Strategic Patient Discharge: Evidence from Long-term Care Hospitals

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Motivating Question

Do Medicare's reimbursement policies influence providers' treatment decisions?

- Economic theory tells us incentives matter
- In health care, this means the way in which we reimburse providers will probably have important consequences
  - on patients' health,
  - and also on government expenses.
- How might different payment policies affect treatment? costs? health?
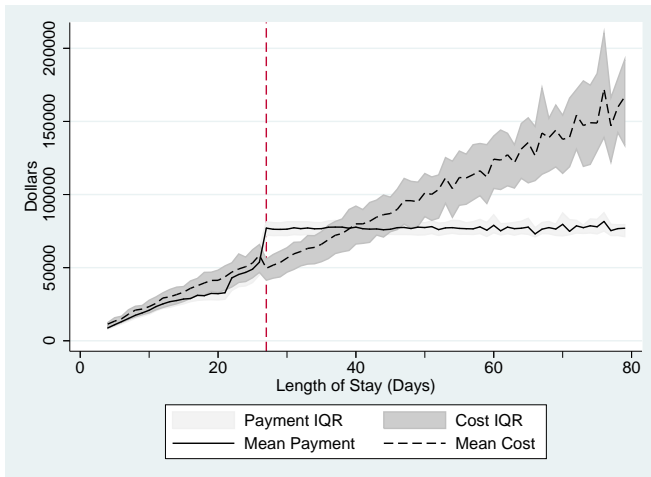
Our Empirical Setting

We focus on patients in long-term care hospitals (LTCHs)

- Special category of hospital for "long-term" stays (3+ weeks)
- Medicare's prospective payment system (PPS) creates strong incentives for hospitals to distort care
  - ▸ Results in wasteful spending by Medicare
  - ▸ Results in unnecessary burden for patients
- Variation in PPS allows us to measure...
  - ▸ How much these incentives affect treatment decisions
  - ▸ How the response varies by type of provider
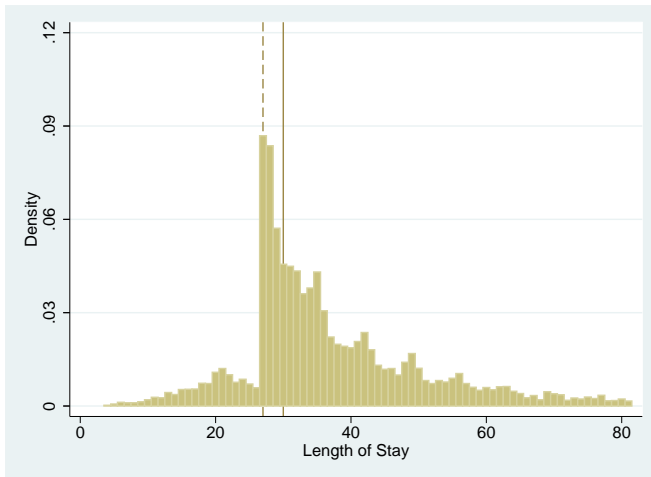 - ▸ How the response varies by type of patient

Our Paper in Two Slides: Slide 1

Typical Medicare reimbursement schedule for hospitals we study
(many more details to come...)

Our Paper in Two Slides: Slide 2

Typical discharge pattern for patients at hospitals we study
(many more details to come...)

Our Empirical Strategy

Use the discontinuity in the LTCH PPS to...

- Provide descriptive evidence that the discontinuity in reimbursements causes a spike in discharges
- Estimate the marginal impact of reimbursements on discharges
- Perform counterfactual simulations of how alternative payment schemes would affect discharges

Our Main Findings

1. Financial incentives have a large impact on LTCHs
2. Their influence varies across hospitals & patients
   - For-profit & hospital-within-hospital LTCHs are more responsive
   - Marginal dollar has larger impact on the discharges of African-Americans
3. Changing PPS would alter LTCHs' discharge decisions
   - "Pure PPS" and "Cost Plus" shift average day of discharge forward 7 or back 2.5 days respectively.
   - Alternative proposed by MEDPAC that removes discontinuity while slightly reducing length of stay.

Institutional Details of Long-term Care Hospitals

Background on Long-term Care Hospitals

- LTCHs provide care for patients with prolonged medical needs, typically following a stay in an acute-care hospital
- Reimbursed under Medicare Part A
  - $145 billion for all inpatient stays in 2015
  - $60 billion of this for post-acute care
  - $6 billion to LTCHs
- Prior to Medicare PPS, no distinction between acute-care and long-term care hospitals
- Spawned in response to PPS for acute-care hospitals in early 1980s
  - Must have average length of stay over 25 days
 - Modal DRG: "Respiratory Ventilation, Greater than 96 Hours"

Some LTCH Facts

- 435 LTCHs in 2015, up from 10 in 1980s
  - Fastest growing segment of post-acute care
  - Moratorium since 2015
  - CON regulation in 25 states (attempt to curb healthcare inflation by reducing "excess capacity")
- Revenue mix: 60% Medicare, 11% MA, 21% Private
- Average bed count of 70
  - Occupancy rate about 70%
- Two-thirds are for-profit facilities
- Two largest chains, Kindred and Select, control 50%
  - Kindred vertically integrated in post-acute care
- One-third are co-located with an acute-care hospital

Medicare Reimbursements for LTCHs

- LTCHs exist due to the concern that LTCH patients would be too costly for standard hospitals
  - Cost per day: $5000 acute care, $1500 LTCH, $300 SNF
- Prior to 2002, were reimbursed based on reported costs
- In 2003, LTCH prospective payment system introduces two-part schedule
  - Early in stay, pay hospitals based on length of stay (LOS)
  - After patient exceeds short-stay outlier (SSO) threshold, pay a fixed rate by diagnosis (PPS-like)
  - SSO threshold set at 5/6 geometric mean LOS for DRG in previous year

Example of Reimbursement Schedule

DRG 207 (Ventilation 96+ hrs) payments by LOS
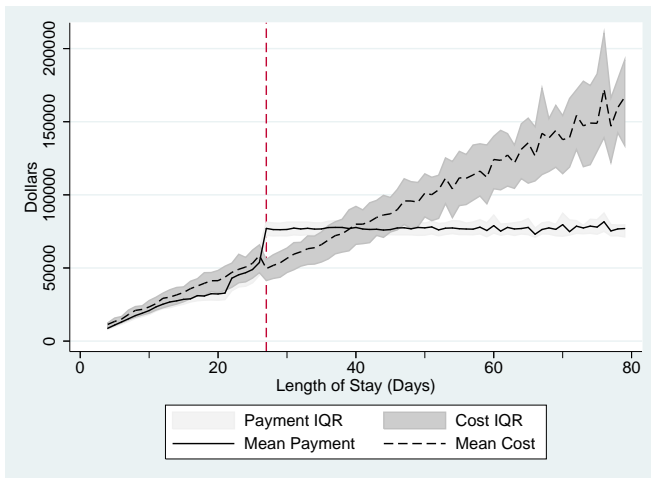
The PPS Provides LTCHs Incentives to Distort Care

LTCHs face large discontinuity in payments at SSO threshold

- E.g., in 2013 for most common DRG average payment if...
  - ▸ released day before SSO threshold: $54k
  - ▸ released day after: $77k
- Administrators refer to SSO threshold as the "magic day"

Recent Media Scrutiny of LTCH Discharge Practices

THE WALL STREET JOURNAL.

Hospital Discharges Rise at Lucrative Times

Facilities Release Medicare Patients After Rules Trigger Higher Payments

Brief Review of Other Related Work

- Providers' response to payments
  - Dafny (2005)
  - Ho and Pakes (2014)
- Differences across for-profit status
  - Dranove (1988)
  - Grieco & McDevitt (2017)
- Studies of long-term care hospitals
  - Kim et al. (2015)
  - Einav et al. (2018)

Einav, Finkelstein, & Mahoney (2018)

Upshot: different models, similar results regarding policy impact

- Our model
  - Non-stationary process where additional day has time-dependent pecuniary and non-pecuniary impact on payoffs
  - Observed heterogeneity through race, age, DRG, LTCH type
  - Downstream discharges only
- Their model
  - Unobserved health follows a Markov process, identified using mortality data as health proxy
  - Only non-stationary element is payment policy
  - Upstream and downstream discharge decisions
  - Impacts on other providers (e.g., skilled-nursing facilities)

Descriptive Evidence of Strategic Discharge

Claims Data

We use the Long-Term Care Hospital PPS Expanded Modified MEDPAR File Limited Data Set

- 100 percent of Medicare beneficiary stays at LTCHs for 2002 and 2004-2013
- Data on billed DRG, Medicare payments, covered cost, length of stay, discharge destination
- Limited demographic information (gender, race, age)
- De-identified, so can't follow patients across Medicare claims (no health outcomes)
- Includes hospital identifier which we link to AHA data on hospital characteristics

# Payment Discontinuity → Discharge Discontinuity

Discharge by LOS for DRG 207, Normalized by SSO Threshold
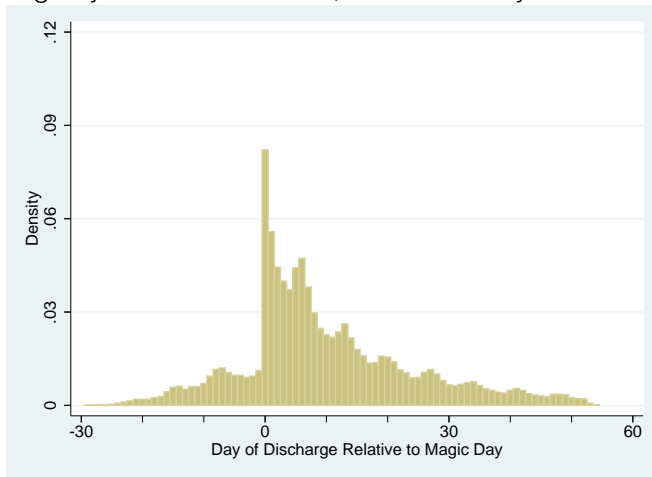
Identification Strategy to Link Payments to Discharges

- Need to rule out alternative explanations
  - Could discharges cluster due to similar treatment regimens?
  - Could some unobservable factor confound our results?

- Use variation in SSO thresholds to show that discharges driven by payments
  - Discharges have no spike in 2002 before LTCH PPS
  - Within DRG, SSO threshold varies across years
  - Across DRGs, SSO thresholds differ
  - LTCHs with strongest financial motives have clearest evidence of manipulating discharges
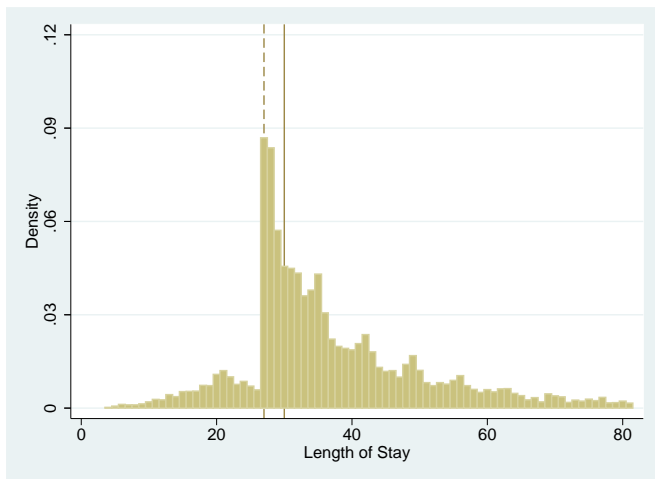
Discharge Distribution: Pre LTCH-PPS in 2002
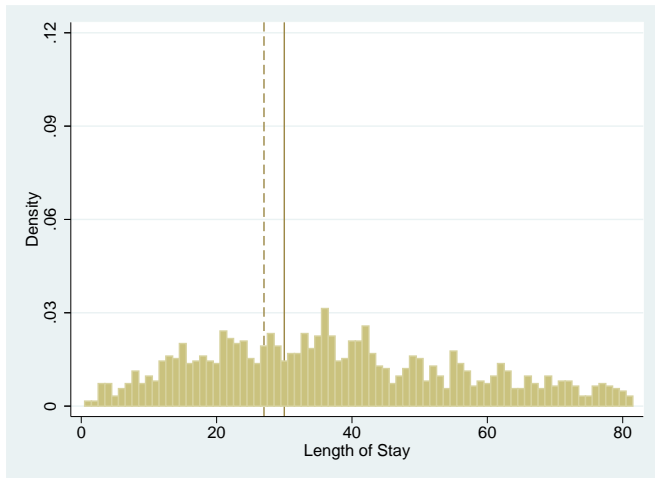
Discharge Distribution: LTCH-PPS in 2004 (SSO = 30)
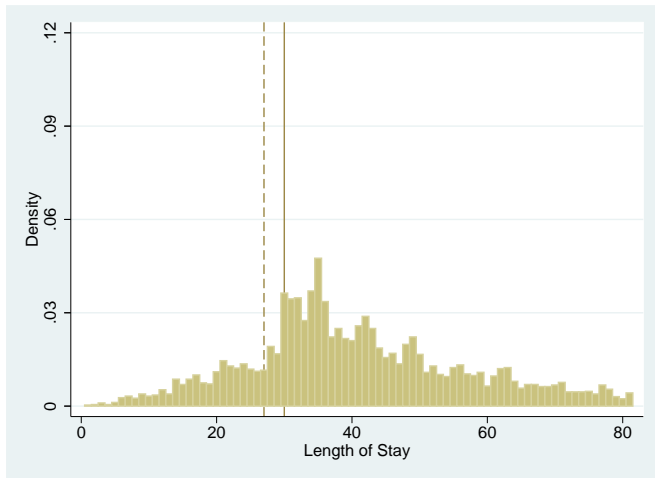
Discharge Distribution: LTCH-PPS in 2014 (SSO = 27)

Effect of Threshold

Consider a probit model of daily discharge decision:

$$Pr(discharge|t, s) = \Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_s)$$

- Quadratic time trend captures underlying discharge sequence
- μ_s captures impact of proximity to threshold

Key assumption: "natural" probability of discharge (accounting for treatment and selection) is continuous in length of stay

Statistically Significant Spike

Days Relative to Threshold (μ_s)		
	Coeff.	Std. Err.
-3	0.522	(0.066)
-2	0.568	(0.070)
-1	0.665	(0.075)
0	1.601	(0.080)
1	1.470	(0.087)
2	1.414	(0.089)
3	1.413	(0.094)

μ_{-14} Normalized to 0

- Clear spike at threshold day
- Elevated discharge probability following threshold day
- Little evidence of pre-threshold "dip"

Quantifying the "Magic Day" Effect

### Discharge probability of DRG 207 on Select Days

Day of stay (t)	Threshold Day	Pre-Threshold Day	Hazard Ratio
27	9.71	1.27	7.63***
28	9.27	1.19	7.80***
29	8.86	1.11	7.96***
30	8.48	1.04	8.12***

Discharge is about 8 times more likely on day after threshold is passed than day before

Heterogeneity in Strategic Discharge

Threshold Has Bigger Impact on Healthier Patients
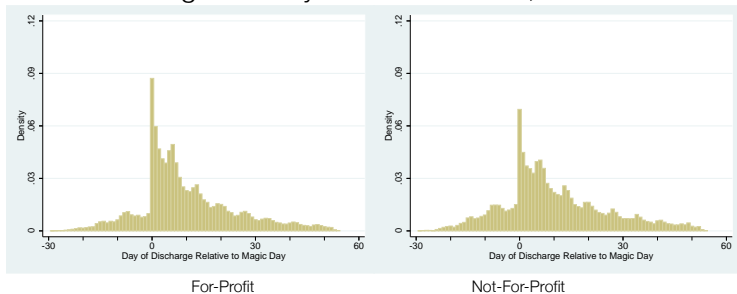

Discharge Rate by Destination, DRG 207

Home Skilled Nursing

Hospital Death
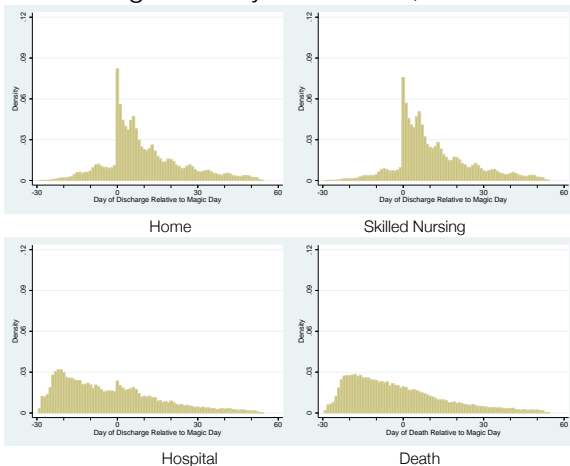
Financial Incentives Have Larger Impact on For-Profits

Discharge Rate by For-Profit Status, DRG 207

For-Profit   Not-For-Profit

Acquired LTCHs Adopt Acquirer's Discharge Strategies

Discharge Rate by Acquisition Status, DRG 207

Pre-Acquisition

Post-Acquisition
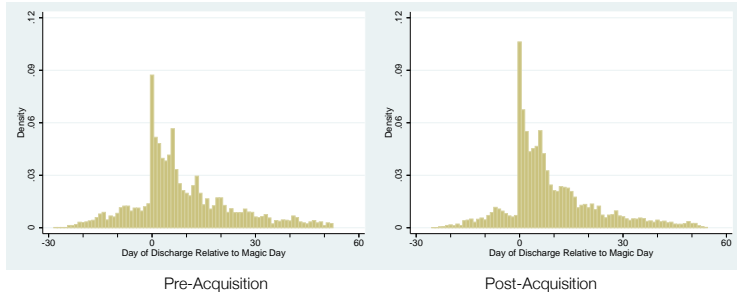
Financial Incentives Matter More for Co-Located LTCHs

Discharge Rate by Co-Location Status, DRG 207

Co-Located | Standalone
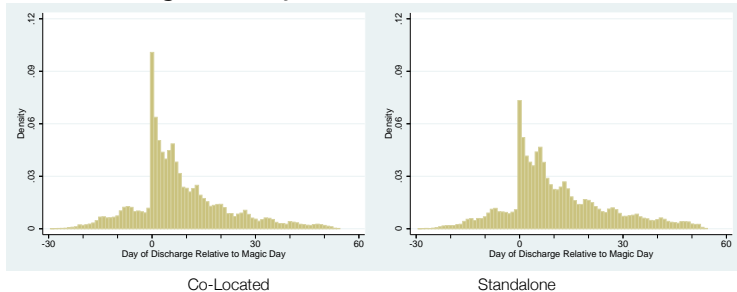
- "Management will use its data analytics capability to identify compliant volume from the acute care hospital they serve" – Select Medical analyst report
- For-profit HwH overweight DRG 207, the most lucrative DRG

Threshold Effect Correlated with Payment Bump

MDE & Payments by DRG		
DRG	Pay Bump	MDE
207	$30,000	7.96
189	$12,000	6.29
871	$11,000	6.55
177	$9,000	3.77

SSO Threshold and Hospital Type

	Predicted Prob. of Discharge.		Hazard	Ratio of
	SSO Threshold Day	Preceding Day	Ratio	Hazard Ratios
Model #1:				
For-profit	9.28 (0.363)	0.967 (0.052)	9.60 [0.000]	1.92 [0.000]
Non-profit	7.61 (0.604)	1.53 (0.160)	4.99 [0.000]	
Model #2:				
Kindred and Select[5]	9.54 (0.426)	0.95 (0.059)	10.01 [0.000]	1.64 [0.000]
Other	8.02 (0.458)	1.31 (0.101)	6.12 [0.000]	
Model #3:				
After Acquisition[6]	11.07 (0.662)	0.66 (0.089)	16.82 [0.000]	2.51 [0.000]
Before Acquisition[7]	9.94 (0.778)	1.48 (0.172)	6.70 [0.000]	0.89 [0.000]
Never Acquired	8.53 (0.357)	1.13 (0.067)	7.54 [0.000]	
Model #4:				
HwH	11.31 (0.508)	1.20 (0.099)	9.42 [0.000]	1.28 [0.000]
Not HwH	7.73 (0.344)	1.05 (0.066)	7.34 [0.000]	

Note: standard errors in parenthesis; p-values in brackets.

SSO Threshold and Patient Type

| | Predicted Prob. of Discharge. | | | Ratio |
	SSO Threshold Day	Preceding Day	Ratio	Hazard Ratios
Model #5, includes LTCH FEs:				
African-American[5]	8.43	0.84	9.94	1.27
	(0.383)	(0.080)	[0.000]	[0.047]
Other	8.62	1.17	7.38	0.94
	(0.328)	(0.149)	[0.000]	[0.686]
White	8.77	1.12	7.82	
	(0.281)	(0.067)	[0.000]	
Model #6, includes LTCH FEs:				
65 and over	8.08	0.99	8.19	1.06
	(0.353)	(0.059)	[0.000]	[0.454]
Under 65	10.65	1.38	7.73	
	(0.353)	(0.010)	[0.000]	

Note: standard errors in parenthesis; p-values in brackets.

Dynamic Model of Strategic Discharge

Dynamic Model

- We've established a direct link between Medicare's PPS and the discharge decisions of LTCHs
- Next step is to use a dynamic model to estimate the marginal impact of payments on discharges
- From the model, we can evaluate the effects of alternative payment policies

A (Very) Simple Model of Discharge Dynamics

A hospital's decision to discharge a patient is described by

$$V_t(\varepsilon_t|x, h) = \alpha(x)p_t + \lambda_t(x) + \max\{\varepsilon_{kt} + \delta EV_{t+1}, \varepsilon_{dt}\}$$

- p_t is the marginal payment holding patient t days versus $t-1$ days
- $\lambda_t(x)$ is the non-revenue costs and benefits of holding patient t days versus $t-1$ days
- x represents observable hospital and patient characteristics (constant over time)
- The value of an empty bed is normalized to 0
- We solve the model via backward induction from terminal date and estimate via maximum likelihood

Payment Schedule

Each hospital faces a specific payment schedule for each DRG in each year with the following structure:

$$p_t = \begin{cases} p & t < t^m \\ P - (t^m - 1) \cdot p & t = t^m \\ 0 & t > t^m \end{cases}$$

- Estimate daily payment pre-threshold for each DRG–Year–MSA–Hospital-Type using payment data
- Compute payment "jump" on threshold day based on policy
- t^m is DRG–Year specific
- Upshot: Model will take advantage of LOTs of variation in payment schedules.

Parameterization: Controls

Controls for non-revenue incentives to discharge:

$$\lambda_t(x) = \gamma_{0,DRG} + \gamma_{1,DRG}t + \gamma_{2,DRG}t^2 + \gamma_{3,DRG}t^3 - \beta\hat{c}_h + \psi_{\text{day of week}}$$

- DRG-specific quadratic length-of-stay trend
- Control for daily average hospital-DRG costs
- Day-of-Week dummies (fewer discharges on weekends)

Parameterization: Revenue-Impact

Our primary parameter of interest is the impact of additional
payments on discharge decisions:

$$\alpha(x) = \alpha_{hospType} + 1[age < 65]\alpha_y + 1[black]\alpha_b$$

- Allow different hospital types to weight revenue differently
- Younger patients may have different say in discharge
- African-American patients may be treated differently

Estimates for $\hat{\alpha}(x)$

		(1)	(2)
Hospital Types			
	For-profit, HwH	0.909	0.891
		(0.004)	(0.004)
	For-profit, standalone	0.789	0.769
		(0.002)	(0.002)
	Non-profit, HwH	0.707	0.678
		(0.005)	(0.005)
	Non-profit, standalone	0.598	0.575
		(0.003)	(0.004)
Patient Types			
	African-American		0.157
			(0.004)
	Under 65 years old		-0.138
			(0.003)
Day of week dummies			X
Average daily cost (β), interacted with four hospital types		X	X
DRG specific λ		X	X
DRG specific Ω		X	X
N = 377,513			

Implications of Differences in α

- For-profit, co-located hospitals respond more strongly to financial incentives
- Payments have a larger effect on the treatment of some types of patients
  - African-American patients expected LOS is 1.4 days longer
  - 82% of African-American patients stay until magic day compared to 77% of others
  - Younger patients are less affected

Model Fit

Observed versus Predicted Discharge Distribution

Pooled DRGs

DRG 207 Only
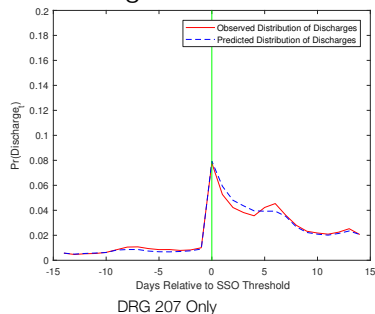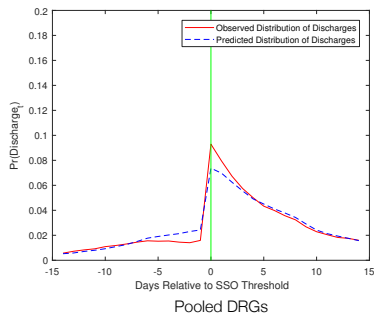
Counterfactual Reimbursement Policies
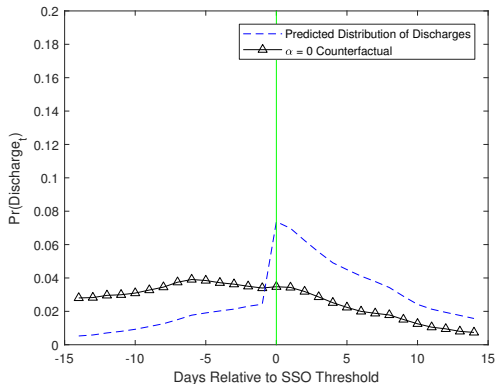
Alternative Payment Policies

We re-solve the model for various alternative policies:

1. "Pure PPS" where payment is independent of LOS
2. "Kink instead of Jump" recently proposed by MedPAC
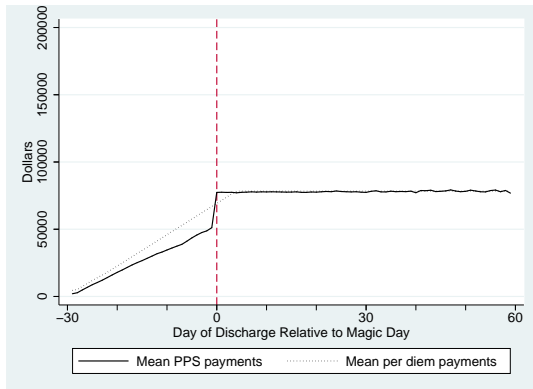3. "Cost-Plus" return to pre-2003 policy

Caveats:

- Mix of patients held constant
- Flow rate of patients held constant
- No entry/exit of LTCHs
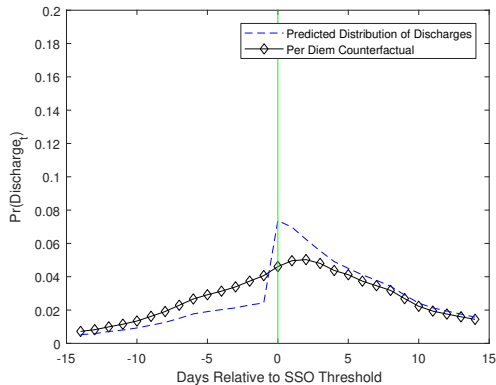
Discharge Distribution: "Pure-PPS"

- Strongest discharge incentive, average LOS falls 7.4 days
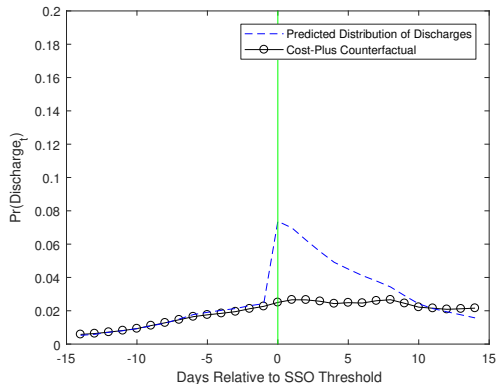- Big changes even for stays far from threshold

MedPAC Proposal

Discharge Distribution: "MedPAC Proposal"

- Eliminates discontinuity and average LOS falls 1.2 days
- Similar discharge rates to baseline away from threshold

Discharge Distribution: "Cost-Plus"

- Eliminates discontinuity and expected declines by 1.2 days
- Little change ahead of threshold, longer stays if threshold is surpassed.

Comparison of Payment Policies

	Baseline model	Counterfactual 1: Pure-PPS	Counterfactual 2: MedPAC Proposal	Counterfactual 3: Cost-plus
Share of patients discharged before SSO threshold	0.21	0.62	0.33	0.21
Share of patients discharged after SSO threshold	0.79	0.38	0.67	0.79
Share of patients with longer stay compared to baseline		0.00	0.04	0.40
Share of patients with shorter stay compared to baseline		0.47	0.12	0.05
Mean day of discharge relative to SSO threshold	3.31	-4.10	2.11	5.60
St. dev. day of discharge	7.82	9.93	8.28	10.44
Mean payments ($1000s)	40.13	25.35	38.90	45.70
St. dev. payments	22.27	15.87	20.13	23.55
Percent change in payments relative to baseline		-29	-3	32
Mean Costs ($1000)	37.10	25.35	35.39	43.50
St. dev. payments	19.61	15.87	19.41	22.44
Percent change in costs relative to baseline		-26	-3	26

Conclusions & Next Steps

Summary & Future Projects

- Medicare's reimbursement policies have large impact discharge decisions
- Incentives distort care differently based on hospital- and patient-type
- Alternative payment policies will substantially affect treatment decisions
  - "Pure PPS" lowers average payment by $15,000
  - MedPAC proposal lowers average payment "only" $500
- Next projects:
  - Measuring how differences in discharge decisions affect health outcomes
  - Role of corporate chains of health providers in developing strategies of care
  - How to evaluate costs and benefits of payment policy on health and budget