How Does Financial Incentive to Hospital Affect Inpatient Care?

Evidence from Reimbursement System in Japan

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Motivation I

- Under rising medical expenditure, reimbursement becomes more important as financial incentive to contain health care cost.
- In Japan, per-diem fixed payment system "DPC" was introduced to reduce unnecessary health care.
- It is critical to understand how medical provider respond to financial incentive.
- Exploiting DPC implementation, we can examine the impact of financial incentive to medical provider mainly through length of stay.

Motivation II

Research Questions:

1. Does DPC implementation reduce length of stay?
    - Is DPC effective to solve long-term hospitalization problem in Japan?
    - Compared with other treatment choices?

2. How does nonlinear-pricing schedule affect distribution of length of stay?
    - Does hospital discharge patients right before reimbursement drop?

What I do

1. Estimate the impact of DPC implementation on length of stay and other variables in DID framework using patient level data.
2. Estimate the increase in discharged patients right before reimbursement drop using method proposed by Chetty et al.(2011).

Main Fidings

First question:

- Length of stay is reduced by 0.85 days due to DPC implementation.
- Treatment choice is less affected by DPC than length of stay is.

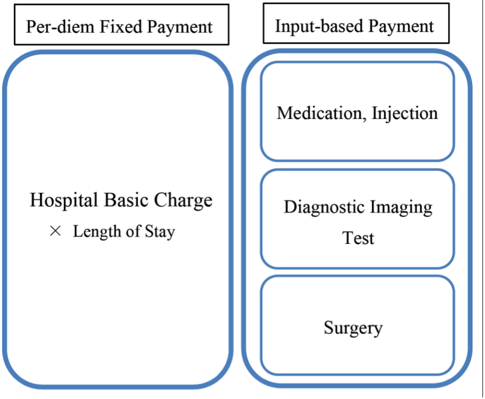
Second question:

- The number of discharged patients increases right before reimbursement drop.
- Nonlinear incentive is concentrated on patients under short hospitalization.

Institutional Background I

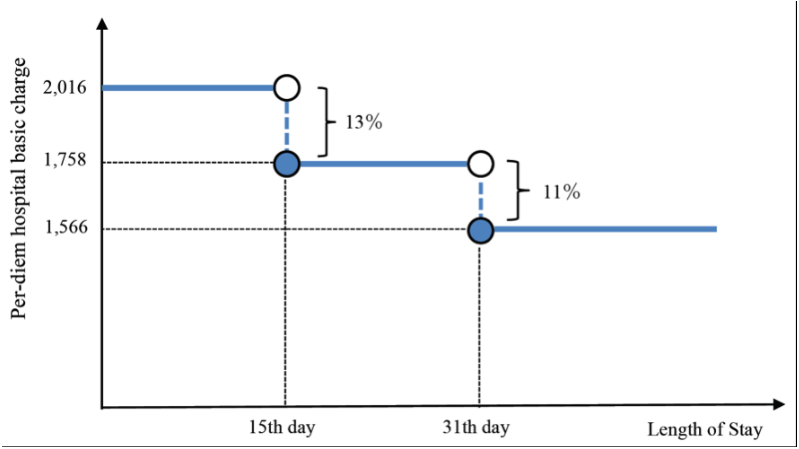
Traditionally, reimbursement had been paid through fee-for-service (FFS) in Japan.

Figure 1. FFS Payment System



Institutional Background II

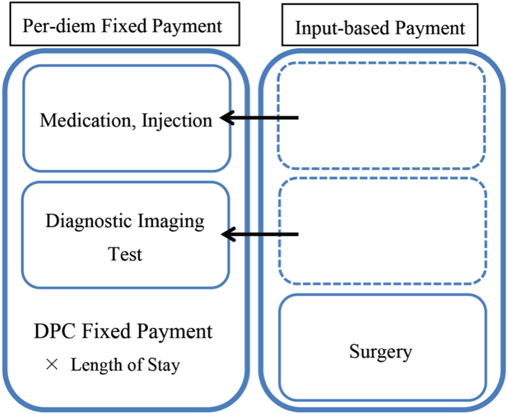
Figure 2. Per-diem Hospital Basic Charge of FFS



Institutional Background III

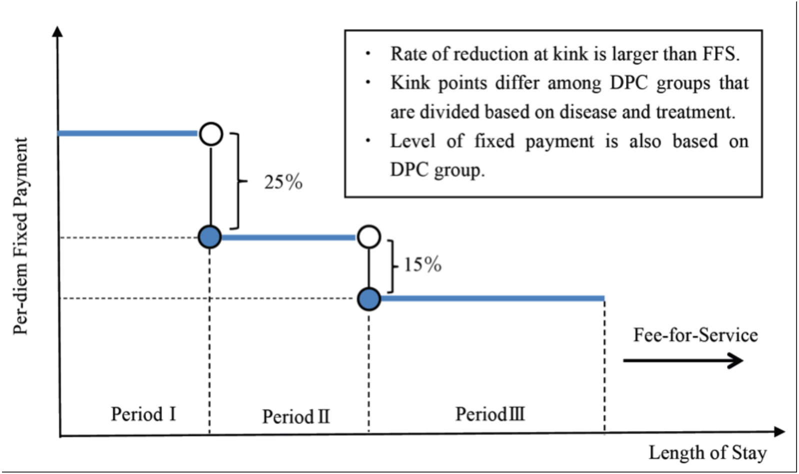
In 2003, alternative payment system called DPC was introduced for inpatient care.

Figure 3. DPC Payment System



Institutional Background IV

Figure 4. Per-diem Fixed Payment of DPC



Financial Incentives I

- DPC reduces length of stay if hospital improve bed turnover rate to keep profitable short-term hospitalization.
- If hospitals cannot admit sufficient new patients, length of stay might not be reduced.
- Additionally, DPC possibly induce hospitals to;
  - Increase frequency and/or input of surgery.
  - Reduce medical input in ward.

Financial Incentives II

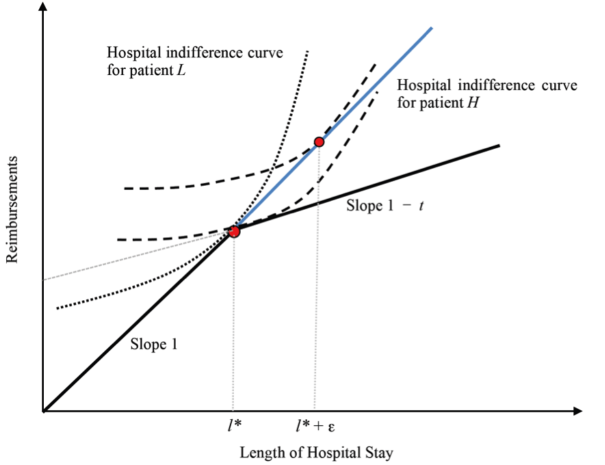
Length of stay has important role in nonlinear-pricing schedule.

- Under nonlinear-pricing, distribution of length of stay is expected to "bunch" at kink point (see Figure 5).
- By changing from FFS to DPC, kinks at 14th and 30th day of hospitalization are eliminated.

$\Rightarrow$ Bunching at kinks should also be eliminated.

Financial Incentives III

Figure 5. Bunching at Kink



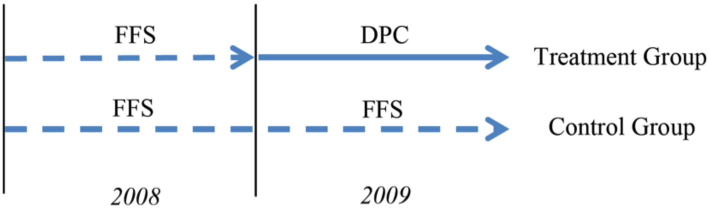
Data I

- Use medical records of circulatory disease patients in DPC database in 2008 and 2009.
- Each hospital can decide when (whether) to adopt DPC.
- Before adoption, hospitals submit medical records under FFS payment for two years.
- Our sample contains only hospitals which are willing to adopt DPC.

Data II

Exploiting one year difference in timing of adoption.

Figure 6. Variation in payment system



Data III

Table 1: Summary Statistics

	Treatment	Control	Treatment 2008-2009		Control 2008-2009	
Number of beds	425	526	425	425	526	526
Length of Stay	12.3	9.8	12.7	11.9	9.6	9.8
Age	71.3	70.4	71.1	71.6	69.9	70.9
Surgery	38%	43%	37%	38%	43%	45%
Comorbidity	9%	5%	7%	10%	5%	6%
Total input	¥925,532	¥1,015,839	¥933,365	¥917,010	¥985,388	¥1,049,221
Input of Surgery	¥489,899	¥649,401	¥487,438	¥492,502	¥627,408	¥673,362
Input in ward per day	¥57,375	¥64,252	¥59,125	¥55,472	¥65,049	¥63,377
Hospital observation	268	68	268	268	68	68
Patient observation	102111	34639	52489	49622	18061	16578

Input of treatment is proxied by FFS-equivalent reimbursement.

Regression Estimation I

Basic specification:

$$LoS_{iht} = t_{2009} + \alpha_h + \beta(DPC * t_{2009}) + \delta_d + X'_{iht}\gamma + \epsilon_{iht} \quad (1)$$

$t_{2009} = 1$ if $t = 2009$
$DPC = 1$ if hospital is in treatament group
α_h : Hospital dummy (336 hospitals).
δ_d : DPC group dummy (150 groups).
X_{iht}: Patient's characteristics.
ϵ_{iht} : Error term (clustered at hospital level).

Estimate with negative binomial regression.

Regression Estimation II

- Following are also used as dependent variable:
  - Surgery dummy
  - ln(Input of Surgery)
  - ln(Average input in ward per day)
- Input was proxied by FFS-equivalent reimbursement.
- In the case of surgery dummy, probit was used and DPC group dummies were dropped.
- OLS was used for other dependent variables.

Results of Regression Estimation

Table 2: The Effect of DPC Implementation

	Length of Stay	Surgery	ln(Input of Surgery)	ln(Average Input in Ward)
$DPC * t_{2009}$	-0.855***	-0.011	-0.039*	-0.0425**
	(0.0171)	(0.0227)	(0.0198)	(0.0160)
N	136734	136153	52829	135127

Standard errors in parentheses

$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$

Covariates: Age, Male, Comorbidity, Switch from outpatient, Referral, Urgent, and Discharge.

Coefficient on Length of Stay is average marginal effect.

Bunching Estimation I

- Recall that price drop at 15th and 31th day of hospitalization were eliminated by DPC.
- What happen to distribution of length of stay around kink?

Figure 2. Per-diem Hospital Basic Charge of FFS

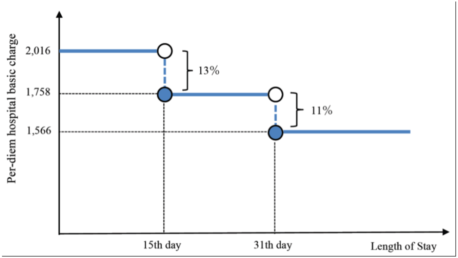
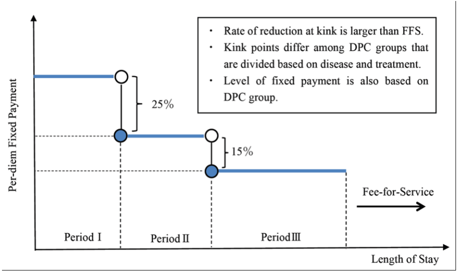


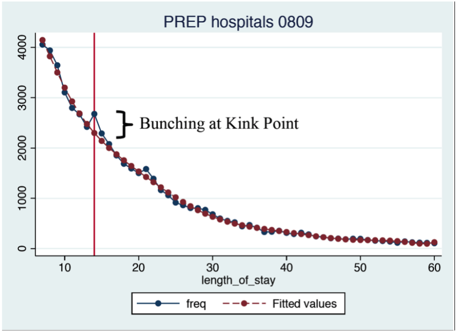
Figure 4. Fixed payment of DPC



Bunching Estimation II

Basic idea of Chetty et al. (2011):

1. Construct “smooth” counterfactual distribution by polynomial.
2. Estimate how much more patients were discharged at kink than counterfactual one.



Bunching Estimation III

First, estimate following regression:

$$C_j = \sum_{i=0}^{p} \beta_i \cdot (Z_j)^i + \gamma_i \cdot \mathbf{1}[Z_j = k] + \epsilon_j \tag{2}$$

C_j : Number of patients discharged at jth day.
Z_j : jth day of hospitalization relative to kink.
k : Kink point.
p : Degree of polynomial.
($p = 9$ in basic specification.)

Bunching Estimation IV

Counterfactual distribution is a predicted value of each C_j excluding contribution of kink:

$$\hat{C}_j = \sum_{i=0}^{p} \hat{\beta}_i \cdot (Z_j)^i \tag{3}$$

Then, bunching estimate is:

$$\hat{b} = \frac{C_k - \hat{C}_k}{\hat{C}_k}. \tag{4}$$

To generate standard error, bootstrap was conducted.

Bunching Estimation V

Divide hospitals into following three groups and compare the change of bunching estimates:

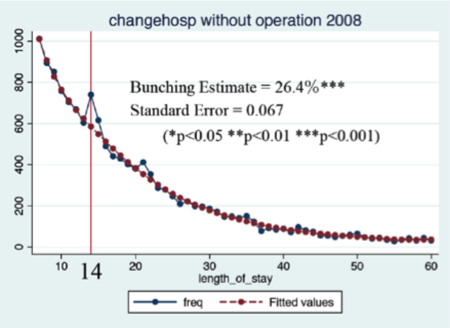
- Hospitals that change from FFS to DPC.
- Hospitals that keep DPC.
- Hospitals that keep FFS.

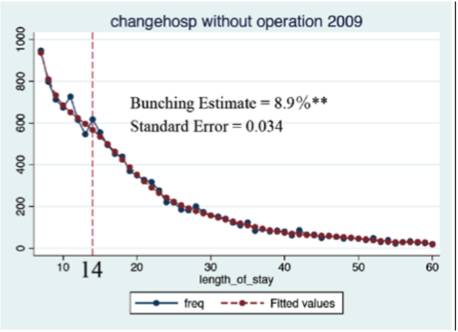
Results of Bunching Estimation I

Limit sample to patients without surgery.

Figure 7.

FFS(Price Drop at 15th Day) → DPC(No Price Drop)





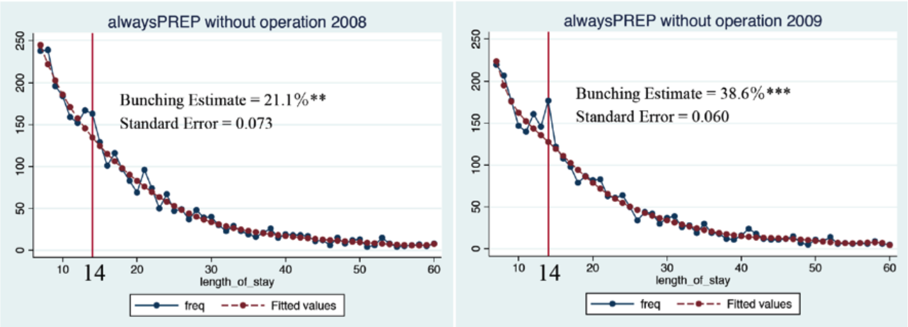
Blue line: Observed distribution

Red line: Counterfactual distribution

Results of Bunching Estimation II

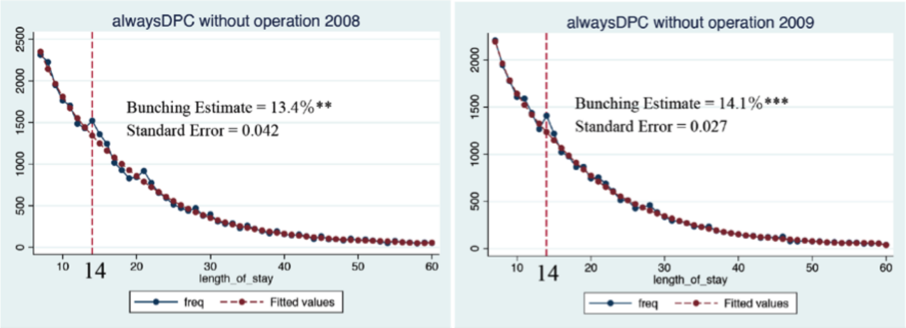
Figure 8.

FFS(Price Drop at 15th Day) → FFS(Price Drop at 15th Day)



Results of Bunching Estimation III

Figure 9.
DPC(No Price Drop) $\rightarrow$ DPC(No Price Drop)



Results of Bunching Estimation IV

- Bunching estimate decreases only when reimbursement drop is eliminated.
- That is, hospital has incentive to discharge patients right before reimbursement drop.
- Excess discharge patients are reduced by 66.3%.

Conclusion

- There is still room to reduce length of stay in Japan.
- It is relatively hard to change actual treatment choice through financial incentive.
- Nonlinear-incentive affect hospital decision on less-serious patients.

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