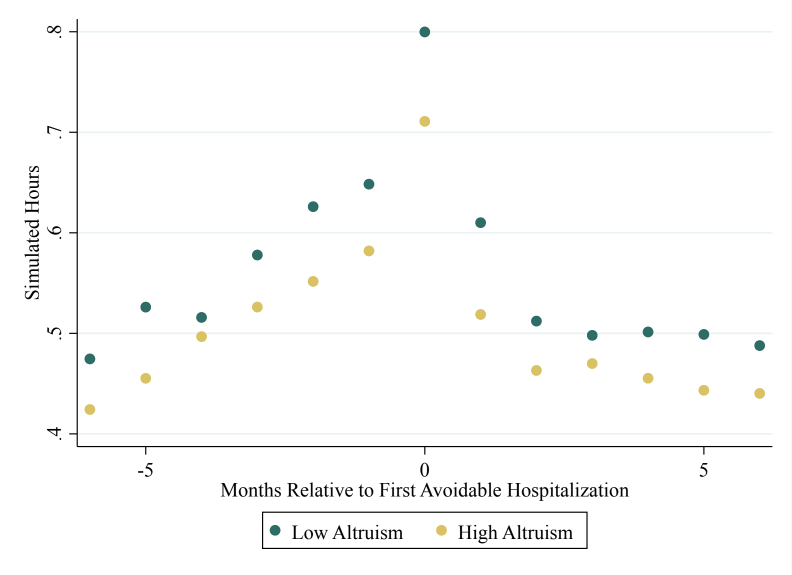
- Responsive to observed shock to patient health Avoidable ER Visits
- Across-time variance in pre-certification workload
- Patients seeking primary care from other physicians

Salience of rate change and learning

- Long-run event study: persistent change, no apparent lagged effects Figure

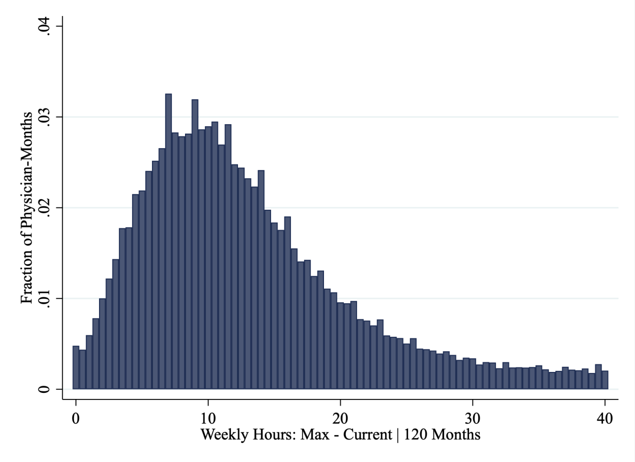
Back: Stylized Facts Back: Robustness

Treatment Intensity Responds to Health Shocks



Back: Altruism

Evidence for Slack Capacity



Notes: This figure shows the distribution of transformed hours per week ($\tilde{M}_{jt}$) across physician-months ($j-t$). The transformation is $\max_t M_{jt} - M_{jt}$. The x-axis is truncated at 40 and I exclude the first month when a physician works the maximum number of hours.

Back: Stylized Facts Back: Robustness Back: Appendix

Estimated Health Predicts Adverse Events, Not Patient Sorting

	$E[h(m, \gamma\lambda)]$ (1)	Switch (2)	Acute ER Visit (3)	Mortality (4)
Patient Type 6	66.041***	−0.007	−0.017	0.003
	(5.647)	(0.007)	(0.014)	(0.010)
Patient Type 7	67.379***	−0.010	−0.005	0.007
	(5.922)	(0.007)	(0.015)	(0.009)
Patient Type 8	46.462***	−0.015*	−0.035**	−0.018**
	(6.148)	(0.008)	(0.016)	(0.009)
Patient Type 9	69.383***	−0.006	0.002	−0.002
	(6.823)	(0.008)	(0.016)	(0.011)
Patient Type 10	46.154***	−0.005	−0.071***	−0.020**
	(7.531)	(0.008)	(0.017)	(0.009)
Observations	8749871	673067	673067	173727
R^2	0.107	0.009	0.042	0.040
Outcome mean	-484.269	0.055	0.136	0.034

Back: Results Back: Robustness

Application to US Medicare and Medicaid

Proposed rules centralize authority for Medicaid rate-setting
→ Larger scale of impact for counterfactual menus

Recent Medicare experiments: alternative (but still uniform) reimbursement schemes
→ May misinterpret treatment effects with selection on multidimensional heterogeneity

Push for uniform prices may backfire

Back