Voluntary Regulation: Evidence From Medicare Payment Reform

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Roadmap

Presentation Outline

Medicare, Fee-For-Service, and Alternative Reimbursement Models

- Medicare was established in 1965 under the SSA and is now administered by CMS.
- Medicare covers individuals who are 65+, qualified disabled, or require dialysis/kidney transplant.
- Medical Part A covers hospital insurance, operates under traditional "fee-for-service" model. Part C ("Medicare Advantage") operates under capitation.
- As of 2020, nearly 63M enrollees covered by Medicare, with 37.8M enrolled in Medicare Part A accounting for $380 billion in spending.[1]

[1] CMS Fast Facts, 2022. Interestingly, overall Medicare enrollment continues to rise (up to 64.5M in 2022), while enrollment in Part A declines (down to 35M in 2022).

Medicare, Fee-For-Service, and Alternative Reimbursement Models

- Alternative payment models include:
    - Accountable Care Organizations (ACOs),
    - Bundled payments*,
    - Primary care coordination.
- Alternative payment models account for over 30% of total Medicare spending as of 2016.

Voluntary Regulation

Market participants willingly decide to opt into voluntary program.

Voluntary regulation not unique to healthcare. Appears in environmental (e.g. pollution), educational (e.g. school vouchers), and energy (e.g. pricing schedules) regulation.

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- Selection on slopes: private information allows participant to forecast gains from changing behavior, net societal benefit.
- Selection on levels: participants opt-in with no behavior change, net societal loss.

Most of the policy debate has been focused on "selection on levels" and has ignored "selection on slopes". Authors key contribution is in investigating selection on moral hazard by hospitals.

Preview of Results

1. Selection on levels quantatively dominates selection on slopes.
2. Voluntary regulation already achieves $\sim \frac{2}{3}$ of the feasible welfare gains in this setting.
3. Very difficult to set optimal bundle prices with available information, but small welfare gains are feasible through improved targeting.

Presentation Outline

Comprehensive Care for Joint Replacement Program

- The program, known as CJR, was announced in 2015 and began in April, 2016.
- Covers hip and knee replacement operations; meaningfully large category, accounting for approx. 5% of Medicare stays and spending.
- Under CJR, select hospitals would receive bundled payments (as opposed to FFS).
- Pre-determined, fixed payments are made to the hospital (based on the DRG/modifier), after which the hospital is responsible for all claims on the stay.

Comprehensive Care for Joint Replacement Program

- CJR announced as a 5-year randomized controlled trial, with **mandatory** participation for hospitals selected into treatment arm.
- MSAs divided into 8 strata (by past LEJR spending quartile, median population), and randomized to treatment or control.

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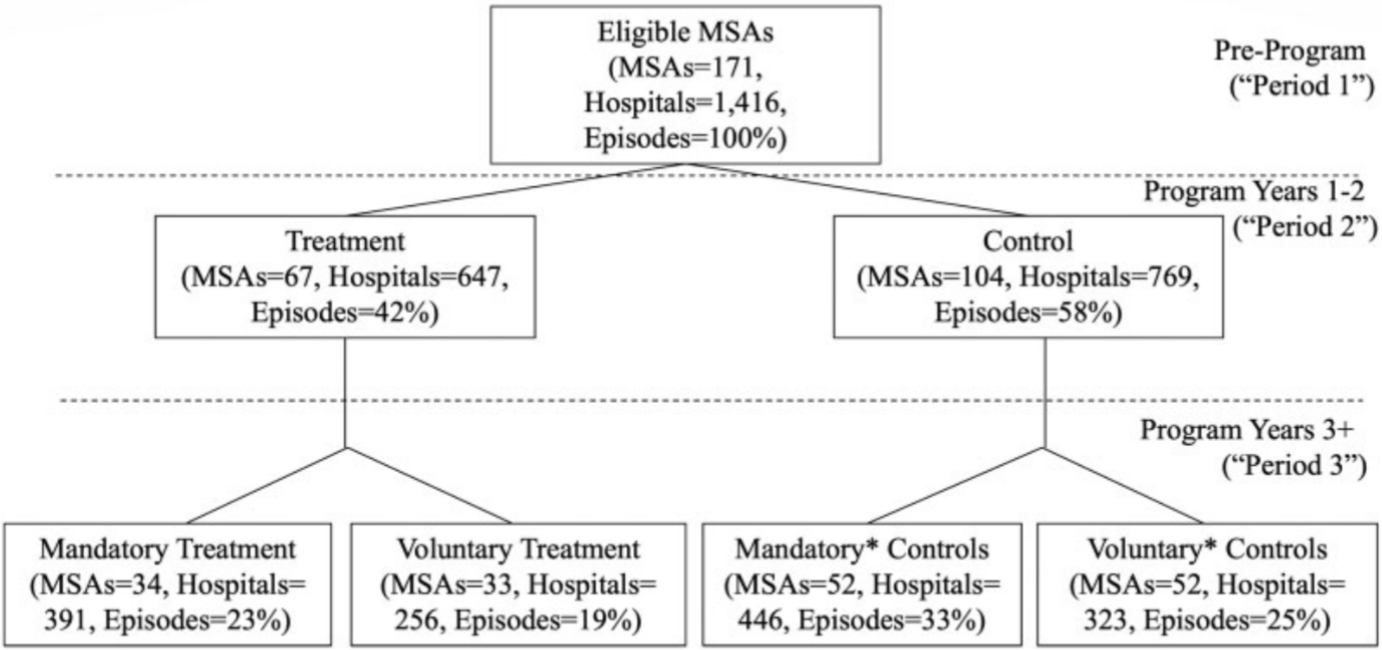
- CJR announced as a 5-year randomized controlled trial, with **mandatory** participation for hospitals selected into treatment arm.
- MSAs divided into 8 strata (by past LEJR spending quartile, median population), and randomized to treatment or control.
- Key intervention: in 2017 Senator Tom Price (then head of HHS) successfully led effort to change the program from mandatory to voluntary for **some** of the treatment hospitals.
- Hospitals in 33 of 67 treatment MSAs given one-time opportunity to opt in or out of program, with the decision taking effect in Jan. 2018.
  - Specifically, MSAs with below median-level historical spending on LEJR were given the option to voluntarily participate.

Comprehensive Care for Joint Replacement Program



How Do Bundled Payments Actually Work?

Reconciliation payments:

- Under FFS, y_{ht} is the average per episode claims submitted to Medicare by hospital h in year t.
  - Includes separate claims for the hospital, surgeon, PAC, etc.
- Under CJR, b_{ht} is the average per episode bundle price at hospital h in year t.
- *However*, hospitals in the treatment group continue to submit claims and receive payment from Medicare as they would under FFS.
- Reconciliation occurs at year's end: treatment hospitals receive $b_{ht} - y_{ht}$ per episode. Gross payment from Medicare is b_{ht}.

Two Important Caveats on Hospital Reimbursement

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2. Risk exposure is mitigated for all parties through stop-loss payments:
   - If $b_{ht} - y_{ht} \leq -\underline{b}$ then hospital pays CMS $\underline{b}$.
   - If $b_{ht} - y_{ht} \geq \overline{b}$, then Medicare pays hospital $\overline{b}$.
   - Stop- loss/gain limits initially set to be small and grow over the course of the program.

Unintended Changes in Quality?

One concern with the change to bundled payments is the impact on incentives: do hospitals now shirk on quality to save on costs?

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Little evidence to support this concern:

- Prior research finds no change in quality after reimbursement changes to bundled payments (Finkelstein et al. 2018).
- Hospitals only receive reconciliation payments by meeting minimum quality standards (non-binding for vast majority).
- Authors control for quality in average treatment effects, find no effect.

Data

- Medicare enrollment claims from 2013 - 2018:
  - Demographics,
  - Inpatient, outpatient, PAC claims,
  - OOP payments owed,
  - Dates and length-of-stay.
- Hospital ownership type, size (beds), teaching status, and quality measures.
- Bundle prices and reconciliation payments for each hospital (in treatment arm).
  - Impute bundle prices for treatment hospitals that voluntarily select out of program in 2018.
- Final sample includes nearly 380k patients at the 1,416 hospitals (in 171 MSAs) that had at least one LEJR discharge in all three periods.

Presentation Outline

Average Treatment Effects

Following Finkelstein et al. (2018), authors estimate:

$$outcome_{j,2} = \beta_0 + \beta_1 BP_j + \beta_2 outcome_{j,2014} + \beta_3 outcome_{j,2013} + \delta_{s(j)} + \epsilon_j \quad (1)$$

- $outcome_{j,2}$: average per episode outcome in MSA j, period 2;
- BP_j: equals 1 if randomly assigned to treatment;
- β_1: average treatment effect of bundled payments;
- $outcome_{j,yyyy}$: lagged outcomes;
- $\delta_{s(j)}$: strata fixed-effects.

Average Treatment Effects

TABLE I

EXPERIMENTAL ESTIMATES DURING THE MANDATORY PARTICIPATION PERIOD

	Control mean	Control std. dev.	Average treatment effect	Standard error	*p*-value
Panel A: Claims, utilization, and gov't spending (per episode)					
Claims	25,294	3,603	−790	204	.001
Claims for index admission	13,542	2,389	−169	89	.060
Claims for institutional PAC	4,119	1,378	−499	128	.001
Claims for home health	1,800	918	−89	59	.131
Other claims	5,832	532	28	55	.610
Utilization					
Number of days in index admission	2.6	0.4	−0.1	0.0	.217
Number of days in institutional PAC	7.7	2.3	−0.6	0.2	.014
Discharge destination					
Institutional PAC	0.313	0.104	−0.034	0.009	.001
Home health agency	0.339	0.196	0.004	0.018	.812
Home (w/o home health agency)	0.329	0.232	0.042	0.018	.020
Other	0.019	0.032	−0.004	0.002	.052
Government spending	25,294	3,603	40	208	.848
Panel B: Quality measures					
Complication rate	0.011	0.005	0.001	0.001	.255
ER visit during episode	0.198	0.027	0.003	0.003	.399
90-day all cause readmission rate	0.102	0.015	−0.001	0.002	.725
Panel C: Admissions and patient composition					
LEJR admissions (per 1,000 enrollees)	29.9	15.8	−0.8	0.5	.095
CJR-eligible LEJR admissions (per 1,000 enrollees)	23.6	11.3	0.1	0.5	.889
Elixhauser comorbidity score	2.4	0.3	0.0	0.0	1.00

Key Findings From Average Treatment Effects Estimation

1. Significant decline in both total & PAC claims*,
2. Decline in discharge to PAC accompanied by increase to home without health agency (likely cascading effect)*,
3. **No change in overall Medicare spending**,
4. No detectable change in measurable quality,
5. No “cream skimming” effect,
6. Dynamic effects are not first order: treatment effects are immediate and steady over time, indicating little learning by doing.
    - Treatment effects do not fade out for voluntary hospitals prior to 2018, indicating no anticipatory effect.

Effects Over Time

Heterogeneity in Levels and Slopes

Substantial heterogeneity across hospitals masked by prior MSA level analysis. Same regression run at hospital level yields:

$$outcome_{h,2} = \beta_0 + \beta_{1,h} BP_h + \beta_2 outcome_{h,2014} + \beta_3 outcome_{h,2013} + \delta_{s(h)} + \epsilon_h \quad (2)$$

TABLE II
CORRELATES OF LEVELS AND SLOPES

	Panel A: Heterogeneity in levels						*Panel B: Heterogeneity in slopes*					
	Claims		Claims for institutional PAC		Probability of discharge to PAC		Claims		Claims for institutional PAC		Probability of discharge to PAC	
Mean (std. dev.)	28,357	(5,998)	5,814	(3,021)	0.455	(0.187)	−1,154	(3,054)	−1,011	(1,809)	−0.057	(0.105)
Coefficient (std. err.) from bivariate regression												
Number of CJR episodes	−5.31	(1.56)	−3.39	(0.69)	−0.0001	(0.0001)	−0.85	(0.57)	−1.10	(0.37)	−0.00003	(0.00002)
Quality	−441	(41)	−197	(18)	−0.010	(0.001)	−123	(24)	−77	(15)	−0.004	(0.001)
Number of beds	3.90	(1.21)	0.62	(0.32)	0.0001	(0.00003)	0.53	(0.46)	0.09	(0.20)	0.000004	(0.00001)
Teaching	4,528	(599)	561	(258)	0.049	(0.021)	819	(525)	−212	(241)	−0.025	(0.017)
For-profit	−3,030	(660)	−387	(304)	−0.064	(0.025)	−1,012	(651)	−414	(292)	−0.030	(0.020)
Nonprofit	−219	(596)	369	(264)	0.008	(0.023)	−32	(617)	−160	(246)	−0.012	(0.018)

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Observable Hospital Characteristics Do Not Explain Variation

- Exercise of variance decomposition (across levels and slopes) shows that observed hospital characteristics explain little cross-variation.
  ▸ Decomposition
- Interviews from prior studies show that hospitals highly value "physician champions" who lead the hospital's behavioral response (slope) to bundled payments (Lewin Group, 2019b).

Voluntary Selection

Clear evidence for selection on levels. Less so for selection on slopes.

TABLE III

SELECTION

	Voluntary control (1)	Voluntary select-in (2)	Voluntary select-out (3)	*p*-value of select-in vs. select-out difference (4)
Number of hospitals	323	73	183	
Number of episodes in period 1	51,469	14,664	24,777	
Percent of episodes in period 1		37.2%	62.8%	
Panel A: Selection on levels (period 1 outcomes per episode)				
Claims	26,524	26,146	27,776	.03
	(5,367)	(4,176)	(5,497)	
Claims for institutional PAC	4,811	4,681	5,551	.01
	(2,402)	(2,054)	(2,446)	
Share discharged to institutional PAC	36.9%	37.3%	41.6%	.10
	(16.0%)	(16.2%)	(14.5%)	
Panel B: Selection on slopes				
Impact on episode claims		−791	−665	.73
		(1,931)	(2,826)	
Impact on institutional PAC claims		−518	−176	.05
		(973)	(1,474)	
Impact on share discharged to institutional PAC		−3.3%	−1.2%	.12
		(7.8%)	(9.2%)	
Panel C: Selection on hospital characteristics				
Mean number of CJR episodes	306	320	252	.13
Mean number of beds	339	320	362	.43
Teaching	18.7%	4.3%	16.1%	.02
For-profit	17.5%	26.6%	12.5%	.06
Nonprofit	78.5%	63.4%	68.6%	.56
Government-owned	4.0%	10.0%	18.9%	.20
Mean quality score	11.7	13.1	10.6	.001

Presentation Outline

Setup

- FFS claims at hospital h denoted by λ_h, where $\lambda_h = f_h^{HOSP} + f_h^{OTH}$.
- Bundled payments average reimbursement per episode denoted by b_h.
- Costs denoted c_h^j for $j \in \{HOSP, OTH\}$, with the assumption $c_h^{OTH} = f_h^{OTH}$ (for tractibility...).
- f_h^{HOSP} are fixed by DRG under the PPS.

Bundled Payments Maximization Problem

Under FFS, hospitals simply receive profits $\pi_h^{FFS} = f_h^{HOSP} - c_h^{HOSP}$.

However, hospitals under bundled payments also incur costs from downstream providers' claims, thus their problem becomes:

$$\pi_h^{BP} = \max_e \left(b_h - [(c_h^{HOSP} + f_h^{OTH}) - e] - \phi_h(e)\right), \tag{3}$$

where $\phi_h(e)$ represents the cost to the hospital of exerting effort to reduce downstream costs by e. Note, we can just think of f_h^{OTH} as c_h^{OTH}.

Effort cost has standard properties: $\phi_h(0) = 0, \phi_h^{'} > 0$, and $\phi_h^{''} > 0$.

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FOC yields optimal (and first-best) effort $\phi_h^{'}(e_h^*) = 1$.

Participation Incentive

Authors assume quadratic effort costs, $\phi_h(e) = \frac{e^2}{2\omega_h}$, where ω_h is a hospital-specific parameter to be estimated.

$$\phi_h^{'}(e_h^*) = 1 \implies e_h^* = \omega_h \implies \phi_h(e_h^*) = \frac{\omega_h}{2} \implies \pi_h^{BP} = b_h - (c_h^{HOSP} + f_h^{OTH} - \omega_h).$$

Hospitals (with the option) will only select into bundled payments if $\pi_h^{BP} > \pi_h^{FFS}$:

$$BP_h = 1 \iff (b_h - \lambda_h) + \frac{\omega_h}{2} > 0. \tag{4}$$

Interpretation?

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Interpretation:

- Level effect: $(b_h - \lambda_h)$
- Slope effect: $\frac{\omega_h}{2}$

Social Welfare

$$W = S + \pi - (1 - \Lambda)G, \tag{5}$$

- W: social welfare;
- S: consumer surplus (assumed fixed, supported by prior evidence);
- π: hospital profits;
- G: government (Medicare) spending;
- Λ: marginal cost of public funds (> 0).
  - Captures DWL associated with distortionary taxation.

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  - Captures DWL associated with distortionary taxation. Assumed to be 0.15!

Socially Optimal Participation

Akin to the hospital's problem, participation is socially optimal when:

$$W_{BP} > W_{FFS} \iff -\Lambda(b_h - \lambda_h) + \frac{\omega_h}{2} > 0. \tag{6}$$

Difference from prior optimality condition?

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Difference from prior optimality condition? $\Lambda(b_h - \lambda_h)$ captures the social cost of public funds transferred to hospitals based on selection on levels.

Rephrased, participation is only welfare enhancing when the slope effect is greater than the cost-weighted level effect.

Socially Optimal Participation

Only socially optimal when $\frac{\omega_h}{2} > \Lambda(b_h - \lambda_h)$.

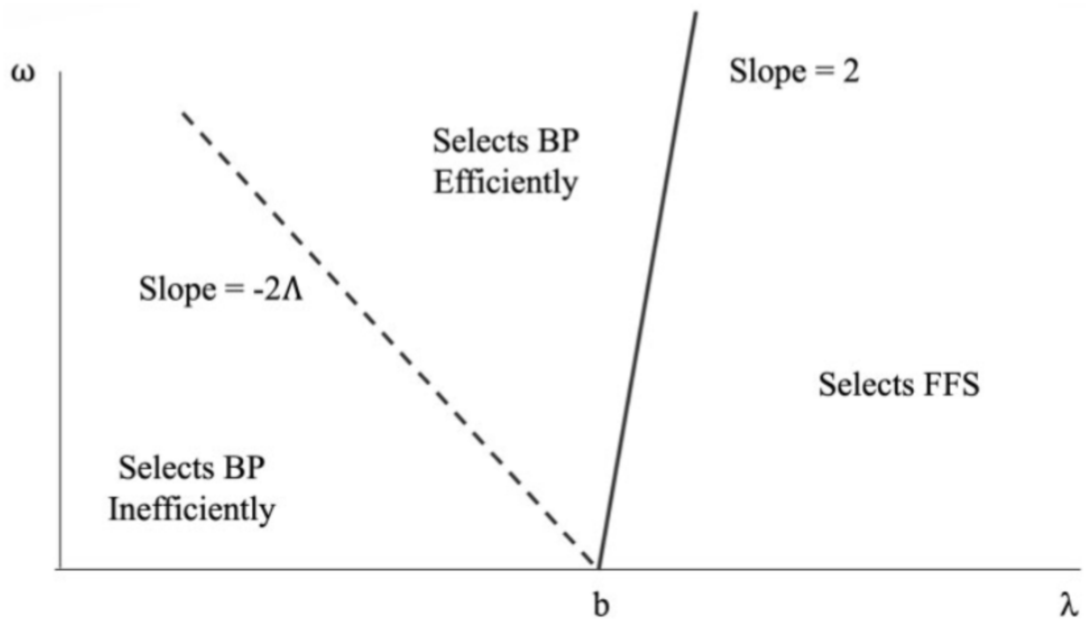
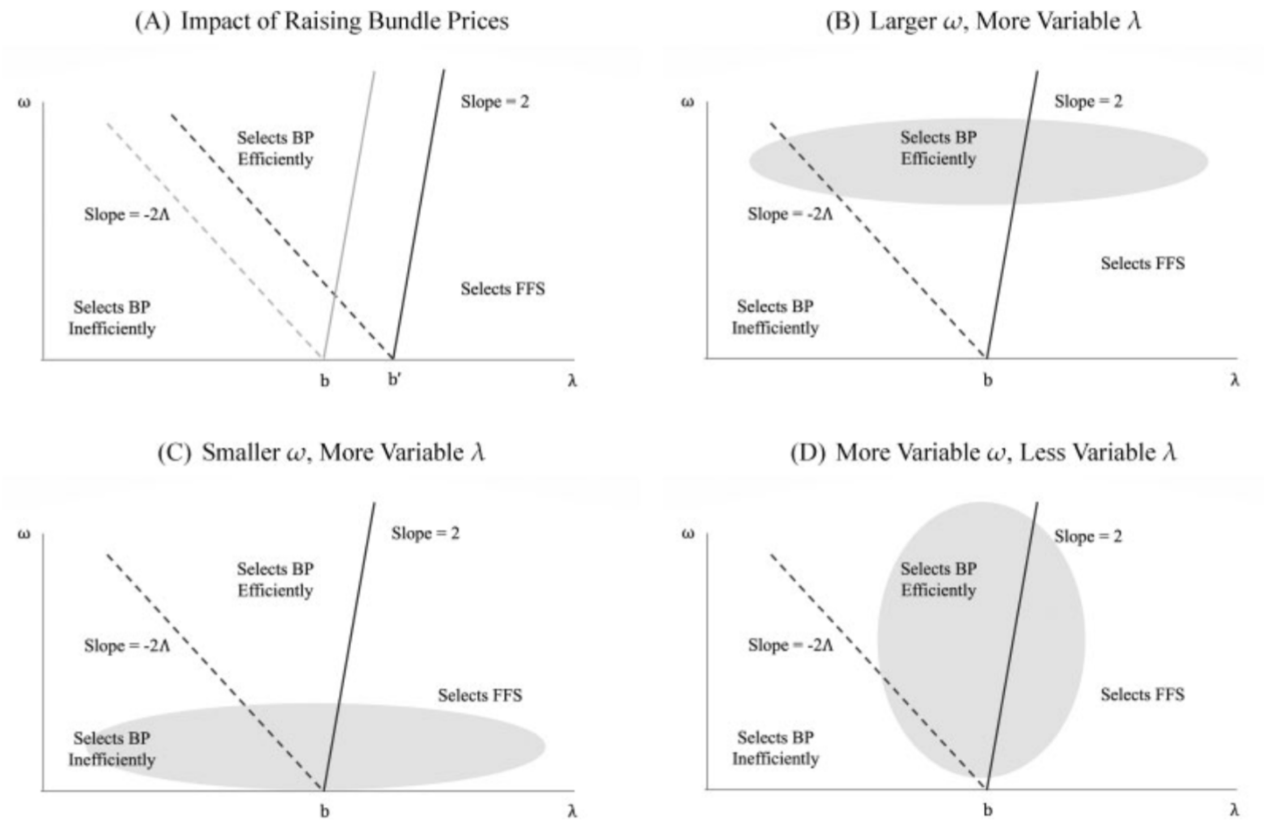


FIGURE II

Hospital Selection Into Bundled Payment and Social Welfare Implications

Targeting

Precise targeting (i.e. small $b_h - \lambda_h$) $\implies$ Panel (D), the desired outcome, is achievable.



Presentation Outline

Econometric Specification

Hospital h associated with pair $\{\lambda_h, \omega_h\}$. Authors fix ω_h, but allow λ_h to evolve over time following:

$$\ln \lambda_{h,t} = \ln \lambda_h + \gamma_t + \epsilon_{h,t}. \tag{7}$$

- t = 1, 2, 3;
- γ_t: period-specific indicators, normalized $\gamma_2 = 0$;
- $\epsilon_{h,t}$: i.i.d. $\sim N(0, \sigma_\epsilon^2)$.

Lastly, $\{\lambda_h, \omega_h\}$ are assumed to be jointly log-normally distributed:

$$\begin{pmatrix} \ln \lambda_h \\ \ln \omega_h \end{pmatrix} \sim N\left(\begin{pmatrix} x_h^{'}\beta^\lambda \\ x_h^{'}\beta^\omega \end{pmatrix}, \begin{pmatrix} \sigma_\lambda^2 & \rho\sigma_\lambda\sigma_\omega \\ \rho\sigma_\lambda\sigma_\omega & \sigma_\omega^2 \end{pmatrix} \right)$$

- x_h: hospital characteristics and strata fixed effects;
- ρ: correlation parameter.

Econometric Specification

Authors observe claims $\{y_{h,t}\}_{t=1,2,3}$ and participation $\{BP_{h,t}\}_{t=1,2,3}$, meaning submitted claims are characterized by:

$$y_{h,t} = \lambda_{h,t} - BP_{h,t}\omega_h. \tag{8}$$

Voluntary participation decision in t=3 becomes:

$$BP_{h,3} = 1 \iff (b_{h,3} - \lambda_{h,t}) + \frac{\omega_h}{2} > 0,$$

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BP_{h,3} = 1 &\iff (b_{h,3} - \lambda_h \exp(\gamma_3)) + \tfrac{\omega_h}{2} + \nu_h > 0. \qquad (9)
\end{aligned}$$

- ν_h: nebulous hospital "choice shifter", i.i.d. $\sim N(x_h^{'}\beta^{\nu}, \sigma_{\nu}^2)$.

Identification I

- "Level" parameters: $\beta^{\lambda}, \sigma_{\lambda}, \gamma_1, \gamma_3, \sigma_{\epsilon}$
  - Identified using $\{\lambda_{h,t}\}_{t=1,2,3}$ and a standard random effects model on control group hospitals.
  - Given the setting is a RCT, the control group parameters will be valid across all hospitals.
- "Slope" parameters: $\beta^{\omega}, \sigma_{\omega}$
  - Using γ_1 from above, average difference between $\lambda_{h,1}$ and $\lambda_{h,2} - \omega_h$ (i.e. observed claims for treatment group) after netting out γ_1 identifies β_{ω}.
  - Residual dispersion in treatment outcomes after controlling for the evolution of $\lambda_{h,t}$ identifies σ_{ω}.

Identification II

- ρ identified similarly to σ_ω:
  - Correlating the observed change in claims between t=1 and t=2 for treatment group with t=1 claims, and adjusting for noise (σ_ϵ), identifies the correlation parameter.
- Choice shifters: β^ν, σ_ν
  - Previously identified joint distribution of $\{\lambda_h, \omega_h\}$ allows for predictions of the model (i.e. $\widehat{BP_{h,3}}$).
  - Any systematic deviations from the model predictions and observed realizations identify (β^ν, σ_ν).

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  - Any systematic deviations from the model predictions and observed realizations identify (β^ν, σ_ν).
  - Thoughts on the ν "choice shifter"?

Estimation

Optimization (MLE) infeasible here due to large number of parameters and numerical integration in the participation equation. Thus, authors employ a Markov Chain Monte Carlo (MCMC) Gibbs Sampler.

- Model is already fully parametrized, and Gibbs sampler allows authors to parametrize latent variables λ_h, ω_h, and ν_h.
- Main idea:
    - Use the priors to derive *conditional* posterior distributions on all other parameters and observable data, then draw each parameter one at a time.
    - Repeat the process iteratively 100k times, discard first 10k iterations (to allow for convergence stable posterior distribution), and use simulations to produce the posterior means and standard deviations.
- Full details of the sampler are outside the scope of this presentation (see Online Appendix C if interested).

Posterior Estimation Results

TABLE IV
PARAMETER ESTIMATES

	$\ln(\lambda)$ equation		$\ln(\omega)$ equation		ν equation	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Panel A: Equation-specific parameters						
Constant*	$\boxed{10.165}$	$\boxed{0.005}$	$\boxed{4.895}$	$\boxed{0.293}$	−7,984	12,616
ln(CJR Episodes)	−0.066	0.004	−0.559	0.145	4,930	7,601
ln(Beds)	0.050	0.006	0.502	0.247	1,172	5,065
Quality score	−0.169	0.022	4.895	1.217	43,473	54,507
Teaching	0.017	0.002	−0.034	0.084	−2,275	3,939
For-profit	−0.008	0.002	0.078	0.066	3,912	4,517
Government-owned	−0.002	0.001	−0.102	0.060	−621	1,322
Nonprofit	omitted category		omitted category		omitted category	
Strata fixed effects	yes		yes		yes	
σ	$\boxed{0.139}$	0.003	0.727	0.117	24,669	27,548
Panel B: Additional model parameters						
γ_1	0.067	0.004				
γ_2	normalized to 0					
γ_3	0.015	0.003				
σ_ϵ	$\boxed{0.073}$	0.001				
ρ	0.143	0.196				

- Episode-weighted mean (across strata) of model parameters.
- Large hospitals assoc. with higher levels/slopes; opposite for high volume hospitals, etc.
- U-shaped time trend (γ's).

Posterior Estimation Results

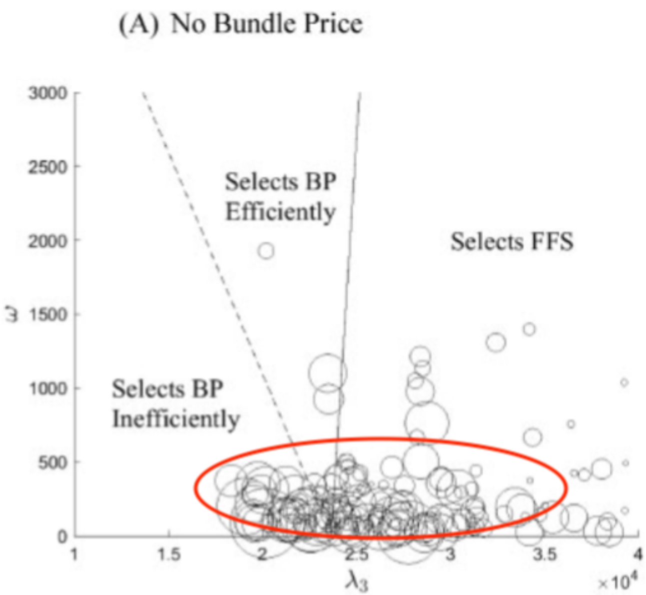
TABLE V

POSTERIOR DISTRIBUTIONS

	E(x)	SD(x)	P5	P25	P50	P75	P95
Panel A: All hospitals							
$\ln(\lambda_h)$	10.17	$\boxed{0.19}$	9.89	10.04	10.14	10.27	10.51
$\ln(\omega_h)$	4.895	1.747	1.835	3.717	5.020	6.179	7.528
λ_{h3}	$\boxed{27{,}028}$	5,960	19,621	23,043	25,921	29,786	38,238
ω_h	$\boxed{485}$	1,180	7	44	160	500	1,902
Panel B: Hospitals in the voluntary treatment group only							
λ_h	25,247	$\boxed{4{,}527}$	19,532	22,207	24,390	27,370	33,723
λ_{h3}	$\boxed{25{,}517}$	5,109	19,333	21,949	24,597	27,841	35,277
b_h	23,659	3,744	19,530	21,174	22,785	25,110	31,141
$b_h - \lambda_h e^{\gamma_3}$	−1,961	$\boxed{2{,}640}$	−6,728	−3,224	−1,706	−358	1,390
ω_h	$\boxed{246}$	$\boxed{611}$	5	24	73	218	1,014
$(b_h - \lambda_h e^{\gamma_3}) + \frac{\omega_h}{2}$	−1,838	2,623	−6,593	−3,074	−1,584	−258	1,477
ν_h	−7,719	31,103	−59,838	−28,472	−7,227	13,454	42,939

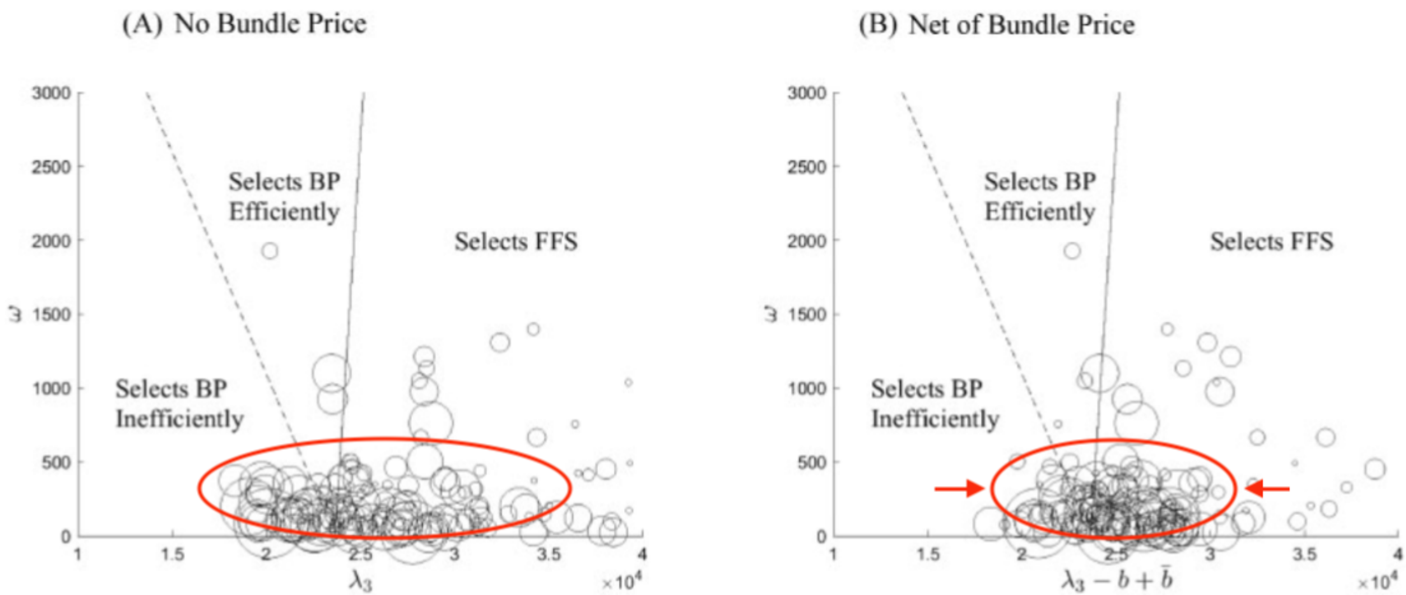
- Lower level of mean claims at voluntary treatment hospitals.
- Smaller ω_h, more variable λ_h.
- Observables account for $< \frac{1}{3}$ of cross-hosp. variation in levels.

Heterogeneous Selection by Voluntary Treatment Hospitals



Netting out bundle price reduces some of the dispersion, but not enough to eliminate all socially undesirable selection.

Heterogeneous Selection by Voluntary Treatment Hospitals



Netting out bundle price reduces some of the dispersion, but not enough to eliminate all socially undesirable selection. Again, thoughts on Λ?

Presentation Outline

Overview of Counterfactuals

Focus on two counterfactuals:

1. Social welfare under FFS, mandatory bundled payments, and voluntary bundled payments.
2. Social welfare under alterantive bundle prices within the voluntary regime.

Analyses will only consider the 256 hospitals in the voluntary treatment group, so that there is no reliance on imputed bundle prices.

Does Bundled Payments Actually Increase Welfare?

TABLE VI
COUNTERFACTUALS

	Percent selecting in (1)	Government spending (2)	Relative social costs (3)	Ignoring choice shifter: Relative hospital profit (4)	Ignoring choice shifter: Relative social surplus (5)
Panel A: Mandatory vs. voluntary					
Mandatory FFS (benchmark)	0.0	25,517	0	0	0
Mandatory bundled payment	100.0	23,659	−2,137	−1,736	402
Voluntary bundled payment	38.8	25,055	−532	−405	127
Panel B: Alternative voluntary regimes with different bundle prices					
Perfect targeting	38.7	24,870	−745	−589	155
Feasible targeting	38.5	24,908	−700	−551	150
Observed targeting	38.7	25,018	−574	−440	133
No targeting	39.1	25,302	−248	−157	91
Narrow bundle, no targeting	38.5	25,045	−543	−413	130

- $(3) = \Delta G * (1+\Lambda) = (b_h - \lambda_h) * (1+\Lambda)$,
- $(4) = (b_h - \lambda_h) + \frac{\omega_h}{2}$,
- $(5) = (4) - (3) = (b_h - \lambda_h) + \frac{\omega_h}{2} - (b_h - \lambda_h) * (1+\Lambda) = -\Lambda(b_h - \lambda_h) + \frac{\omega_h}{2}$,
- When choice shifter ν_h is ignored, **effects are economically small**.

▸ ν_h Welfare Relevant

Can Alternative Pricing Increase Gains Under Voluntary Participation?

TABLE VI
COUNTERFACTUALS

	Percent selecting in (1)	Government spending (2)	Relative social costs (3)	Ignoring choice shifter: Relative hospital profit (4)	Ignoring choice shifter: Relative social surplus (5)
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Narrow bundle, no targeting	38.5	25,045	−543	−413	130

- Approximate observed bundle prices assuming $\{b_{h,3}, \lambda_{h,3}\}$ are joint log-normally distributed.
- Feasible targeting increases average welfare by \$17 per episode ("feasible" meaning $\ln b_h$ perfectly correlated with $\ln \lambda_h$ (see equation (7)).
- No targeting sets uniform bundle prices.
- Observed targeting already generates $\sim \frac{2}{3}$ of the feasible welfare gains.

Appendix

TABLE A.3
Experimental Estimates: Effects Over Time

	Period	Control Mean	SD	Change with Bundled Payment	SE	P-Value
Panel A: All MSAs						
Total Episode Claims	2016 Q2	25,337	3,642	-591	232	0.02
	2016 Q3Q4	25,552	3,710	-739	223	0.01
	2017 Q1Q2	24,996	3,624	-684	224	0.01
	2017 Q3Q4	25,427	3,744	-900	253	0.01
Claims for Institutional PAC	2016 Q2	4,296	1,499	-443	156	0.01
	2016 Q3Q4	4,246	1,445	-406	140	0.01
	2017 Q1Q2	3,905	1,390	-502	139	0.01
	2017 Q3Q4	4,070	1,601	-635	161	0.01
Share Discharged to Institutional PAC	2016 Q2	0.34	0.12	-0.040	0.010	0.01
	2016 Q3Q4	0.32	0.11	-0.027	0.009	0.01
	2017 Q1Q2	0.30	0.10	-0.034	0.009	0.01
	2017 Q3Q4	0.29	0.10	-0.031	0.009	0.01
Panel B: Voluntary MSAs						
Total Episode Claims	2016 Q2	25,222	4,455	-573	353	0.11
	2016 Q3Q4	25,335	4,575	-629	344	0.08
	2017 Q1Q2	24,993	4,376	-719	335	0.04
	2017 Q3Q4	25,305	4,614	-1,001	362	0.01
Claims for Institutional PAC	2016 Q2	3,883	1,537	-328	209	0.13
	2016 Q3Q4	3,763	1,489	-255	190	0.19
	2017 Q1Q2	3,557	1,393	-448	174	0.02
	2017 Q3Q4	3,585	1,708	-442	213	0.05
Share Discharged to Institutional PAC	2016 Q2	0.29	0.10	-0.020	0.014	0.16
	2016 Q3Q4	0.27	0.08	-0.013	0.012	0.28
	2017 Q1Q2	0.25	0.08	-0.024	0.011	0.04
	2017 Q3Q4	0.24	0.08	-0.017	0.011	0.13
Panel C: Mandatory MSAs						
Total Episode Claims	2016 Q2	25,452	2,631	-483	347	0.17
	2016 Q3Q4	25,770	2,601	-671	313	0.04
	2017 Q1Q2	24,998	2,715	-616	327	0.07
	2017 Q3Q4	25,549	2,644	-713	391	0.08
	2018 Q1Q2	25,857	2,589	-959	406	0.03
	2018 Q3	26,214	2,783	-1,282	396	0.01
Claims for Institutional PAC	2016 Q2	4,709	1,352	-486	236	0.05
	2016 Q3Q4	4,730	1,235	-435	208	0.05
	2017 Q1Q2	4,254	1,310	-481	219	0.04
	2017 Q3Q4	4,555	1,334	-752	244	0.01
	2018 Q1Q2	4,591	1,165	-644	254	0.02
	2018 Q3	4,907	1,418	-901	279	0.01
Share Discharged to Institutional PAC	2016 Q2	0.40	0.11	-0.053	0.016	0.01
	2016 Q3Q4	0.37	0.11	-0.033	0.014	0.03
	2017 Q1Q2	0.34	0.10	-0.039	0.014	0.01
	2017 Q3Q4	0.34	0.09	-0.048	0.014	0.01
	2018 Q1Q2	0.35	0.07	-0.059	0.014	0.01
	2018 Q3	0.35	0.09	-0.054	0.017	0.01

Return

TABLE A.5

Correlates of Cross-Hospital Heterogeneity

	Panel A: Heterogeneity in Levels			Panel B: Heterogeneity in Slopes		
	Total Episode Claims	Institutional PAC Claims	Probability of Discharge to PAC	Total Episode Claimis	Institutional PAC Claims	Probability of Discharge to PAC
Unconditional S.D. of Hospital Fixed Effects	5,998	3,021	0.187	3,054	1,809	0.105
S.D. of Hospital Fixed Effects with additional controls:						
Number of CJR Episodes	5,843 (97.4%)	2,894 (95.8%)	0.183 (98.1%)	3,055 (100.0%)	1,799 (99.4%)	0.105 (99.9%)
Quality	5,604 (93.4%)	2,867 (94.9%)	0.180 (96.2%)	3,026 (99.1%)	1,778 (98.3%)	0.103 (98.0%)
Number of Beds	5,864 (97.8%)	3,017 (99.9%)	0.186 (99.7%)	3,048 (99.8%)	1,804 (99.7%)	0.104 (99.7%)
Teaching	5,751 (95.9%)	3,017 (99.9%)	0.186 (99.6%)	3,041 (99.6%)	1,802 (99.6%)	0.104 (99.4%)
Ownership (For-Profit, Non-Profit, Government)	5,896 (98.3%)	3,006 (99.5%)	0.185 (98.9%)	3,041 (99.6%)	1,809 (100.0%)	0.105 (99.9%)
Strata Fixed Effects	5,718 (95.3%)	2,882 (95.4%)	0.173 (92.8%)	3,054 (100.0%)	1,809 (100.0%)	0.105 (100.0%
MSA Fixed Effects	4,532 (75.6%)	2,557 (84.6%)	0.139 (74.5%)	2,665 (87.2%)	1,685 (93.2%)	0.092 (87.9%)
All of the above	3,537 (59.0%)	2,236 (74.0%)	0.125 (66.8%)	2,637 (86.4%)	1,638 (90.5%)	0.090 (85.9%)
All of the above, as well as all observed patient characteristics	2,830 (47.2%)	1,687 (55.8%)	0.107 (57.4%)	2,169 (71.0%)	1,236 (68.3%)	0.077 (73.1%)

◂ Return

Choice Shifter Costs Considered "Real" (Welfare-Relevant)

TABLE A.10
Counterfactuals Incorporating Choice Shifter

	Share Selecting In	Government Spending	Relative Social Costs	Incorporating Choice Shifter	
				Relative Hospital Profit	Relative Social Surplus
	(1)	(2)	(3)	(4)	(5)
Panel A: Mandatory vs. Voluntary					
Mandatory FFS (Benchmark)	0.0%	25,517	0	0	0
Mandatory Bundled Payment	100.0%	23,659	-2,137	-9,455	-7,318
Voluntary Bundled Payment	38.8%	25,055	-532	8,393	8,925
Panel B: Alternative Voluntary Regimes with Different Bundle Prices					
Perfect targeting	38.7%	24,870	-745	8,225	8,970
Feasible targeting	38.5%	24,908	-700	8,232	8,932
Observed targeting	38.7%	25,018	-574	8,302	8,876
No targeting	39.1%	25,302	-248	8,526	8,773
Narrow bundle, no targeting	38.5%	25,045	-543	8,330	8,873

Sorting on ν_h leads to large welfare surplus under the voluntary regime, in part due to large dispersion in ν_h across hospitals. Return