

# **The Best of Both Worlds? The Economic Effects of a Hybrid Fee-For-Service and Prospective Payment Reimbursement System**

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**Appendix A. Data Extraction Process****Table A1. Data extraction**

	Inpatient		Outpatient	
	N	(%)	N	(%)
<b>I. SMCA</b>				
Original data as of 1997	752,343	(100)	4,217,188	(100)
Keep hospital claims only (exclude clinics)	415,924	(55)	1,376,425	(33)
Keep acute care hospitals only	254,901	(34)	781,006	(19)
Keep acute care inpatient only	247,844	(33)	781,006	(19)
Exclude voluntary hospitals	152,316	(20)	508,324	(12)
<b>II. DRPS &amp; SSMI</b>				
Original data as of 1996	6,206,867	(100)		
Keep acute care hospitals only	1,959,918	(32)		
Keep acute care inpatient only	1,914,431	(31)		
Exclude voluntary hospitals	1,629,842	(26)		

*Notes:* Percentage share of the original data in parentheses.

**Table A2. Number of hospital and number of records for inpatient and outpatient care**

	Hospital (n)		Inpatient Care (N)		Outpatient Care (N)	
	non-DPC	82-DPC	non-DPC	82-DPC	non-DPC	82-DPC
<b>I. SMCA</b>						
<b>Before</b>						
1997	481	79	7,527	4,723	26,563	15,795
1998	448	79	6,711	4,769	24,403	16,542
1999	387	80	8,204	3,731	28,031	11,628
2000	333	80	10,915	3,916	29,034	12,368
2001	312	77	10,002	3,940	26,002	12,564
2002	330	81	10,162	4,038	25,813	13,030
<b>After</b>						
2003	331	81	10,124	3,834	25,329	12,163
2004	324	81	10,725	3,751	25,158	11,552
2005	347	82	5,641	4,061	27,421	11,739
2006	330	81	4,813	4,041	26,446	11,587
2007	349	79	4,886	3,654	25,272	11,277
2008	336	79	4,689	2,293	21,073	9,139
2009	316	81	3,612	2,380	16,332	9,132
2010	315	80	3,281	1,893	12,908	10,023
<b>II. DRPS &amp; SSMI</b>						
<b>Before</b>						
1996	1,526	77	139,610	52,174		
1999	1,576	81	163,410	61,383		
2002	1,463	81	155,920	69,509		
<b>After</b>						
2005	1,410	82	151,171	85,304		
2008	1,356	81	148,925	91,354		
2011	1,295	81	152,281	100,931		
2014	1,230	81	150,776	107,094		

Notes: 2003 in SMCA is categorized into “after” because the survey was conducted in June, two months after the adoption.

**Appendix B. Descriptive statistics of the patient and hospital characteristics****Table B1. Descriptive statistics of the claims**

	<b>Inpatient (N=152,316)</b>		<b>Outpatient (N=508,324)</b>	
	<b>Control</b>	<b>Treatment</b>	<b>Control</b>	<b>Treatment</b>
<b>A: Patient Characteristics</b>				
Female (%)	50.77	47.90	55.77	53.66
Age in years	50.91 (26.34)	57.06 (23.16)	57.66 (23.99)	60.48 (20.91)
Diagnosis (%; Ref: Injury)				
Infectious diseases	3.87	2.46	3.49	3.09
Neoplasms or diseases of the blood	17.50	35.06	8.76	17.60
Endocrine	4.33	4.28 <sup>ns</sup>	9.53	10.21
Mental disorders	1.15	0.48	2.35	4.99
Diseases of the eye or ear	7.14	10.43	11.27	14.24
Diseases of the circulatory system	15.89	14.66	22.04	16.33
Diseases of the respiratory system	11.16	5.01	9.45	4.88
Diseases of the digestive system	10.21	6.64	7.08	5.47
Diseases of the skin	0.86	1.45	3.31	3.91
Diseases of the musculoskeletal system	5.15	5.04 <sup>ns</sup>	9.88	8.48
Diseases of the genitourinary system	4.69	4.65 <sup>ns</sup>	5.38	5.68
Pregnancy or childbirth	5.12	2.39	0.60	0.26
Certain conditions in the perinatal period	1.84	1.12	0.11	0.12 <sup>ns</sup>
Congenital malformations	1.03	1.47	0.58	0.90
Not elsewhere classified symptoms	1.85	0.92	1.79	1.82
Insurance payers (%; Ref: Elderly health insurance)				
Employees' health insurance type 1	34.25	34.37 <sup>ns</sup>	32.46	32.26 <sup>ns</sup>
Employees' health insurance type 2	31.24	25.71	23.13	23.62
National health insurance	31.92	34.22	40.42	40.43 <sup>ns</sup>
<b>B: Hospital Characteristics</b>				
Number of hospital beds	295.88 (210.10)	962.30 (251.12)	278.84 (214.67)	977.28 (240.15)
Public hospital (%)	46.66	53.08	43.66	48.36

Notes: Employees' health insurance types 1 and 2 are under the charge of government and company, respectively. Standard deviations in parentheses for continuous variables. "ns" stands for the insignificant treatment-control difference at a 10% level of significance.

**Table B2. Descriptive statistics of the patient survey**

	Non-Surgical (N=1,047,210)		Surgical (N=582,639)	
	Control	Treatment	Control	Treatment
<b>A: Patient Characteristics</b>				
Female (%)	51.20	48.62	48.72	47.88
Age in years	57.57	51.31	58.38	54.39
	(26.95)	(24.73)	(21.88)	(22.68)
Diagnosis (%; Ref: Injury)				
Infectious diseases	5.10	3.50	0.38	0.50
Neoplasms or diseases of the blood	14.21	32.17	22.43	33.70
Endocrine	4.43	4.60	0.76	1.76
Mental disorders	5.25	5.91	1.18	1.50
Diseases of the eye or ear	1.06	2.10	10.59	14.77
Diseases of the circulatory system	14.92	12.55	9.62	10.35
Diseases of the respiratory system	13.72	5.33	2.24	2.86
Diseases of the digestive system	9.90	6.44	17.43	9.01
Diseases of the skin	1.24	1.92	0.84	1.22
Diseases of the musculoskeletal system	4.47	4.22	5.72	5.03
Diseases of the genitourinary system	4.71	4.84	5.31	4.90
Pregnancy or childbirth	6.36	5.22	5.23	3.28
Certain conditions in the perinatal period	2.17	3.65	0.44	0.66
Congenital malformations	0.47	1.99	1.20	3.53
Not elsewhere classified symptoms	4.31	2.04	0.94	0.87
Insurance payers (%; Ref: Others)				
Employees' health insurance (personal)	12.51	19.21	20.60	22.43
Employees' health insurance (family)	14.29	19.93	14.57	18.98
National health insurance	18.97	24.86	23.43	26.11
Medical Services for Retired Persons	3.10	4.23	4.02	4.35
Elderly health insurance	37.98	20.61	30.59	22.56
Type of surgery (%; Ref: Others)				
Craniotomy			1.48	2.49
Thoracotomy			2.11	4.85
Laparotomy			15.27	14.02
Musculoskeletal surgery			15.78	8.67
Endoscopic or laparoscopic surgery			17.57	13.11
Level of insurance coverage (%; Ref: None)				
Partially	6.84	16.82	10.16	20.05
Fully	86.00	76.57	88.66	78.86
Drawing public assistance (%)	12.69	18.30	8.55	15.15
<b>B: Hospital Characteristics</b>				
Number of hospital beds	236.06	950.90	240.83	933.49
	(172.32)	(242.48)	(171.91)	(234.29)
Public hospital (%)	48.58	53.07	45.05	53.46
Number of hospitalized patients	177.52	753.93	196.89	748.06
	(140.40)	(194.84)	(154.26)	(190.92)
University hospital (%)	2.84	96.10	5.39	96.85

Notes: Standard deviations in parentheses for continuous variables. "ns" stands for the insignificant treatment-control difference at a 10% level of significance.

## Appendix C. Changes in Case-mix

Table C1. Changes in Case-mix in control and treatment groups

	Inpatient			
	Control		Treatment	
	Before	After	Before	After
Infectious diseases	4.14	3.57	2.62	2.27
Neoplasms or diseases of the blood	17.07	17.99	34.96	35.35
Endocrine	4.48	4.15	4.59	4.06
Mental disorders	1.19	1.22 <sup>ns</sup>	0.49	0.48 <sup>ns</sup>
Diseases of the eye or ear	6.68	7.66	9.79	11.04
Diseases of the circulatory system	15.90	15.88 <sup>ns</sup>	14.99	14.34 <sup>ns</sup>
Diseases of the respiratory system	11.19	11.13 <sup>ns</sup>	4.99	5.03 <sup>ns</sup>
Diseases of the digestive system	10.56	9.81	6.72	6.43
Diseases of the skin	0.79	0.93	1.54	1.36
Diseases of the musculoskeletal system	5.50	4.75	4.69	5.38
Diseases of the genitourinary system	4.71	4.66 <sup>ns</sup>	4.67	4.59 <sup>ns</sup>
Pregnancy or childbirth	4.98	5.28	2.52	2.27
Certain conditions in the perinatal period	2.04	1.63	1.15	1.10 <sup>ns</sup>
Congenital malformations	0.79	1.30	1.44	1.50 <sup>ns</sup>
Not elsewhere classified symptoms	1.64	2.09	1.11	0.89
Injury	8.41	7.95	3.73	3.91
	Outpatient			
	Control		Treatment	
	Before	After	Before	After
Infectious diseases	3.23	3.71	2.98	3.19
Neoplasms or diseases of the blood	7.95	9.48	15.98	19.15
Endocrine	9.41	9.64	10.92	9.50
Mental disorders	1.95	2.70	4.47	5.48
Diseases of the eye or ear	11.89	10.71	14.15	14.32 <sup>ns</sup>
Diseases of the circulatory system	22.97	21.19	18.42	14.36
Diseases of the respiratory system	9.34	9.54 <sup>ns</sup>	4.96	4.81 <sup>ns</sup>
Diseases of the digestive system	7.54	6.66	6.03	4.94
Diseases of the skin	3.31	3.31 <sup>ns</sup>	3.72	4.08
Diseases of the musculoskeletal system	10.53	9.33	8.37	8.61
Diseases of the genitourinary system	5.22	5.51	5.66	5.70
Pregnancy or childbirth	0.52	0.68	0.20	0.32
Certain conditions in the perinatal period	0.06	0.16	0.05	0.19
Congenital malformations	0.28	0.84	0.58	1.20
Not elsewhere classified symptoms	1.51	2.03	1.69	1.94
Injury	4.29	4.51	1.82	2.21

Notes: "ns" stands for the insignificant treatment-control difference at a 10% level of significance.

## Appendix D. Linear trend

Based on equation (1), we include a set of interaction terms between the hospital fixed effect and continuous time indicator in years to capture the linear trend in costs. This linear trend can capture hospital-specific trend in costs caused by unobserved characteristics that vary across time. Table D1 demonstrate similar results to the main findings.

**Table D1. Changes in medical payments**

	PPS		FFS		Total	
Post (Inpatient)	-0.063		0.262	**	0.067	
	(0.053)		(0.103)		(0.064)	
Post (Outpatient)	0.042	*	0.074		0.046	**
	(0.023)		(0.047)		(0.021)	

Notes: \*Inference: \*\*\* p<0.01; \*\* p<0.05; \* p<0.1

## Appendix E. Placebo effect

A hypothetical adoption is assumed in the year 1999 for a robustness check. We remain re-adoption years (before 2003) to estimate the placebo effect (1997-2002 for Tables E1; and 1996, 1999, 2002 for Tables E2). Estimations are duplicates of equations (1) and (6) where the variable Post is replaced by Placebo, taking one for the treatment group after 1999 and zero if otherwise. The statistically insignificant estimates support the common pre-adoption trend.

**Table E1. Changes in medical payments**

	PPS	FFS	Total
Placebo (Inpatient)	-0.025 (0.031)	-0.018 (0.072)	-0.014 (0.036)
Placebo (Outpatient)	0.027 (0.050)	-0.063 (0.042)	0.010 (0.036)

Notes: \*Inference: \*\*\* p<0.01; \*\* p<0.05; \* p<0.1

**Table E2. Changes in patient health**

	Cured	Lightened	Unchanged	Worsen/Dead	Others
Placebo (Inpatient)	0.017 (0.011)	-0.018 (0.010)	0.005 (0.003)	0.001 (0.002)	-0.005 (0.006)
Placebo (Outpatient)	0.015 (0.009)	-0.013 (0.012)	-0.003 (0.004)	0.003 (0.002)	-0.002 (0.008)

Notes: \*Inference: \*\*\* p<0.01; \*\* p<0.05; \* p<0.1



## Appendix F. Effect of Fee Schedule Reform in 2006

The 2006 national fee schedule reform renewed the structure of basic hospital fees for inpatient care based on the patient-nurse ratio (MHLW 2007). To alleviate the shortage of nurses, a new 7:1 category was established with the highest basic hospital fee (Table F1).

**Table F1. Newly-established category for the basic hospital fee**

Before (per-diem)	Patient-nurse Ratio	After (per-diem)
	7:1	<b>15,550 yen</b>
12,690 yen	10:1	12,690 yen
10,920 yen	13:1	10,920 yen
9,450 yen	15:1	9,450 yen

All the treatment-group hospitals satisfied the 10:1 ratio before the 2006 reform; it is one of the standards to be designated as advanced treatment hospitals (in fact, most of the hospitals met the 7:1 ratio before the 2006 reform). However, the treatment-group hospitals are unaffected by the reform because the basic hospital fee is bundled as of 2003. In contrast, the control-group hospitals may be motivated to increase the basic hospital fee by meeting the 7:1 patient-nurse ratio. Therefore, the main findings may be affected by the confounding effect of the reform.

To test the potential impact of the reform of fee schedule in 2006, survey years up to 2005 remain for estimation (1997-2005 for Tables F1 and 1996, 1999, 2002, and 2005 for Tables F2). Estimations are duplicates of equations (1) and (6). The estimates are close to the main findings, verifying that the robustness and potential impact of price change in 2006 could be moderate.

### Reference

MHLW (2007). References for the 7:1 basic hospital fee. <https://www.mhlw.go.jp/shingi/2007/10/dl/s1003-5c.pdf> Accessed December 25, 2018 (in Japanese).

**Table F1. Changes in medical payments**

	PPS		FFS		Total
Post (Inpatient)	-0.050	*	0.570	***	0.028
	(0.025)		(0.044)		(0.024)
Post (Outpatient)	0.131	***	-0.007		0.077
	(0.045)		(0.024)		(0.037)

Notes: \*Inference: \*\*\* p<0.01; \*\* p<0.05; \* p<0.1

**Table F2. Changes in patient health**

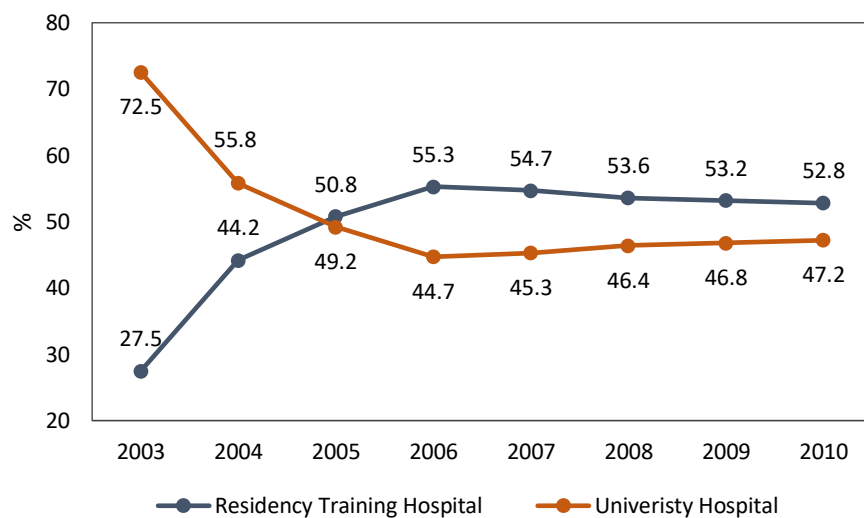
	Cured	Lightened	Unchanged	Worsen/Dead	Others
Post (Inpatient)	0.053	-0.085	0.023	0.025	-0.015
	(0.032)	(0.061)	(0.028)	(0.017)	(0.026)
Post (Outpatient)	0.034	-0.047	-0.004	0.031	-0.015
	(0.019)	(0.034)	(0.014)	(0.019)	(0.023)

Notes: \*Inference: \*\*\* p<0.01; \*\* p<0.05; \* p<0.1

## Appendix G. Effect of New Residency Program in 2004

According to [Iizuka and Watanabe \(2016\)](#), the 2004 new residency program changed the structure of physician recruitment among hospitals affiliated to medical universities (hereinafter, university hospitals). Since most of the treatment-group hospitals (about 97%) are university hospitals, the recruitment shock may shed confounding impacts on the observed program adoption impacts.

Before 2004, most graduate medical students had residencies (not mandatory) at their universities. The new residency program introduced a 2-year mandatory training for the students; many new residents chose non-university hospitals for the residency (residency training hospitals). As Figure G1 shows, the share of medical students who complete residencies at universities drops from 72.5% in 2003 to 49.2% in 2005 ([MHLW 2014](#)).



**Figure G1. Share of medical students having clinical training in university hospitals**

Given the decline in young physician numbers, university hospitals had to call back or recruit experienced physicians from nearby hospitals. Therefore, treatment-group hospitals have the financial burden of hospital operation since such recruitment was much more expensive than having young residents. We maintain the post-adoption period as of 2003 to test the impact of the 2004 new residency program. In addition, to exclude the confounding impacts of the 2006 fee schedule change, we leave out years as of 2006. Eventually, the years 2003, 2004, and 2005 are used for G1. Since the patient survey is available once every three years, and only the year 2005 remains following the criteria, we cannot test the impacts of the 2004 new residency program on patient health. Estimations are duplicates of equation (1). Table G1 shows that the treatment group responds to the 2004 new residency program by allocating more resources to the FFS components than control. However, the magnitude is moderate, and the total medical payment remains unchanged. We conclude that the main results may slightly overestimate the hospital response to the program adoption.

**Reference**

- Iizuka, T., Watanabe, Y. (2016). The impact of physician supply on the healthcare system: Evidence from Japan's new residency program. *Health economics*, 25(11), 1433-1447.
- MHLW (2014). Information about the recruitment of residents under the new residency program. <https://www.mhlw.go.jp/file/06-Seisakujouhou-10800000-Iseikyoku/0000056634.pdf> Accessed December 25, 2018 (in Japanese)

**Table G1. Changes in medical payments**

	PPS	FFS		Total
Post (Inpatient)	0.011 (0.052)	0.307 (0.083)	***	0.014 (0.046)
Post (Outpatient)	-0.042 (0.045)	0.093 (0.096)		0.016 (0.055)

Notes: \*Inference: \*\*\* p<0.01; \*\* p<0.05; \* p<0.1