Strategic Patient Discharge: The Case of Long-Term Care Hospitals

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Outline

Motivation

"The Magic Day" - Short-stay outliers (SSOs) threshold

Reform of the Prospective Payment System(PPS) Medicare system

- Since 2002 –
  - Medicare pay LTCHs a fixed 5% mark-up over reported cost ("Cost-plus")
- Since 2002 –
  - **SSOs threshold** (five-sixths of the geometric mean of the length of stay for each DRG) introduced to discourage needless transfer from general acute-care hospitals to LTCHs
  - SSOs case are paid linearly with the length of stay and the payment is much smaller

Motivation

"The Magic Day" - Short-stay outliers (SSOs) threshold

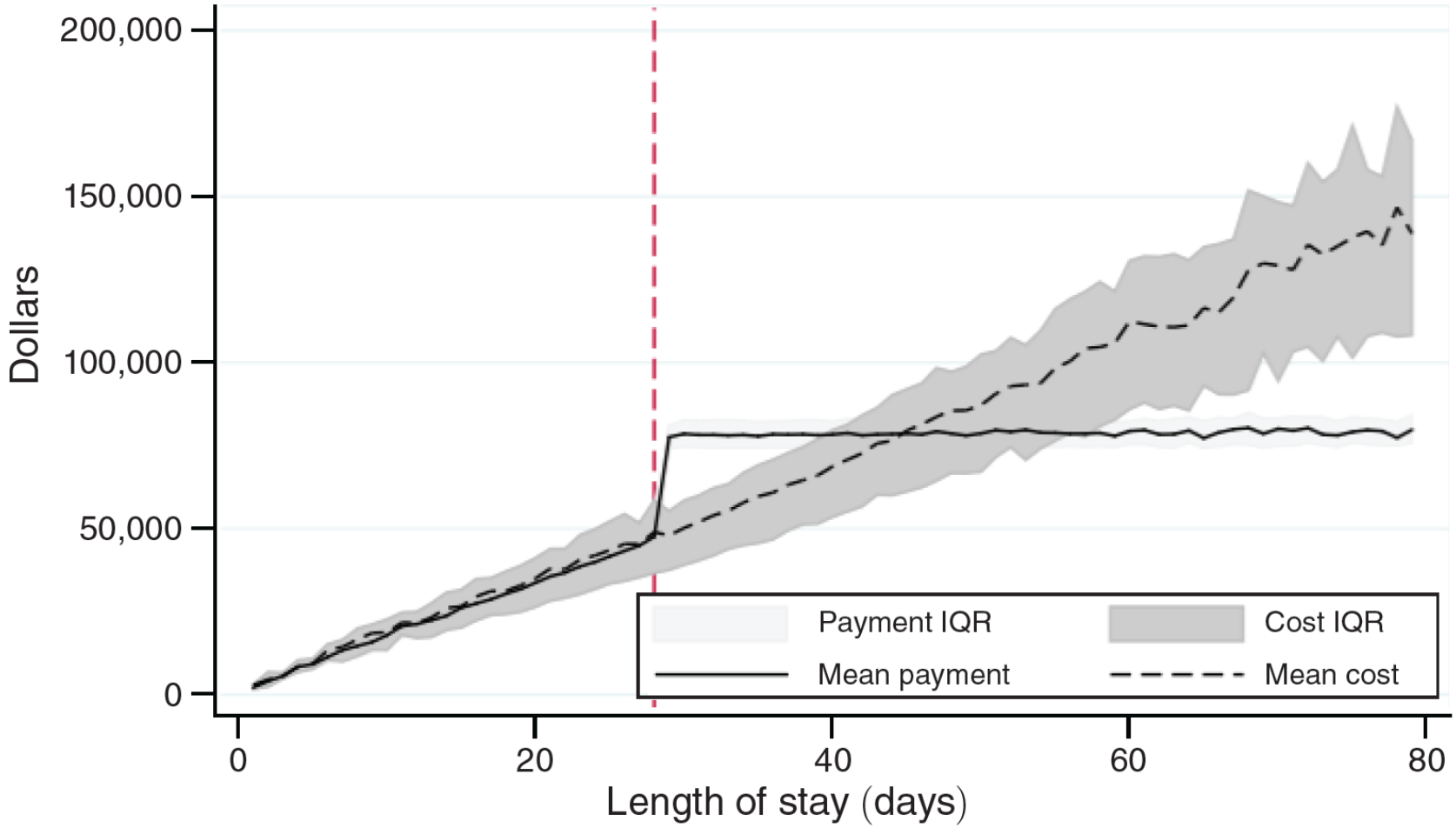

FIGURE 1. REVENUES AND COSTS FOR DRG 207 PATIENTS BY LENGTH OF STAY, 2005–2010

Research question

1. Given the financial incentives, **do LTCHs demonstrate strategic discharge** and **how is the SSO threshold effect**?
   $\Rightarrow$ Graphical evidence and Probit regression models

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1. Given the financial incentives, **do LTCHs demonstrate strategic discharge** and **how is the SSO threshold effect**?
   $\Rightarrow$ Graphical evidence and Probit regression models
2. **How LTCHs would behave under alternative payment schemes?**
   1. Hospital payments independent of a patient's length of stay
   2. New proposal by MedPAC –
      The "per diem counterfactual"
   3. Policy prior to having PPS for LTCHs –
      The cost-plus reimbursement scheme

   $\Rightarrow$ Dynamic structural model

Contribution

On the topic of agents' responses to incentives to reduce health care expenditures: **Inpatient hospitals**

Preview of findings

1. The SSO threshold effect
   - LTCHs respond to the financial incentives by holding patients until right after they reach this point
2. Alternative payment systems that remove the sharp jump would provide substantial savings for Medicare.

Data

1. Claims dataset from CMS
   - cover all Medicare beneficiaries stays at LTCHs
   - 2002 (old reimbursement system) and 2004-2013
   - DRG/Medicare payments/Covered costs/Length of stay/Diagnosis and procedural codes/Race/Age/Gender/Type of hospital admission/Patient was discharged alive?/If alive, the discharge destination
2. Data on hospital characteristics from CMS and the American Hospital Association (AHA)
   - Name/Location/Hospital type/Size/For-profit status/Medical school affiliation/Services offered/Hospital's CMS certification number

The SSO Threshold Effect - DRG 207

Graphical Evidence - DRG 207

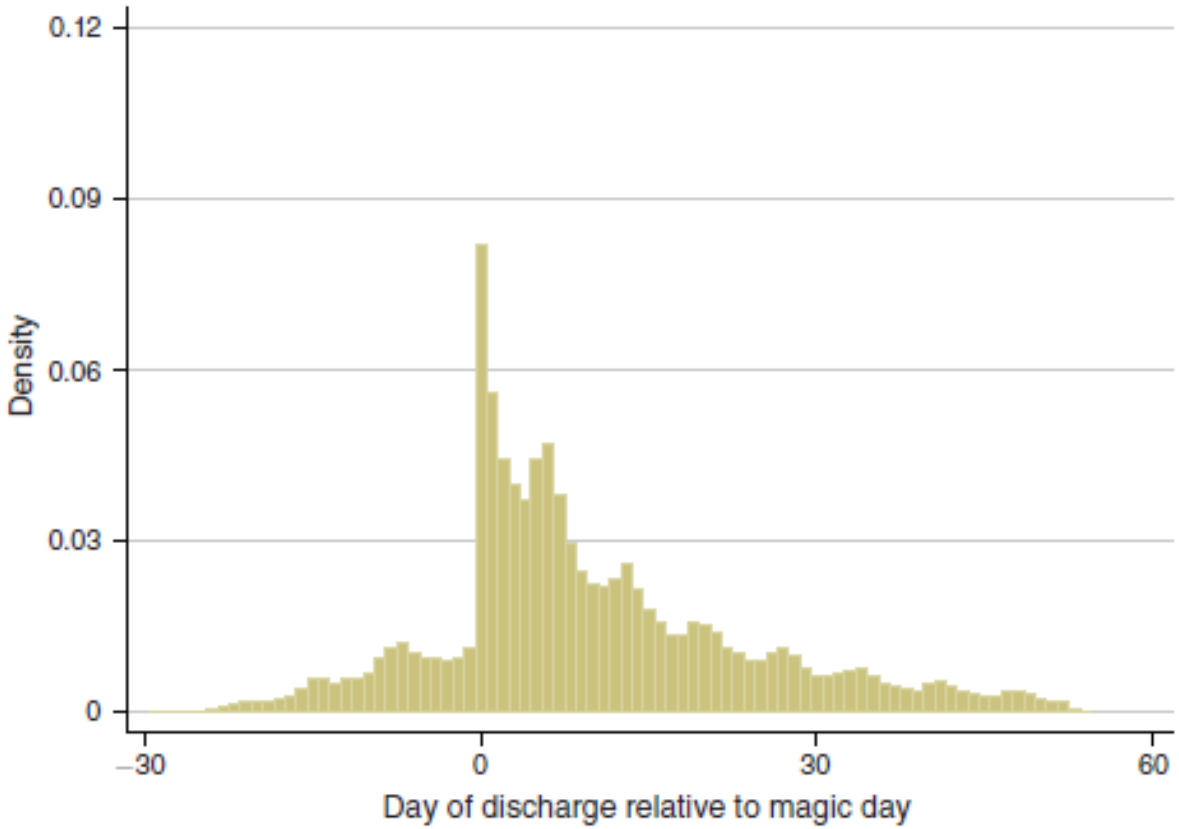


FIGURE 2. DISTRIBUTION OF LENGTH OF STAY RELATIVE TO MAGIC DAY, FY 2004–2013

Qs: What if the SSO threshold really reflects the clincal nature of the DRG?

The SSO Threshold Effect

Graphical Evidence - By Year

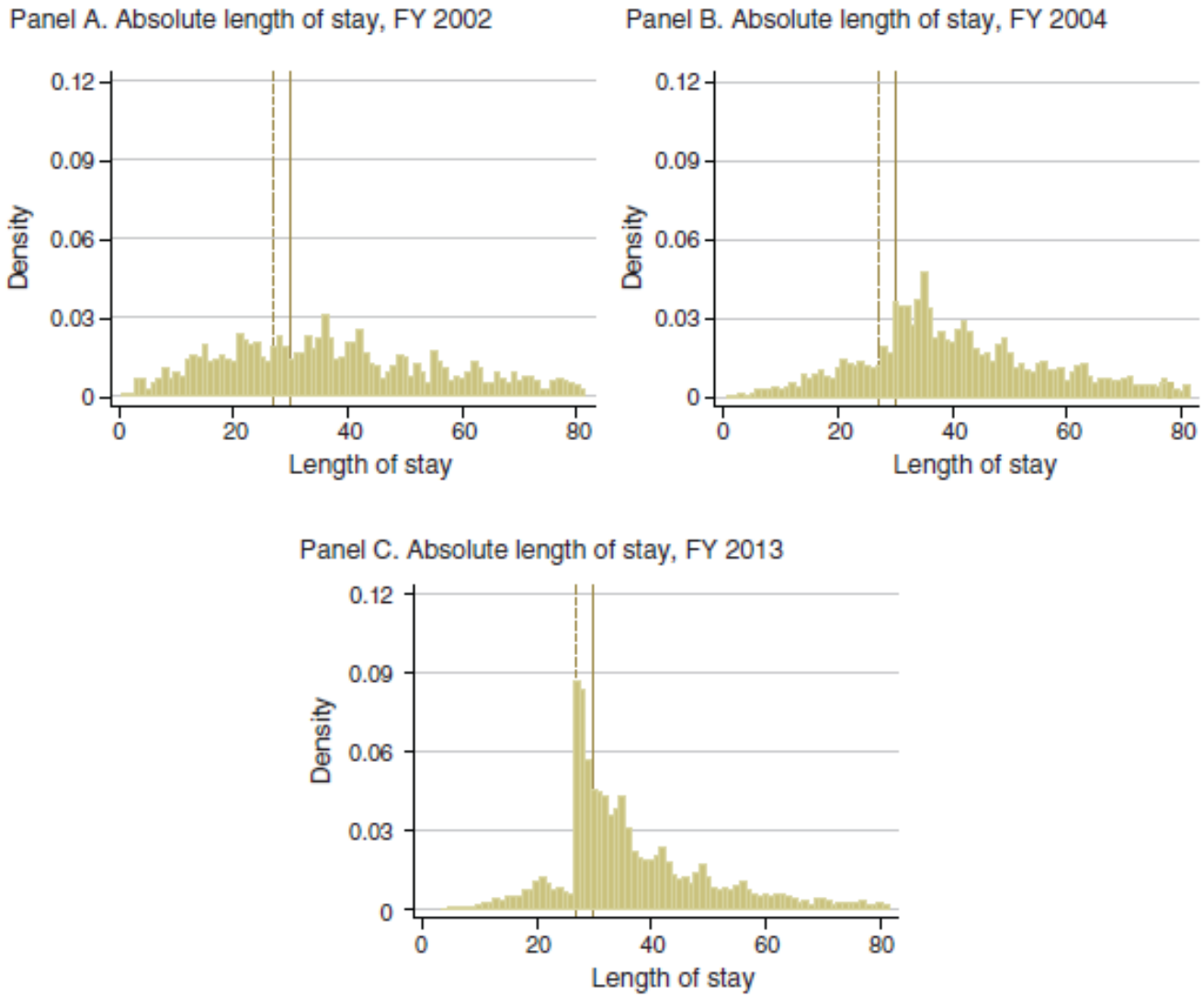
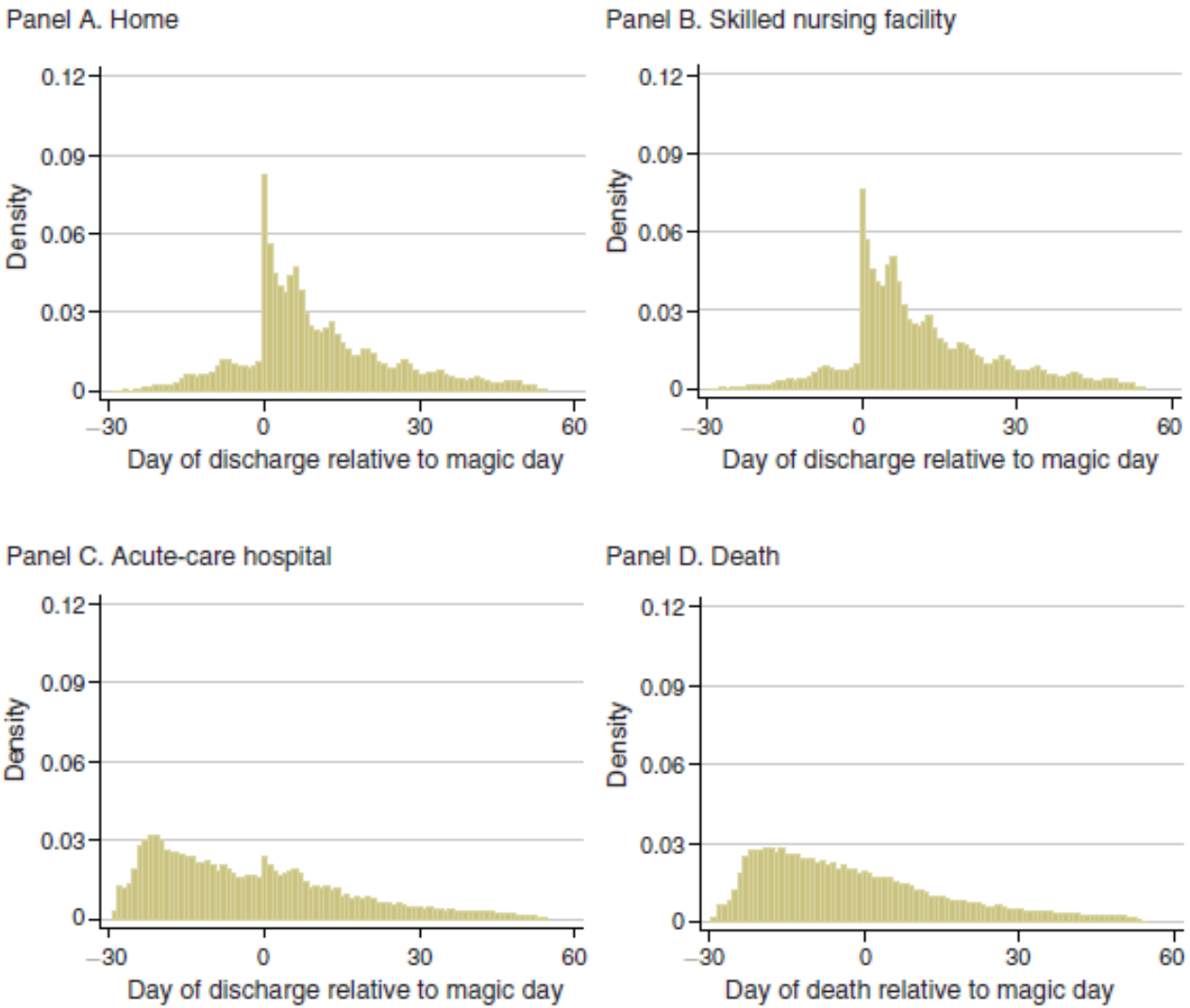


FIGURE 3. DISCHARGE PATTERNS FOR DRG 207 BY YEAR

The SSO Threshold Effect

Graphical Evidence - By Destination



The SSO Threshold Effect

Graphical Evidence - By LTCH Location Type

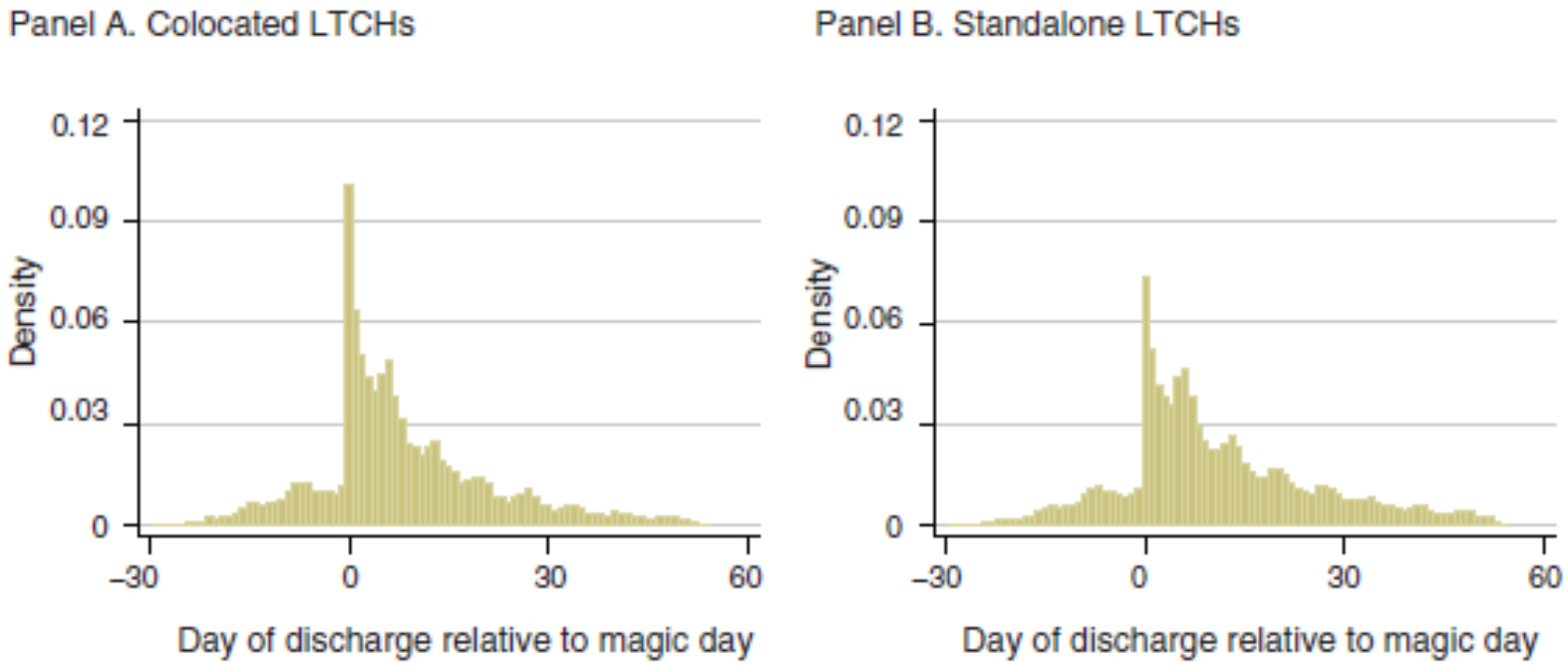


FIGURE 7. DISCHARGE PATTERNS FOR DRG 207 BY LTCH LOCATION TYPE, FY 2004–2013

The SSO Threshold Effect

Graphical Evidence - By LTCH Profit Type

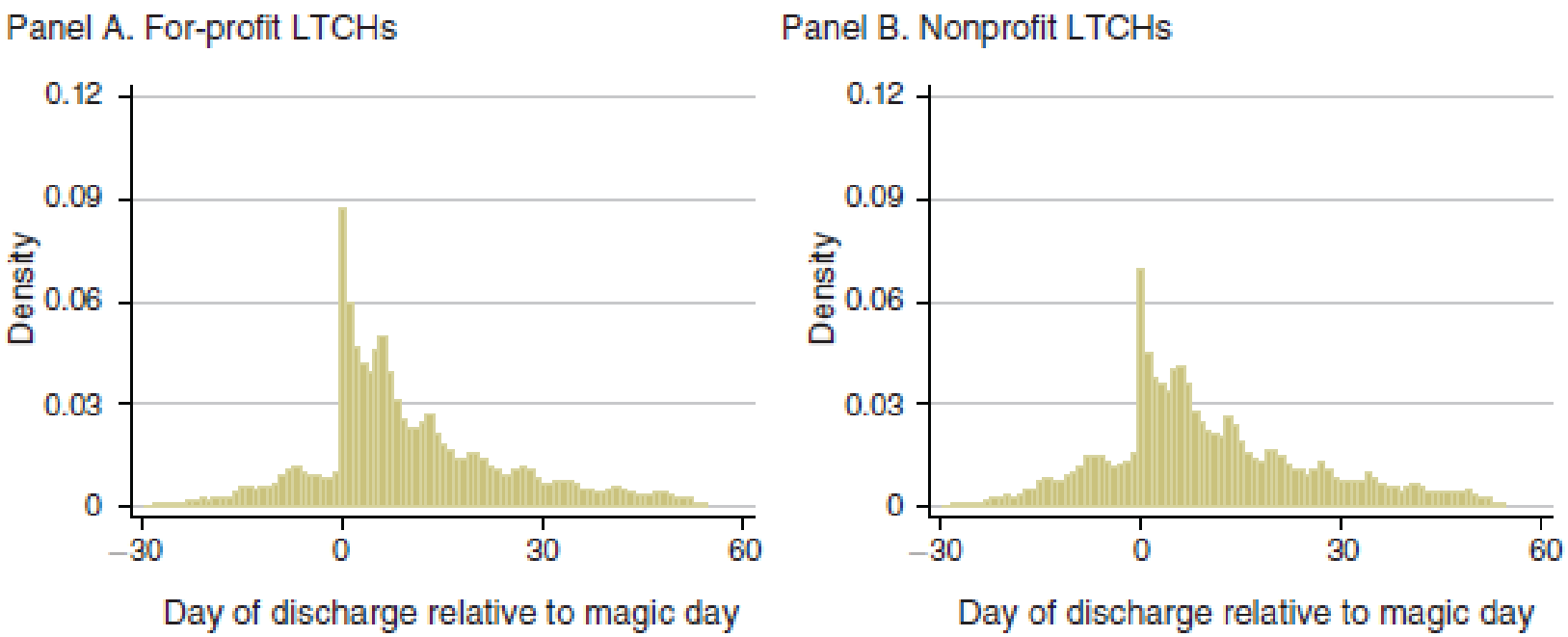


FIGURE 5. DISCHARGE PATTERNS FOR DRG 207 BY LTCH PROFIT TYPE, FY 2004–2013

$$\Pr(discharge|t,s) = \Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_s) \quad (1)$$

t: Absolute day of hospital stay, s: day relative to the threshold
*Note: s is not a function of t [SSO threshold changes over time]

TABLE 3—MARGINAL EFFECTS ON PROBABILITY OF DISCHARGE DRG 207

Day of stay (t)	Probability of discharge on threshold day[a]	Probability of discharge on day preceding threshold day[b]	Hazard ratio[c]
27	9.71 (0.337)	1.27 (0.059)	7.63 [0.000]
28	9.27 (0.319)	1.19 (0.057)	7.80 [0.000]
29	8.86 (0.320)	1.11 (0.060)	7.96 [0.000]
30	8.48 (0.336)	1.04 (0.064)	8.12 [0.000]

Notes: Standard errors in parentheses. p-values in brackets. This sample contains only episodes of hospitalization that terminated in discharge to home care or nursing facilities. For results for other common DRGs, see Table A9.

[a] $\Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_0) \times 100$

[b] $\Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_{-1}) \times 100$

[c] Hazard ratio: $\frac{\Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_0)}{\Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_{-1})}$. Square brackets contain the p-value from a Wald test for H_0: $HR = \frac{\Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_0)}{\Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_{-1})} = 1$.

$$\Pr(discharge|t,s) = \Phi(\gamma_0 + \gamma_1 t + \gamma_2 t^2 + \mu_{s,x(i)}) \qquad (2)$$

TABLE 4—PROBIT MARGINAL EFFECTS BY LTCH TYPE, DRG 207 AT DAY 29

Model number/Partition	Predicted prob. of discharge: SSO threhold day	Predicted prob. of discharge: Preceding day	Hazard ratio[a]	Ratio of hazard ratios[b]
Model 1				
For-profit	9.28	0.967	9.60	1.92
	(0.363)	(0.052)	[0.000]	[0.000]
Nonprofit	7.61	1.53	4.99	
	(0.604)	(0.160)	[0.000]	

Idea: Model daily decision of an LTCH to discharge a patient

$$u_t = \lambda_t + \alpha p_t \tag{3}$$

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

Bellman equation:

$$V_t(\varepsilon_t) = u_t + \max\{\varepsilon_{kt} + \delta EV_{t+1} + \varepsilon_{dt}\} \tag{4}$$

1. Payment policies

$$V_t(\varepsilon_t) = u_t + \max\{\varepsilon_{kt} + \delta EV_{t+1} + \varepsilon_{dt}\} \tag{5}$$

2. Non-revenue benefits (λ_t)

$$\lambda_{i,t} = \gamma_{0,DRG} + \gamma_{1,DRG}\, t + \gamma_{2,DRG}\, t^2 + \gamma_{3,DRG}\, t^3 - \beta \hat{c}_h + \Psi_{dayofweek} \tag{6}$$

3. **KEY** parameter of interest: Effect of payment structure on discharge decision

$$\alpha = \alpha_k + \alpha_z \tag{7}$$

Counterfactual Analysis

Simulating Alternative Payment Schemes - Estimation

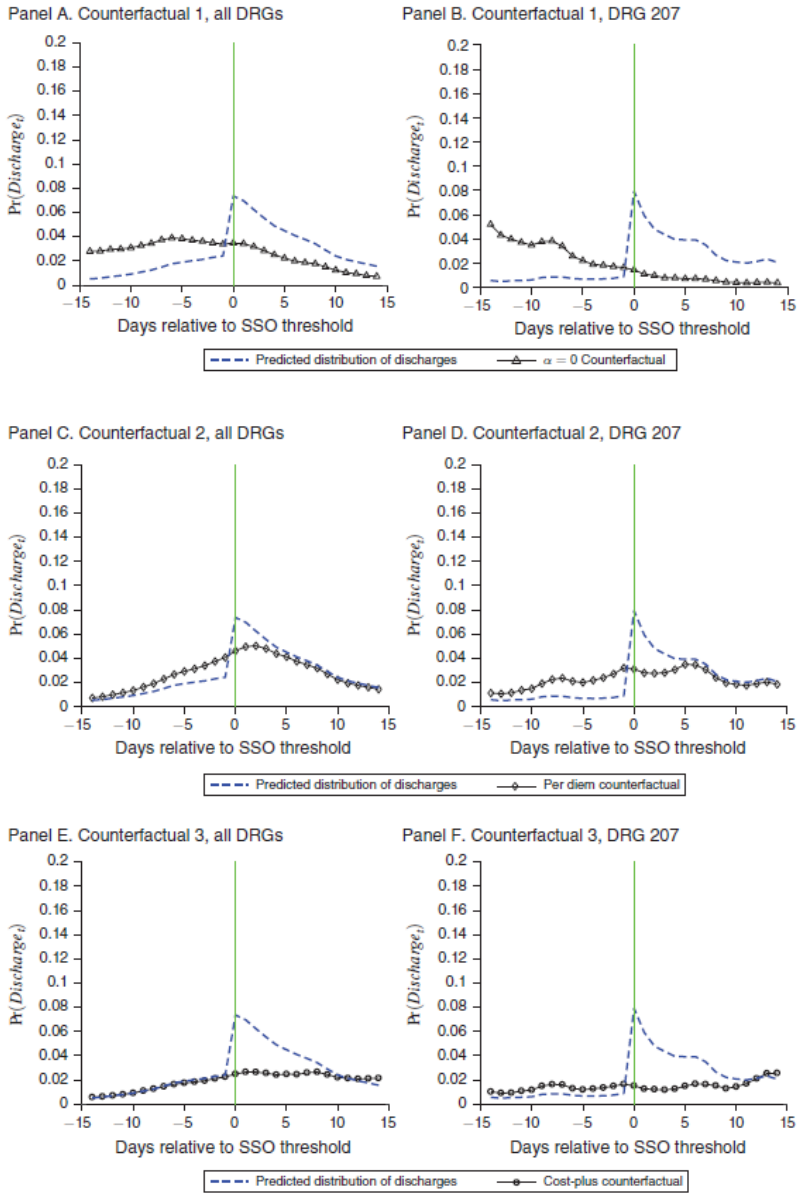
TABLE 5—MODEL ESTIMATES

	(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)
Nonprofit, HwH	0.707	0.678
	(0.005)	(0.005)
Nonprofit, 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
Observations	377,513	

Note: Coefficients for α were multiplied by 10,000 for readability.

Counterfactual Analysis

Simulating Alternative Payment Schemes - Discharge probabilities



Counterfactual Analysis

Simulating Alternative Payment Schemes - Outcomes

TABLE 6—COUNTERFACTUAL OUTCOMES

	Baseline model	Counter. 1: $p_t = 0$	Counter. 2: Per diem	Counter. 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
SD day of discharge	7.82	9.93	8.28	10.44
Mean length of stay	27.64	19.35	26.39	32.36
Mean percent change in length of stay relative to baseline		−26	−3	27
Of patients in the hospital 3 days prior to the magic day:				
Percent held until the magic day	90	73	82	91
Percent discharged within 3 days after the SSO threshold	30	25	24	12
Mean payments ($1,000s)	40.13	25.35	38.90	45.70
SD payments	22.27	15.87	20.13	23.55
Percent change in payments relative to baseline		−29	−3	32
Mean Costs ($1,000s)	37.10	25.35	35.39	43.50
SD payments	19.61	15.87	19.41	22.44
Percent change in costs relative to baseline		−26	−3	26

Note: Baseline model and counterfactuals based on simulations with 100,000 patient draws.

Threats

- Estimation on the dynamic structural model is just based on data of the 9 most common DRGs, is it general enough to make a conclusion?
- Maybe under alternative payment systems, hospitals behave differently when treating less common DRGs?

Conclusion

Sharp jump in the LTCH Medicare payment system induced strategic discharge that based on financial incentives outside of clinical consideration, aternative proposal that remove the jump can bring substantial saving to Medicare (at least when paying for some of the DRGs).