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

Rong FU[1], Yichen SHEN[2], Haruko NOGUCHI[3]

* We are grateful to Jonathan Skinner, Randall Ellis, Hitoshi Shigeoka, Shiko Maruyama, Toshiaki Iizuka, Rachel Lu, Reo Takaku, seminar participants at the 1st Asian Workshop on Econometrics and Health Economics, and participants at the International Health Economics Association 2019 Congress for their helpful comments and suggestions. Several funds support this study: the Waseda University Research Initiatives entitled "Empirical and theoretical research for social welfare in sustainable society-Inheritance of human capital beyond 'an individual' and 'a generation'"- (PI: Haruko Noguchi); Grant-in-Aid for Scientific Research Project funded by the Ministry of Health, Labour and Welfare (MHLW): "Effects of the prevention policy of lifestyle-related disease on labor productivity and macroeconomy from viewpoint of cost-effective analysis" (PI: Haruko Noguchi); and JSPS KAKENHI grant 19K13729 (PI: Rong Fu). The MHLW approved the use of data under Tohatsu-0507-3 as of May 7, 2018. The views and opinions expressed by the independent authors in this article are provided in their capacity and are their sole responsibility.

[1] Corresponding Author. School of Political Science and Economics, Waseda University, 1-6-1 Nishi-Waseda, Shinjuku-ku, Tokyo 169-8050, Japan, +81 (3)5272-4782 (e-mail: nataliefu1988@aoni.waseda.jp)

[2] Graduate School of Economics, Waseda University. (e-mail: shenyc@toki.waseda.jp)

[3] School of Political Science and Economics, Waseda University. (e-mail: h.noguchi@waseda.jp)

Abstract

Countries seeking to move away from a purely fee-for-service (FFS) system may consider a hybrid approach whereby only some procedures are paid by FFS while others are paid prospectively. Yet little evidence exists whether such a hybrid payment system contains overall costs without adverse influences on health outcomes. In 2003, Japan experienced a reform from FFS to a hybrid payment system in which only some inpatient procedures were paid prospectively. We exploit this reform to test how such a hybrid system affects overall costs and health outcomes. Briefly, we find that healthcare providers responded opportunistically to the reform, moving some procedures out of the bundled inpatient setting to FFS cares, leading to no reduction in cost. There was some evidence of a deterioration in health outcomes, though mortality was not affected. In sum, our results suggest that in some cases, a hybrid payment system can be non-superior to either FFS or prospective payment system.

Keywords: hybrid payment system, bundled payment, substitution behavior, price regulation

1 Introduction

Since 2000, global health spending has increased at an annual rate of 4.0%, about 1.5 times the 2.8% annual growth rate of the global economy (Xu et al., 2018). To contain costs, many countries have opted to replace traditional Fee-For-Service (FFS) payments with a prospective payment system (PPS), incentivizing providers to reduce costs by avoiding unnecessary services (Carroll et al., 2018; Ho & Pakes, 2014). However, providers could also be incentivized to avoid unprofitable patients and discharge patients inappropriately early (Ellis, 1998; Gilman, 2000). Such behaviors may reduce costs at the expense of population health; for example, Cutler (1995) finds higher mortality and readmission rates at hospitals paid by PPS.

Consequently, an increasing number of countries have experimented with mixing the two payment systems to preserve the advantages and attenuate disadvantages of each (Ellis & McGuire, 1986; Ma, 1994; Robinson, 2001). Specifically, the PPS elements of a hybrid payment system can blunt the excessive financial incentives of FFS to contain costs. The FFS elements, in turn, can mitigate the unintended incentives of PPS. Empirical evidence is mixed regarding whether a hybrid payment system is better at containing costs than a pure FFS. A few experimental studies show that capitation-FFS hybrid systems have smaller deviations from the optimal level of treatments compared to a pure FFS (Brosig-Koch et al., 2017; Hennig-Schmidt et al., 2011). Moreover, a study on Medicare's voluntary bundled payment also finds that the hybrid system reduces costs (Navathe et al., 2020). However, Zhang & Sweetman (2018) find Canadian capitation-FFS hybrid system incentivizes general practitioners to induce more FFS services. There is much less evidence of whether patient health outcomes under the hybrid payment system are superior (or at least non-inferior) to either FFS or PPS (Feldhaus & Mathauer, 2018).

In this paper, we investigate a payment system in Japan that mixes PPS and FFS along two dimensions. First, PPS covered inpatient care only, leaving all procedures performed at

outpatient care paid through FFS. Second, only selected inpatient procedures were bundled and paid by PPS; the others were paid using FFS. Therefore, the only bundles were for specific inpatient procedures; other inpatient and all outpatient procedures was paid through FFS. In theory, a hybrid payment system should be better at containing costs than a pure FFS, but without the potentially harmful undertreatment arising from a pure PPS. In practice, however, providers can substitute between the bundled PPS procedures and FFS procedures (either different procedures, or the same procedure on an outpatient basis). The purpose of this study is to test whether providers engage in this kind of substitution behaviors, and if so how total medical costs and patient health are affected.

Japanese universal healthcare coverage is an appropriate setting to analyze a hybrid payment system as providers are reimbursed under a uniform national fee schedule regardless of insurance type of patients. Because of this reimbursement system, providers do not have financial incentives to discriminate among patients based on their insurance types (Richards & Tello-Trillo, 2019). Thus provider's substitution behaviors are likely to reflect financial incentives rather than shifting care for patients with different insurance coverage. However, the literature on Japan's hybrid payment system is scant. Previous studies focused exclusively on the PPS reforms (Hamada et al., 2012; Kondo & Kawabuchi, 2012; Yasunaga et al., 2005), showing that the hybrid system lowered the volume of procedures performed at PPS bundles, but did not consider the potentially offsetting effects of substitution into other FFS procedures.[4] Moreover, these studies are limited to specific diagnoses, e.g., lung cancer, making generalizations difficult.

To circumvent these issues, we make use of nationwide administrative claims that enable identification of the substitution behaviors for most, if not all, diagnoses. We alleviate the endogeneity issue by exploiting a reform from a pure FFS to a hybrid payment system in 2003.

[4] An exception is Shigeoka & Fushimi (2014). They find an increase in admissions to the neonatal intensive care unit (NICU) under the hybrid payment system. NICU is one of the FFS carve-outs. The increase indicates the substitution into NICU services to at-risk newborns.

Specifically, we leverage the *mandatory* adoption of the hybrid payment system by a group of acute-care hospitals.

Briefly, we find evidence that providers substitute bundled inpatient procedures with FFS procedures. The substitution behaviors reduce the payment for bundled procedures by 10.9%. Meanwhile, it increases the payment for FFS procedures by 81.3% and 20.0% for inpatient and outpatient care, respectively. On net, there is no reduction in total inpatient payment and a 12.2% increase in total outpatient payment. Furthermore, we find financial heavily-burdened providers substitute more than financial lightly-burdened providers. Finally, we find a moderate health reduction arising from the introduction of the hybrid payment system, as it reduces the probability of being discharged with cured symptom by more than three percentage points; in-hospital mortality is unchanged. Thus the effect of the hybrid payment system does not appear to show any improvement over a pure FFS system, suggesting that a hybrid system could potentially be worse than either system alone.

2 Background

2.1 The hybrid payment system

Before April 2003, all healthcare providers in Japan were paid using FFS. Japanese government assigned a uniform nationwide price for each medical procedure and revised the price schedule biennially. Thus, a principal method of cost-containment was to keep the price reasonably low (Hashimoto et al., 2011). Despite the government's effort, the ratio of health spending to GDP continued to climb from 5.8% in 1990 to 7.2% in 2000 (OECD, 2019), attributable not only to a rapidly aging population but also to financial incentives induced by FFS. To contain costs, the government proposed a payment system that prospectively determined payment for a set of selected procedures. Under the new system, providers were reimbursed with a hybrid of PPS and FFS for different procedures. In April 2003, the

government mandatorily enrolled the 82 acute-care hospitals.[5] Since it was a mandatory adoption, these hospitals were not allowed to withdraw from the hybrid payment system. Since April 2004, hospitals meeting quality standards also could voluntarily adopt or withdraw from the hybrid payment system.[6]

The hybrid payment system only allowed a set of selected procedures to be paid by PPS while the rest was paid by FFS.[7] Specifically, the selected procedures—(1) diagnostic tests, (2) diagnostic imaging, (3) medication, (4) injection, and (5) medical treatment priced below US$ 100[8]—were bundled and paid by PPS. We name them as the *PPS bundles*. The other procedures—(6) medical supervision, (7) home medical service, (8) rehabilitation, (9) psychotherapy, (10) treatment priced over US$ 100, (11) surgery, (12) anesthesia, and (13) radiation therapy—were paid by FFS. We name these procedures as the *FFS carve-outs*. Furthermore, the system also restricted the PPS to inpatient care whereas all outpatient procedures, regardless of PPS bundles or FFS carve-outs, were paid by FFS. By combining the type of procedures and cares, we can define four distinct categories of procedures: inpatient-PPS bundles, outpatient-PPS bundles, inpatient-FFS carve-outs, and outpatient-FFS carve-outs. Note that only the inpatient-PPS bundles were paid by PPS; the outpatient-PPS bundles, despite its name, were paid by FFS.

Given the PPS element of the hybrid payment system, it may drastically reduce revenues

[5] The group of hospitals is named "advanced-treatment hospitals."

[6] The primary standards are (1) patient-nurse ratio shall be 7:1 or 10:1 for acute-care beds; (2) Regular electronic diagnosis procedure combination data submission; (3) at least 87.5% of the data submitted shall be appropriately recorded. Hospitals adopting the hybrid system are publicized as "diagnosis procedure combination hospitals."

[7] The payment is determined regarding a 14-digit diagnosis procedure combination classification reflecting the most resource-consuming diagnosis coding with the International Statistical Classification of Disease and Related Health Problems, Tenth Revision (ICD-10); the corresponding major procedures based on the national fee schedule; and the major complications or comorbidities. There were 2,522 initial diagnosis procedure combination groups, covering a vast majority of possible combinations. The payment is adjusted for the average length of hospital stay for each diagnosis procedure combination group to prevent inappropriate early discharge. Another goal of introducing PPS is to standardize the pattern of treatment procedure combinations for a specific diagnosis with identical severity, because one of critical issues in Japan is the pattern varies significantly across hospitals. Please see the following website at the Ministry of Health, Labour and Welfare for fee-schedule of PPS in detail: https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000039920.html (Access Date: January 13, 2020).

[8] For simplicity, we assume US$ 1 = 100 yen.

for providers. In order to mitigate the possible catastrophic revenue shocks on providers and to allow them a smooth transition into the new system, the government implemented a tentative measure. Specifically, for each hospital paid by the hybrid payment system, the payments for the inpatient-PPS bundles were multiplied by a hospital-unique adjustment factor (Shigeoka & Fushimi, 2014).[9] The factor was set higher or equal to one and increasing with the share of revenues covered by the inpatient-PPS bundles before the hybrid payment system. To some extent, the adjustment factor protected the hospitals against revenue shortfalls.

It is worth to clarify that providers in this study are hospitals, not the physicians who work there and perform procedures on-site. Unlike physicians in diagnosis-related group-like systems who are paid fees based on volume, Japanese physicians are paid salaries by hospitals. Thus, the financial incentives of hospitals are still relevant to physicians because their salaries and financial rewards depend on hospitals' revenues. Studies suggest hospital-physician financial integration enhances hospitals' influences over physician behaviors (Baker et al., 2016; Koch et al., 2017). Because of this integration, Japanese physicians are likely to internalize the financial incentives of their hospitals and align their practices accordingly, even though they are not immediately affected by the hybrid payment system. Below we use the words providers, hospitals, and physicians synonymously.

2.2 Conceptual framework

In this section, we discuss a framework of providers' reactions to the hybrid payment system. McGuire & Pauly (1991) show that the effect of a price change on the provision of care is a combination of two effects: (1) the response to the change in relative prices between services (substitution effect) and (2) the response to the change in overall price level (income

[9] The adjustment factor was a tentative scheme to alleviate hospitals' financial burden and was abolished in 2018.

effect).

Under the hybrid payment system, substitution effects would dominate over income effects because the adjustment factor guarantees a certain level of income and thus moderates income effects. Instead, the hybrid payment system can have significant substitution effects because it increases the relative price of FFS procedures in relation to PPS bundles. Therefore, providers have strong financial incentives switch to FFS procedures. We classify substitution effects into procedure- and care-based. The *procedure-based* substitution effect means that providers substitute inpatient-PPS bundles with the identical procedures on an outpatient basis (i.e., outpatient-PPS bundles). The *care-based* substitution effect means that providers substitute inpatient-PPS bundles with inpatient-FFS carve-outs. We assume no substitution effect between inpatient-PPS bundles and outpatient FFS carve-outs.[10]

Since both substitution and income effects affect financial incentives of providers, we expect a change in volume across procedures in accordance to the directions and the magnitudes of these effects (Table 1). Specifically, we expect an increase in outpatient-PPS bundles and an increase in inpatient-FFS carve-outs because both substitution and income effects (though modest) are positive. The volume of outpatient-FSS carve-outs may also increase, but we expect the magnitude is moderate at most, given substitution effects are absent and income effects are small. The change in inpatient-PPS bundles is not immediately known since substitution and income effects move in opposite direction. However, we expect a decline in inpatient-PPS bundles due to stronger substitution effects versus income effects. In sum, substitution effects are dominant and determine the direction of volume changes whereas income effects modify the magnitude of the changes.

[Table 1]

Furthermore, the substitution effects could be stronger among providers facing a heavy

[10] It is feasible, but not rational, to do substitutions across both the type of procedures and cares, given the more convenient procedure-based and care-based substitutions.

financial burden—a higher share of inpatient revenue covered by the PPS bundles.[11] In light of McGuire & Pauly (1991), providers will react more substantially to a price cut when it happens to a service with a larger share in revenues. We thus hypothesize a greater volume change for providers who are more heavily-burdened under the hybrid payment system.

Finally, we expect a deterioration in the health outcome of the hybrid payment system in comparison with a pure FFS because the procedure-based and care-based substitution manipulates the order and contents of procedures, respectively. However, the deterioration should not be as severe as a pure PPS, since the substitutions do not induce fewer procedures to patients.

3. Data and Measurements

We use three nationally representative datasets collected by the Ministry of Health, Labour and Welfare. To analyze the effect of the substitution behaviors on costs, we employ the 1997-2010 universal health insurance claims, named Statistics of Medical Care Activities. The claims data were collected every June from randomly selected medical institutions from 1984 to 2010. An advantage of the claims data is that the Japanese national fee schedule unifies the fee for each procedure, which enables an accurate monetary value of each procedure.[12] To examine the health effect of the substitution behaviors, we use the 1996-2010 Discharge Records of Patient Survey linked to the Static Survey of Medical Institutions. The surveys have been conducted triennially since 1984. The discharge records thoroughly document inpatient episodes of patients who were discharged in September of every survey year from randomly selected medical institutions. The medical institution survey summarizes the necessary information of all medical institutions in Japan on October 1 of every survey year.

[11] Although income effects would also be larger among providers with heavy financial burden, we do not explicitly discuss it because the overall magnitude of income effects are small.

[12] It is much more challenging to do so for the healthcare system without universal coverage or uniform price schedule since a procedure is priced differently across insurers, and the claims are commonly incomplete.

3.1. Treatment and control groups

To construct the treatment group, we extract the 82 acute-care hospitals based on the unique-hospital identifiers assigned uniformly across the three datasets.[13] To construct the control group, we extract acute-care hospitals that never adopted the hybrid payment system until 2010. Namely, we exclude acute-care hospitals voluntarily adopting the hybrid system since April 2004 and exclude all the other types of medical institutions (Appendix A).[14] We finally extract a sample of 152,316 inpatient records and 508,324 outpatient records from the claims data and a sample of 1,629,842 discharged-patients records from the patient survey.

The treatment group is selected by the government, and thus may suffer from the issue of selection. We assume the differences in characteristics between the treatment and control groups are inherent and not affected by the payment reform. Thus, we use hospital fixed effects to capture the unobserved differences (see Section 4). Appendix D relaxes the time-invariant assumption by including interaction terms between hospital fixed effects and a linear year trend, which captures the trends in outcomes caused by unobserved time-variant hospital characteristics. Appendix D demonstrates similar results to the main findings.

3.2. Outcome variables

We first generate a set of procedure dummies, taking the value of one if the procedure is performed at least once in a claim record and zero otherwise, separately for inpatient and outpatient care. They measure how substitution behaviors affect the probability of performing procedures at PPS bundles and FFS carve-outs.

We then measure the effect on medical payments for the PPS bundles (PPS payment) and

[13] We verify the identifiers of the 82 acute-care hospitals by recognizing the hospital names.

[14] For the acute-care hospitals, we also exclude records of non-acute inpatient care: infectious-disease inpatient, psychiatric inpatient, long-term-care inpatient, and tuberculosis inpatient. We also exclude records from psychiatric hospitals, hospitals with beds for long-term care, hospitals with tuberculosis beds, elderly hospitals, and all types of clinics with beds.

the FFS carve-outs (FFS payment), separately for inpatient and outpatient care. Each of the payments is a sum of government reimbursements and patient copayments, equivalent to the hospital revenue. Two points are worth clarifying. First, the inpatient-PPS payment is calculated without multiplying the adjustment factor.[15] Furthermore, the outpatient-PPS payment, despite named after PPS, is paid through FFS. We further derive the total medical payment as a summation of the PPS and FFS payments to examine how the substitution behaviors affect the final cost.

To measure the corresponding health effect, we use a five-level categorical health outcome of patients at discharge (cured, improved, unchanged, worse/dead, and others), which is evaluated by physicians in charge.[16] The health outcome is generated separately for surgical patients and non-surgical patients.

3.3. Heterogeneity by financial burden

We allow the magnitude of substitution behaviors to vary across the degree of the hospital's financial burden. It is measured with a three-level categorical variable corresponding to the terciles of the share of hospital inpatient revenues covered by the PPS bundles prior to the hybrid payment system. The higher the level, the heavier the financial burden.

3.4. Patient and hospital characteristics

We control for patient and hospital characteristics to adjust for potential case-mix changes across treatment and control groups before-after the introduction of hybrid payment system. Patient characteristics are gender, age in years, diagnosis, type of insurers, level of insurance

[15] As discussed above, the adjustment factor is intrinsically inflationary and thus may lead to an underestimate of the decline in inpatient-PPS payment.

[16] Patients being worse-off or dead are classified into one category to ensure sufficient observations for analyses.

coverage, type of surgery if a patient underwent surgery, and public assistance status.[17] Hospital characteristics are the number of beds, hospital ownership (public or private),[18] the number of hospitalized patients on October 1, and the university hospital status.[19]

4. Estimation Strategy

We apply a difference-in-difference (DID) approach to identify the substitution behaviors at procedure and payment level. At the procedure level, we test changes in the probability of performing PPS bundles and FFS carve-outs separately for inpatient and outpatient care, using logistic regressions,

$$\text{logit}\left(\text{S}_{k,iht}^{P\ F}=1\right)=\boldsymbol{\lambda}_t+\boldsymbol{\lambda}_h+\mathbf{X}_{k,iht}\boldsymbol{\alpha}_{1k}^{P\ F}+\mathbf{Z}_{k,ht}\boldsymbol{\alpha}_{2k}^{P\ F}+\alpha_{3k}^{P\ F}\,\text{Post}_{k,ht}+\tau_{k,iht} \qquad 1$$

for procedure k to patient i at hospital h in time t. Outcomes of equation (1) are the procedure dummies. Superscript P and F strands for the PPS bundles and FFS carve-outs, respectively. $\boldsymbol{\lambda_t}$ is a vector of year dummies controlling for the year fixed effect (FE) and $\boldsymbol{\lambda_h}$ is a vector of hospital dummies for the hospital FE. $\mathbf{X}_{\boldsymbol{k,iht}}$ is the set of patient characteristics. It also includes a set of interaction terms between the diagnosis and other patient characteristics. $\mathbf{Z}_{\boldsymbol{k,ht}}$ is a set of hospital characteristics. $\text{Post}_{k,ht}$ equals to one for treatment hospitals in years after the hybrid payment system initiated and zero otherwise. $\tau_{k,iht}$ is the error term. $\alpha_{3k}^{P(F)}$ is the coefficient of interest. According to the framework, we expect $\alpha_{3k}^{P}<0$ for inpatient care and $\alpha_{3k}^{P}>0$ for outpatient care (procedure-based substitution), and $\alpha_{3k}^{F}>0$ for inpatient care (care-based substitution). We report the marginal effect of each

[17] Level of insurance coverage, type of surgery if the patient underwent surgery, and being public assisted or not are available only in the patient survey.

[18] Public hospital refers to hospitals owned by following entities: national, prefectural, or municipal government; the ministry of health, labor and welfare; the federation of national health insurance associations; the federation of employees' health insurance associations; the federation of agricultural cooperative associations; national hospital organization; national organization of employee's welfare.

[19] The number of hospitalized patients on October 1 and the university hospital status are available only in the survey of medical institutions.

procedure.

At the payment level, we examine changes in medical payment separately for inpatient and outpatient care,

$$\text{Payment}_{iht}^{P\ F} \ = \ \mathbf{V} \cdot \ \ + \sigma_3^{P\ F} \, \text{Post}_{ht} + \epsilon_{iht}. \tag{2}$$

For simplicity, we define $\mathbf{V} \cdot$ as the fixed effects and the time-varying characteristics presented in equation (1). Outcomes are the log-scaled PPS and FFS payments; superscript P and F strands for the payment type, respectively. We conduct ordinary least squares regressions. $\sigma_3^{P\ F}$ is the coefficient of interest. We expect $\sigma_3^P < 0$ for inpatient care and $\sigma_3^P > 0$ for outpatient care (procedure-based substitution), and $\sigma_3^F > 0$ for inpatient care (care-based substitution). Estimations on the total payment are duplicates of equation (2). The direction of the change in inpatient-total payment is not immediately clear according to the framework, whereas we expect the outpatient-total payment moves upwards. Based on equation (2), we further allow heterogeneous effects across hospital financial burden,

$$\text{Payment}_{iht}^{P\ F} \ = \ \mathbf{V} \cdot \ + \gamma_{3,\text{B}}^{P(F)} \ \text{Post}_{ht} \times \text{Burden}_h \ \ + v_{iht}, \tag{3}$$

where Burden_h measures the three levels of hospital financial burden (light, moderate, and heavy). We expect $\left|\gamma_{3,\text{light}}^{P\ F}\right| < \left|\gamma_{3,\text{moderate}}^{P\ F}\right| < \left|\gamma_{3,\text{heavy}}^{P\ F}\right|$ for both inpatient and outpatient care. Finally, we investigate the health consequences of the substitution behaviors for surgical and non-surgical discharged patients, using multinomial logistic regressions,

$$\text{P}(\text{H}_{iht} = j|\mathbf{W} \ = \frac{\exp(\mathbf{W}_j)}{1 + \sum_{g=1}^{5} \exp\ (\mathbf{W}_g)}, \quad j = 1 \ldots 5, \tag{4}$$

where $\mathbf{W} = \boldsymbol{\theta_t} + \boldsymbol{\theta_h} + \mathbf{O_{iht}}\boldsymbol{\varphi_1} + \mathbf{Q_{ht}}\boldsymbol{\varphi_2} + \varphi_3 \text{Post}_{ht} + \mu_{iht}$. H_{iht} is the five-level health outcome. $\boldsymbol{\theta_t}$ and $\boldsymbol{\theta_h}$ are the year and hospital FEs. $\mathbf{O_{iht}}$ and $\mathbf{Q_{ht}}$ are patient and hospital characteristics. For surgical patients, $\mathbf{O_{iht}}$ also controls for interactions between the diagnosis and the type of surgery. Post_{ht} is identically defined as in equation (1), and φ_3 is

the coefficient of interest. We expect downward shifts from being cured to lower categories, attributing to the substitution behaviors. Like for equation (3), we further allow φ_3 to vary across different levels of hospital financial burden. We expect greater deteriorations for hospitals with a heavier financial burden. In all the estimations, we report the marginal effect for each category of the health outcome.

5. Result

5.1. Descriptive statistics

Table 2 describes the outcome variables. Panel A summarizes the probability of performing each procedure. For inpatient care, the treatment performs fewer procedures at PPS bundles and more procedures at FFS carve-outs than the control. For outpatient care, conversely, the treatment performs more PPS bundles than the control. Discrepancies for the outpatient-FFS carve-outs are less evident: the treatment performs more for some (e.g., psychotherapy) and fewer for the others (e.g., rehabilitation). Panel B shows that the treatment receives larger inpatient payments than the control. In particular, the average inpatient-FFS payment of the treatment is more than twice of the control. In contrast, there is little differences in outpatient payments between the two. In Panel C, the treatment reports a lower rate of discharging patients with symptoms cured than the control. Interestingly, the treatment also reports a lower rate of discharging patients with symptoms worse-off or dead than the control.

[Table 2]

We describe the details of the patient and hospital characteristics in Appendix B. A key question is whether the hybrid payment system alters case-mix in the treatment and control, given that the treatment may be more willing to accept patients requiring more FFS carve-outs. In Appendix C, we present a before-after comparison of the proportions of diagnoses for

the two groups. The treatment shares a similar trend with the control in accepting various types of diseases, indicating the case-mix manipulation is trivial.

5.2. Event study

Another critical question, when applying a DID approach, is whether the common trend assumption is satisfied. In this section, we conduct an event study on medical payment and health outcomes to show graphical evidence of periodic changes in outcome variables between the treatment and control. We replace the Post_{ht} in equation (2) and (4) with a treatment dummy interacted with year dummies with the reference year as 2002 (a year before the initiation).[20]

[Figure 1]

Figure 1 illustrates the results for inpatient payments (A1-A3), outpatient payments (B1-B3), and the probability of being cured and worse/dead for non-surgical patients (C1-C2) and surgical patients (D1-D2). The y-axes share a uniform scale within panels for visual comparability, except for that of A2. The figures support the common trend assumption because the estimates are statistically indifferent to zero in all years before the initiation. Since 2002 is the reference year, the "zero" estimates also reveal no anticipation to the initiation. Moreover, the effects appear to be permanent rather than transitory because the increases-decreases as of $\mathrm{T} = 0$ do not revert to zero. In sum, the event study suggests that DID is an appropriate approach for this study.

5.3. Main results

5.3.1. Substitution behaviors

Figure 2 presents the marginal effects of the hybrid payment system on the probability of

[20] The year range varies across equations due to the different datasets to use. In equation (1), it includes six years before adoption to seven years after ($\mathrm{T} = -6$ to 7, where $\mathrm{T} = 0$ is the year 2003). In equations (6), $\mathrm{T}' = -7$ to 11 and $\mathrm{T}' = 0$ is the year 2003.

performing PPS bundles (Panel A) and FFS carve-outs (Panel B) at inpatient and outpatient care. Panel A shows that, overall, the hybrid payment system reduces the probability of performing PPS bundles at inpatient care. For instance, the system reduces the probability of performing inpatient diagnostic imagining (computed tomography or magnetic resonance imaging, CT/MRI) by 24.5 percentage points. Corresponding to the decline, there is an overall increase in the probability of performing PPS bundles at outpatient care, e.g., the probability of performing outpatient CT/MRI increases by 5.6 percentage points. Panel B shows that the hybrid system increases the probability of performing FFS carve-outs at both inpatient and outpatient care. As expected, the magnitudes are larger at inpatient than outpatient care. For instance, the increase in the probability of performing treatments priced over US$100 is 3.0 percentage points for inpatient care, but no effect is detected for outpatient care.

[Figure 2]

The findings from Figure 2 are consistent with the procedure-based substitution by which providers move the inpatient-PPS bundles to outpatient care, for example, moving CT/MRI diagnostic imaging from inpatient to outpatient care. The magnitude of the substitution varies across procedures, with two of the highest injections and diagnostic imaging. These two procedures are relatively fast to perform, low cost, and non-risky. Given the nature of these procedures, providers prefer to manipulate PPS procedures that have little drawbacks in order to increase revenue at low health risks.

Providers also react to the price cuts by moving more into the inpatient-FFS carve-outs (care-based substitution), particularly for less risky procedures like psychotherapy, or for inherently expensive treatments like treatments priced over US$100. In sum, providers prefer to substitute PPS procedures with other FFS procedures that are safe and expensive.

[Table 3]

Next, Table 3 shows the payment changes owing to the endogenous response of physician practice. In Panel A, Column (1) to (3) report the changes in PPS payment, FFS payment, and

total payment at inpatient care, respectively. Column (4) to (6) report the corresponding changes at outpatient care. Column (1) and (4) show that the hybrid payment system reduces inpatient-PPS payment by 10.9% and increases outpatient-PPS payment by 20.0%. Consistent with Figure 2, the opposite change in PPS payments across the type of care reflects the procedure-based substitution. Column (2) further shows that the system increases inpatient-FFS payment by 81.3%. The opposite changes between PPS and FFS payments at inpatient care reflects the care-based substitution. Column (5) shows no effect on outpatient-FFS payment. Finally, Column (3) and (6) show that the system does not reduce inpatient-total payment and increases outpatient-total payment by 12.2%.

The magnitude of the care-based substitution is much larger than the procedure-based substitution (81.3% versus 20.0%). This can be attributed to the fact that the size of the FFS payment is much smaller than the PPS payment (see Table 2). This can also be explained by the fact that the FFS carve-outs are generally more expensive than the PPS bundles. A unit increase in the more expensive inpatient-FFS carve-outs would lead to a much larger increase in the payments than a unit increase in the outpatient-PPS bundles. Furthermore, there is no increase in the outpatient-FFS payment, which is consistent with our assumption that providers do not substitute across both the type of care and procedure.

5.3.2. Heterogeneous effects on payments

Panel B of Table 3 reports the heterogeneous effects of the hybrid system on payments by the financial burden of providers. For lightly-burdened providers, the hybrid payment system reduces inpatient-PPS payment by 13.9%, increases outpatient-PPS payment by 19.3% and inpatient-FFS payment by 65.3%, reflecting the procedure-based and care-based substitution, respectively. Still, there is no effect on the outpatient-FFS payment. Taken together, the outpatient-total payment increases by 13.0%. For moderately-burdened providers, the magnitudes of the substitution behaviors are close to those lightly-burdened. For heavily-

burdened providers, however, the magnitudes jump up to a notably higher level than the other two. Particularly, for them, the care-based substitution is overwhelmingly large (96.3%), surpassing the reduction in the inpatient-PPS payment and driving up the inpatient-total payment by 8.9%. The procedure-based substitution also is the largest for heavily-burdened providers (22.0%). Furthermore, heavily-burdened providers substitute across both the type of care and procedure. Namely, the outpatient-FFS payment increases by 4.0%.

Overall, the results suggest that the hybrid payment system induces the heaviest burdened providers to experience the largest magnitude response. On the one hand, this could be explained by heterogeneity in substitution effect, i.e., the incentives to substitute PPS procedures with FFS procedures is greater for providers who are more financially distressed. On the other hand, this could be a result of a larger income effect. Providers with a higher share of inpatient-PPS payment would experience a greater revenue shock. They thus have a stronger incentive to increase procedures. Despite not being able to disentangle the two effects, we underline the first because the results indicate that the substitution effect is dominant. Specifically, for lightly-burdened providers—those are the least likely to experience income effects—the changes in payment are still substantial, indicating that the leading factor of provider behaviors is the substitution effect.

Again, the care-based substitution is larger than the procedure-based substitution, regardless of the type of providers. The care-based substitution also appears to be more sensitive to financial burden than the procedure-based. This is probably because providers become more willing to induce expensive FFS carve-outs as the financial burden increases.

5.3.3. Health consequences

Table 4 presents the effect of the hybrid payment system on the discharged outcome of surgical and non-surgical patients. Column (1) to (5) report the marginal effects for each category of health outcome for non-surgical patients and Column (6) to (10) for surgical

patients. According to Panel A, for non-surgical patients, the hybrid payment system reduces the probability of being discharged with cured symptoms by 2.7 percentage points and increases the probability of discharged with improved symptoms by 2.6 percentage points. Likewise, for surgical patients, the system reduces the probability of being discharged with cured symptoms by 3.6 percentage points and increases the probability of discharged with improved symptoms by 2.4 percentage points. For both the non-surgical and surgical patients, the system does not affect the other three lower categories (unchanged, worse/dead, others).

[Table 4]

Panel B reports the heterogeneous effects on discharged outcomes by the financial burden of providers. For non-surgical patients discharged at lightly-burdened providers, the hybrid payment system reduces the probability of being discharged with cured symptoms by 2.8 percentage points and increases the probability of discharged with improved symptoms by 3.3 percentage points. The magnitude of estimates appears to be stable across the level of providers' financial burden. Namely, for non-surgical patients, there is no clear pattern that health deterioration becomes severe, with an increased provider financial burden. For surgical patients, however, the system reduces the probability of being discharged with cured symptoms only for heavily-burdened providers (4.7 percentage points), where it does not affect the probability for those lightly- and moderately-burdened.

The results suggest that the hybrid payment system still adversely affects the health outcomes of discharged patients, although the measured magnitude is modest, with no effect on more severe symptoms. Furthermore, the heterogeneity analysis by the financial burden of providers does not show a substantial difference in the system on health outcomes among the three types of providers, except for a larger reduction in the probability of cured symptoms for surgical patients at heavily-burdened providers. The modest decline in health outcomes could be because the procedure-based and care-based substitution manipulates the order and contents of procedures performed, respectively, but they do not undertreat patients as a pure

PPS does.

5.4. Robustness Checks

We conduct a series of robustness checks. The results justify the robustness of the main findings. In Appendix E, we assume a placebo effect of the initiation in the year 1999 to test the common trend. The estimates refute pre-trend, as does the event study. We also test the potential effects of other health system reforms in the mid-2000s. Appendix F limits the sample to surveys years until 2005 to exclude the confounding effect of the fee schedule reform in 2006. The results reflect the main findings, underscoring the robustness. Appendix G limits the sample to years between 2003 and 2005 to exploit the residency reform confounding effect in 2004. Mostly, the estimates are insignificant except for an increase in the inpatient-FFS payment, indicating the corresponding effect could be trivial.

6. Discussion and Conclusion

In this study, we examine how a hybrid payment system would affect medical payments and health outcomes. We find that providers react to the system by substituting between the bundled PPS procedures and FFS procedures. Specifically, providers move the bundled procedures from inpatient to outpatient care, where the same procedures are paid through FFS. Providers also induce more FFS procedures at inpatient care. Consequently, the substitution behaviors lead to no reductions in total payment for inpatient care; and even increases the total payments for outpatient care. We also examine the heterogeneous magnitude of substitution behaviors by the financial burden of providers. We find that heavily-burdened providers experience the greatest response, suggestive of a heterogeneous substitution behavior. Finally, we find the substitution behaviors cause a moderate health deterioration with a decline in the probability of being discharged with a cured symptom and a simultaneous rise in the probability of being discharged with a symptom improved. The

health deterioration also appears to be the strongest among the heavily-burdened providers.

Japan is not the only country to initiate hybrid systems; our results are relevant for other systems including the United States, the United Kingdom, Australia, Korea, and China (Tsiachristas et al., 2016; Yip et al., 2010). We also contribute to the literature of supply-side responses to price regulation (Brekke, Holmås, Monstad, & Straume, 2017; Clemens & Gottlieb, 2014; Hennig-Schmidt et al., 2011; Salm & Wübker, 2019). In the case of this hybrid payment system, it makes the task of substituting out of the bundled payment easier by providing any number of FFS procedures that are reasonable substitutes, particularly those provided on an outpatient basis. Our results are consistent with the findings of Zhang and Sweetman (2018), where providers in Canada induce more procedures paid by FFS.

How might these adverse consequences of hybrid payment systems be addressed? First, the system should mix only along the dimension of the procedure, providing a bundle whether at the inpatient or outpatient setting. Second, when paying the FFS carve-outs, the system may consider replacing the FFS with an alternative payment system, such as a value-based payment system, that captures cost-effectiveness of the procedure, thus reducing the opportunity for inducing the expensive FFS carve-outs. Providers will have much less incentive to substitute without accounting for the "value" of procedures.

However, our proposed system could incentivize providers to reduce the overall volume of PPS bundles, or even avoid treating diagnoses with high demand on the bundles. The health deterioration of the proposed system, therefore, could be more severe than the current system. This is a similar issue to a pure PPS but with less deterioration since the volume of procedures paid by the value-based payment system would not decline. All in all, we conclude a dilemma between cost containment and health improvement, as literature shows (Geruso & McGuire, 2016). Thus, before any reforms, it is essential to settle a priority between health spending and population health.

This study is subjected to several limitations. First, we cannot examine the per-episode

payment due to the data constraint. As noted in Section 3, the claims data are collected every June. Therefore, the medical payments we derived do not account for costs before June 1 or after June 30. Second, we cannot identify the health consequences of outpatient care. If the health effect is heterogeneous across care, our results may under- or over-estimate the effect. Since the endogenous provider response is strongest in terms of the care-based substitution at inpatient care, we expect the results of health deterioration in this study are at the upper bound of the overall health effects. Third, the external validity of our findings is a concern. Many of the hospitals in the treatment group are university hospitals that are large and technological advanced. This renders difficulties in generalizing our findings to small or medium hospitals. However, it is plausible that our findings can be applied to other large hospitals sharing similar characteristics to the treatment.

In sum, our results suggest that a hybrid payment system, rather than resolving the adverse influences of FFS and PPS system, can be non-superior to either pure system because the opportunities for provider substitution are more plentiful, and those substitution activities can lead to potential adverse patient health effects. Future research with more comprehensive data should focus on these issues.

References

Baker, L. C., Bundorf, M. K., & Kessler, D. P. (2016). The effect of hospital/physician integration on hospital choice. *Journal of Health Economics*, *50*, 1–8. https://doi.org/10.1016/J.JHEALECO.2016.08.006

Brekke, K. R., Holmås, T. H., Monstad, K., & Straume, O. R. (2017). Do treatment decisions depend on physicians' financial incentives? *Journal of Public Economics*, *155*, 74–92. https://doi.org/10.1016/j.jpubeco.2017.09.012

Brosig-Koch, J., Hennig-Schmidt, H., Kairies-Schwarz, N., & Wiesen, D. (2017). The Effects of Introducing Mixed Payment Systems for Physicians: Experimental Evidence. *Health Economics*,

26(2), 243–262. https://doi.org/10.1002/hec.3292

Carroll, C., Chernew, M., Fendrick, A. M., Thompson, J., & Rose, S. (2018). Effects of episode-based payment on health care spending and utilization: Evidence from perinatal care in Arkansas. *Journal of Health Economics*, *61*, 47–62. https://doi.org/10.1016/J.JHEALECO.2018.06.010

Clemens, J., & Gottlieb, J. D. (2014). Do physicians' financial incentives affect medical treatment and patient health? *American Economic Review*, *104*(4), 1320–1349. https://doi.org/10.1257/aer.104.4.1320

Cutler, D. M. (1995). The Incidence of Adverse Medical Outcomes Under Prospective Payment. In *Econometrica* (Vol. 63). Retrieved from https://pdfs.semanticscholar.org/1ed0/2f310e1fc258cf4018d991806df4d460a5d0.pdf

Ellis, R. P. (1998). Creaming, skimping and dumping: provider competition on the intensive and extensive margins. *Journal of Health Economics*, *17*(5), 537–555. https://doi.org/10.1016/S0167-6296(97)00042-8

Ellis, R. P., & McGuire, T. G. (1986). Provider behavior under prospective reimbursement: Cost sharing and supply. *Journal of Health Economics*, *5*(2), 129–151. https://doi.org/10.1016/0167-6296(86)90002-0

Feldhaus, I., & Mathauer, I. (2018). Effects of mixed provider payment systems and aligned cost sharing practices on expenditure growth management, efficiency, and equity: a structured review of the literature. *BMC Health Services Research*, *18*(1), 996. https://doi.org/10.1186/s12913-018-3779-1

Geruso, M., & McGuire, T. G. (2016). Tradeoffs in the design of health plan payment systems: Fit, power and balance. *Journal of Health Economics*, *47*, 1–19. https://doi.org/10.1016/J.JHEALECO.2016.01.007

Gilman, B. H. (2000). Hospital response to DRG refinements: the impact of multiple reimbursement incentives on inpatient length of stay. *Health Economics*, *9*(4), 277–294. https://doi.org/10.1002/1099-1050(200006)9:4<277::AID-HEC513>3.0.CO;2-1

Hamada, H., Sekimoto, M., & Imanaka, Y. (2012). Effects of the per diem prospective payment system with DRG-like grouping system (DPC/PDPS) on resource usage and healthcare quality in Japan. *Health Policy*, *107*(2–3), 194–201. https://doi.org/10.1016/J.HEALTHPOL.2012.01.002

Hashimoto, H., Ikegami, N., Shibuya, K., Izumida, N., Noguchi, H., Yasunaga, H., … Reich, M. R. (2011). Cost containment and quality of care in Japan: Is there a trade-off? *The Lancet*, Vol. 378, pp. 1174–1182. https://doi.org/10.1016/S0140-6736(11)60987-2

Hennig-Schmidt, H., Selten, R., & Wiesen, D. (2011). How payment systems affect physicians' provision behaviour—An experimental investigation. *Journal of Health Economics*, *30*(4), 637–646. https://doi.org/10.1016/J.JHEALECO.2011.05.001

Ho, K., & Pakes, A. (2014). Physician Payment Reform and Hospital Referrals. *American Economic Review*, *104*(5), 200–205. https://doi.org/10.1257/aer.104.5.200

Koch, T. G., Wendling, B. W., & Wilson, N. E. (2017). How vertical integration affects the quantity and cost of care for Medicare beneficiaries. *Journal of Health Economics*, *52*, 19–32. https://doi.org/10.1016/J.JHEALECO.2016.12.007

Kondo, A., & Kawabuchi, K. (2012). Evaluation of the introduction of a diagnosis procedure combination system for patient outcome and hospitalisation charges for patients with hip fracture or lung cancer in Japan. *Health Policy*, *107*(2–3), 184–193. https://doi.org/10.1016/J.HEALTHPOL.2012.08.010

Ma, C. A. (1994). Health Care Payment Systems: Cost and Quality Incentives. *Journal of Economics & Management Strategy*, *3*(1), 93–112. https://doi.org/10.1111/j.1430-9134.1994.00093.x

McGuire, T. G., & Pauly, M. V. (1991). Physician response to fee changes with multiple payers. *Journal of Health Economics*, *10*(4), 385–410. https://doi.org/10.1016/0167-6296(91)90022-F

Navathe, A. S., Emanuel, E. J., Venkataramani, A. S., Huang, Q., Gupta, A., Dinh, C. T., … Liao, J. M. (2020). Spending And Quality After Three Years Of Medicare's Voluntary Bundled Payment For Joint Replacement Surgery. *Health Affairs (Project Hope)*, *39*(1), 58–66. https://doi.org/10.1377/hlthaff.2019.00466

OECD. (2019). OECD Health Statistics 2019. Retrieved July 3, 2019, from http://www.oecd.org/els/health-systems/health-data.htm

Richards, M. R., & Tello-Trillo, D. S. (2019). Public Spillovers from Private Insurance Contracting:

Physician Responses to Managed Care. *American Economic Journal: Economic Policy*, *11*(4), 375–403. https://doi.org/10.1257/pol.20170441

Robinson, J. C. (2001). Theory and Practice in the Design of Physician Payment Incentives. *The Milbank Quarterly*, *79*(2), 149–177. https://doi.org/10.1111/1468-0009.00202

Salm, M., & Wübker, A. (2019). Do hospitals respond to decreasing prices by supplying more services? *Health Economics*, hec.3973. https://doi.org/10.1002/hec.3973

Shigeoka, H., & Fushimi, K. (2014). Supplier-induced demand for newborn treatment: Evidence from Japan. *Journal of Health Economics*, *35*, 162–178. https://doi.org/10.1016/J.JHEALECO.2014.03.003

Tsiachristas, A., Dikkers, C., Boland, M. R. S., & Rutten-van Mölken, M. P. M. H. (2016). Impact of financial agreements in European chronic care on health care expenditure growth. *Health Policy*, *120*(4), 420–430. https://doi.org/10.1016/J.HEALTHPOL.2016.02.012

Xu, K., Soucat, A., Kutzin, J., Brindley, C., Maele, N. Vande, Touré, H., … Siroka, A. (n.d.). *Public Spending on Health: A Closer Look at Global Trends*. Retrieved from http://apps.who.int/bookorders.

Yasunaga, H., Ide, H., Imamura, T., & Ohe, K. (2005). Impact of the Japanese Diagnosis Procedure Combination-based Payment System on Cardiovascular Medicine-related Costs. *International Heart Journal*, *46*(5), 855–866. https://doi.org/10.1536/ihj.46.855

Yip, W. C.-M., Hsiao, W., Meng, Q., Chen, W., & Sun, X. (2010). Realignment of incentives for health-care providers in China. *The Lancet*, *375*(9720), 1120–1130. https://doi.org/10.1016/S0140-6736(10)60063-3

Zhang, X., & Sweetman, A. (2018). Blended capitation and incentives: Fee codes inside and outside the capitated basket. *Journal of Health Economics*, *60*, 16–29. https://doi.org/10.1016/J.JHEALECO.2018.03.002

Figures

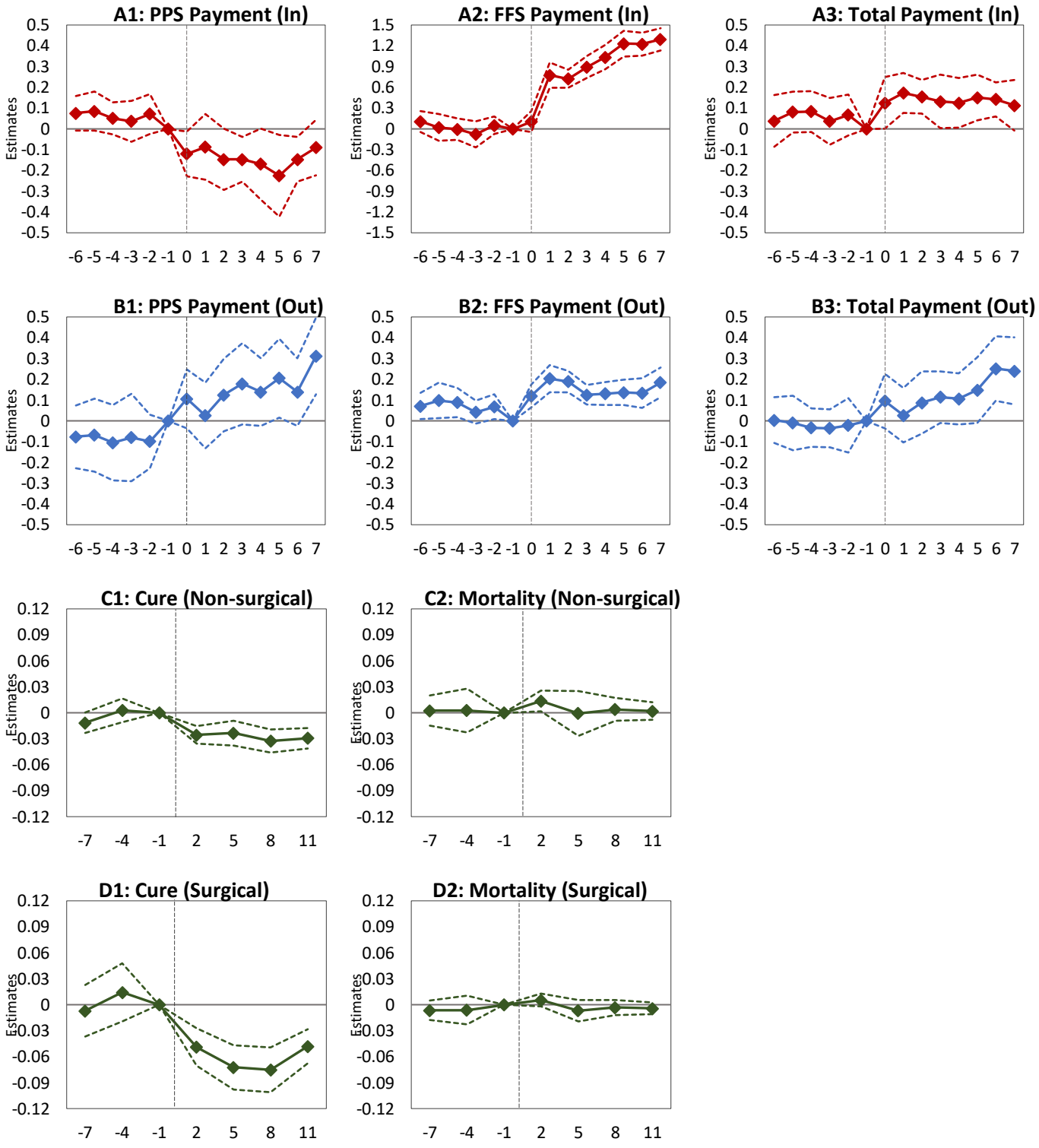

Figure 1. Event study

Notes: The solid lines in Panels A and B plot the estimates from equation (2) where Post_{ht} is replaced with the treatment dummy interaction and a set of dummy years ranging from six years before the hybrid payment system initiated to seven years after. Similarly, Panel C and D plot the estimates from equation (4). The dash lines are the 95th confidence intervals where standard errors are clustered at the prefecture level; the reference year is 2002, i.e., one year before the adoption. "In" for inpatient, "Out" for outpatient.

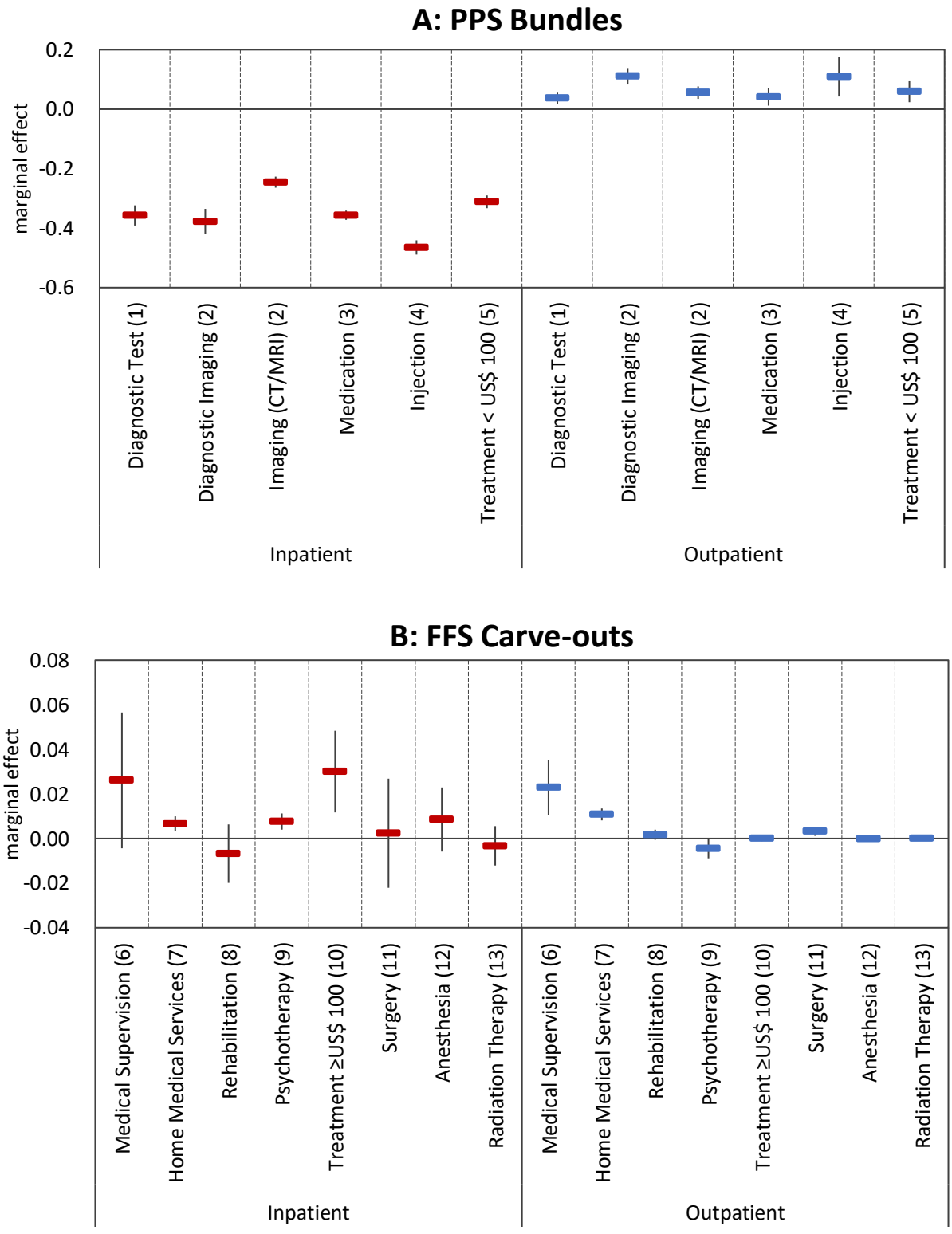

Figure 2. Changes in service provision for inpatient and outpatient cares

Notes: The markers with 95th confidence intervals represent the marginal effects derived from equation (1).

Tables

Table 1. Changes in volume of procedures

	Inpatient Care	**Outpatient Care**
PPS Bundles	Decrease [S(-), i(+)]	Increase [S(+), i(+)]
FFS Carve-outs	Increase [S(+), i(+)]	Increase [i(+)]

Notes: "S" stands for the substitution effect, "i" for the moderate income effect. Sings in the parentheses show the direction of the volume changes.

Table 2. Descriptive statistics

	Inpatient (N=152,316)		Outpatient (N=508,324)	
	Control	**Treatment**	**Control**	**Treatment**
A: Service Provision (%)				
PPS bundles				
Diagnostic test	82.50	69.58	40.64	48.63
Diagnostic Imaging	57.92	41.87	15.68	16.73
Medication	83.20	69.69	78.76	70.76
Injection	68.06	41.32	4.74	8.64
Treatment < US$ 100	42.70	27.27	2.14	8.05
FFS carve-outs				
Medical supervision	83.96	84.42^{ns}	96.10	93.92
Home medical services	1.84	2.35	2.59	2.79
Rehabilitation	15.72	10.57	2.06	0.73
Psychotherapy	0.71	1.32	1.58	4.30
Treatment ≥ US$ 100	1.78	2.14	0.37	0.10
Surgery	22.32	28.96	1.31	0.91
Anesthesia	14.02	18.46	1.10	0.64
Radiation therapy	1.37	7.16	0.05	0.20
Pathology	1.23	2.76	0.26	0.45
B: Medical Payment (10 thousand yen)				
PPS payment	25.58	35.01	0.99	1.15
FFS payment	6.70	13.73	0.52	0.41
Total payment	32.34	49.97	1.51	1.56
	Non-Surgical (N=1,047,210)		**Surgical (N=582,639)**	
	Control	**Treatment**	**Control**	**Treatment**
C: Health at discharge (%, reference: others)				
Cured	6.00	4.76	10.87	6.54
Lightened	66.25	61.69	80.94	84.70
Unchanged	9.08	18.45	2.3	3.67
Worse/Dead	6.73	4.60	1.97	1.88

Notes: Panel A and B describe the sample of claims; Panel C describes the sample of the patient survey. "ns" stands for the insignificant treatment-control difference at 10% level of significance.

Table 3. Changes in inpatient and outpatient payments

	Inpatient			Outpatient		
	PPS Payment (1)	FFS Payment (2)	Total Payment (3)	PPS Payment (4)	FFS Payment (5)	Total Payment (6)
A: Benchmark						
Post	-0.109 ***	0.813 ***	0.036	0.200 ***	0.010	0.122 ***
	(0.032)	(0.038)	(0.025)	(0.044)	(0.021)	(0.037)
B: by Financial Burden						
Post × Light	-0.139 ***	0.653 ***	-0.025	0.193 ***	0.026	0.130 ***
	(0.038)	(0.050)	(0.017)	(0.043)	(0.024)	(0.031)
Post × Medium	-0.135 ***	0.752 ***	0.006	0.188 ***	0.014	0.129 ***
	(0.025)	(0.051)	(0.032)	(0.046)	(0.018)	(0.038)
Post × Heavy	-0.141 ***	0.963 ***	0.089 **	0.220 ***	0.040 *	0.133 ***
	(0.040)	(0.054)	(0.034)	(0.068)	(0.021)	(0.052)
Patient Controls	Yes	Yes	Yes	Yes	Yes	Yes
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes
Hospital Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes

Notes: "Post" and "Post × Burden" corresponds to estimates of equation (2) and (3), respectively. Outcomes are log-scaled. The patient controls are gender, age, diagnoses, and type of insurers. The hospital controls are the number of beds and ownership. Standard errors in parentheses are clustered at the prefecture level. *Inference: *** p<0.01; ** p<0.05; * p<0.1

Table 4. Changes in health outcomes for non-surgical and surgical patients

	Non-surgical					Surgical				
	Cured	Improved	Unchanged	Worse/Dead	Others	Cured	Improved	Unchanged	Worse/Dead	Others
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A: Benchmark										
Post	-0.027 ***	0.026 **	-0.016	0.026	-0.009	-0.036 *	0.024 ***	0.008	0.016	-0.012
	(0.008)	(0.012)	(0.035)	(0.051)	(0.018)	(0.020)	(0.008)	(0.015)	(0.029)	(0.011)
B: by Financial Burden										
Post × Light	-0.028 ***	0.033 **	-0.034	0.036	-0.007	-0.018	0.034 ***	0.007	-0.014	-0.009
	(0.007)	(0.015)	(0.035)	(0.056)	(0.026)	(0.022)	(0.011)	(0.018)	(0.035)	(0.014)
Post × Medium	-0.021 *	0.028 *	-0.022	0.016	-0.001	-0.029	0.024 ***	0.010	0.001	-0.006
	(0.011)	(0.015)	(0.034)	(0.058)	(0.021)	(0.020)	(0.008)	(0.014)	(0.029)	(0.012)
Post × Heavy	-0.024 **	0.029 ***	-0.019	-0.002	0.016	-0.047 **	0.018 ***	0.013	0.018	-0.003
	(0.010)	(0.011)	(0.039)	(0.047)	(0.022)	(0.019)	(0.006)	(0.017)	(0.035)	(0.015)
Patient Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hospital Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: "Post" for estimations of equation (4), "Post × Burden" further allows the marginal effects to vary hospital financial burden, respectively. The patient controls are gender, age, diagnoses, type of insurers, level of insurance coverage, type of surgery, and public assistance status. The hospital controls are the number of beds, ownership, number of hospitalized patients, and university hospital status. Standard errors in parentheses are clustered at the prefecture level. *Inference: *** p<0.01; ** p<0.05; * p<0.1