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Employed for Higher Pay? How Medicare Payment Rules Affect Hospital Employment of Physicians[†]

By DAVID DRANOVE AND CHRISTOPHER ODY*

Hospitals employ an increasing number of physicians and bill for a growing share of outpatient procedures. We exploit a plausibly exogenous increase in Medicare prices for hospital-employed physicians relative to Medicare prices for other physicians to show that payer reimbursement rules explain part of this trend. The shock we study explains 20 percent of the increase in physician employment and 75 percent of the increase in hospital-billed outpatient procedures between 2009 and 2013. (JEL G22, I22, I13, J23, J31, J44)

During the first half of this decade, an increasing percentage of medical procedures was performed by hospital-employed physicians and/or in hospital-owned locations. Medicare and many private insurers more generously reimburse procedures performed by such vertically integrated providers, relative to the reimbursements for the same procedures performed by independent physicians in their own offices. We exploit a plausibly exogenous shock to Medicare prices in 2010 to show these phenomena are causally connected—reimbursement rules encouraged hospitals to employ physicians and bill for procedures in hospital-owned sites rather than in physician offices.

It is widely accepted that hospitals employ an increasing percentage of physician practices (Kocher and Sahni 2011, Merritt Hawkins 2014, Welch et al. 2013). Capps, Dranove, and Ody (2018) estimates the overall share of physician spending by hospital-employed physicians increased from 16.9 percent in 2007 to 26.5 percent in 2013. Similarly, Medicare spending in hospital outpatient departments grew at an annual rate of 8.3 percent from 2007 to 2013, substantially faster than the 5.2 percent growth rate in Medicare spending overall (US GAO 2015, CMS 2017).¹

These trends are part of a larger pattern of growing hospital-based systems. For example, Goldsmith et al. (2015) identifies 15 integrated delivery networks that control a substantial share of their local health care markets. In seeking to explain this integration, the economics literature usually refers to efficiencies stemming from coordination and specific assets (Besanko et al. 2016), risk sharing, efforts to increase

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¹The rate is also faster than the 5.8 percent growth rate for Medicare Part B spending. Medicare Part B covers most outpatient and physician spending.

market power (Gal-Or 1999; Vistnes and Sarafidis 2013; Peters 2014; Dafny, Ho, and Lee 2018), or exclusion of potential competitors (Rasmusen, Ramseyer, and Wiley 1991; Segal and Whinston 2000; Baker, Bundorf, and Kessler 2016).

A burgeoning literature examines the reasons hospitals employ physicians. Burns et al. (2000) and Cuellar and Gertler (2006) find hospitals employ physicians in response to managed care, a pattern that could result from pressure to increase efficiencies or from attempts to improve bargaining position with insurers. Additional results in Cuellar and Gertler (2006), as well as analyses in Brunt and Bownblis (2014) and McCarthy and Huang (2018), also suggest hospitals employ physicians to improve bargaining positions. Neprash, Chernew, and McWilliams (2017) casts doubt upon a hypothesis that hospitals employ physicians to prepare for alternative payment models.

We argue at least some vertical integration (VI) is a reaction to reimbursement rules established by Medicare and often mimicked by private insurers.² This should not be surprising, as previous authors have shown providers respond to the incentives created by Medicare's reimbursement rules. Some responses affect reimbursements but not the delivery of health care, such as when hospitals "upcode" patients to more remunerative diagnoses (Carter, Newhouse, and Relles 1990; Dafny 2005). Other responses represent fundamental changes in organizational structure. For example, hospitals that fail to upcode are more likely to be acquired by hospital systems that do upcode (Dafny and Dranove 2009). As another example, hospitals extend the scope of discounts on drugs under the 340B Drug Discount Program by acquiring physician groups (Desai and McWilliams 2018).

Song et al. (2015) offers a third example that is closely related to our study. They show three cardiology procedures shifted from physician offices to hospital outpatient departments following the same 2010 shock to Medicare prices that we exploit. Building on their analysis, we examine a broader range of procedures, document the shock increased hospital employment of physicians, and examine whether increased employment of physicians contributed to the shift to the hospital outpatient department.

In general, aggregate Medicare reimbursements for a service performed by VI physicians exceed aggregate reimbursements for the same service performed by non-VI physicians in an office setting, due to the way Medicare treats payments for overhead expenses. In 2010, Medicare replaced the physician survey it used to estimate practice costs, which led to procedure-level shocks to Medicare prices. This tended to lower the aggregate Medicare reimbursements for office-based care by non-VI physicians, accentuating the incentive for VI. We refer to the price changes resulting from the 2010 survey update as the "2010 price shock." We measure the intensity of the 2010 price shock as the increase in the reimbursement premium for vertically integrated delivery of a given procedure. As we discuss later in this paper, when studying physicians' decisions, we calculate this treatment variable using

²MedPAC (2013) highlights that Medicare's reimbursement rules often lead to higher prices in hospital-owned sites and/or by hospital-employed physicians. Capps, Dranove, and Ody (2018) documents that hospital employment of physicians increases private insurer prices by 6.7 percent more than it would if private insurers did not follow Medicare's reimbursement rules.

the quantities of procedures that a physician performs in data from one or more anonymous private insurers; we show the 2010 price shock, when calculated using procedure quantities from private claims data, is highly correlated with the price shock calculated from publicly available Medicare claims data. We supplement our private claims data with a number of publicly available sources of Medicare data on prices and quantities by procedure.

From 2010 onward, hospitals increased employment of physicians for whom the 2010 price shock made VI more attractive. We estimate the 2010 price shock explains approximately 20 percent of the overall increase in hospital employment of physicians between 2009 and 2013. The share of procedures performed in hospital-owned sites also increased in response to the 2010 price shock. The survey update explains approximately 75 percent of the overall move toward hospital-owned sites for in-sample procedures billed to Medicare.³ We also confirm hospital-employed physicians bill more in hospital-owned sites. We conclude that organizational structure responds to profit incentives, even in cases in which profit incentives may not be socially desirable.

I. Medicare Prices and Physician Responses

Physicians can perform procedures in numerous sites, such as an office, a hospital outpatient department, or an emergency room. Regardless of the site, Medicare reimburses physicians using the physician fee schedule (PFS). Medicare bases the PFS on the intensity of inputs needed to perform each procedure and estimates input needs separately for the same procedure depending upon whether the physician performs it in a “facility” or “non-facility” site. Facilities include hospital-owned sites (inpatient, outpatient, and emergency room), as well as other related sites, whereas non-facility sites (or simply “non-facilities”) include physician offices, urgent care clinics, and other sites that are not a part of a hospital (CMS 2013). When an independent physician (i.e., a physician who is not a hospital employee) performs a procedure in a non-facility, the PFS covers all costs. When an independent physician performs a procedure in a facility or a VI physician (i.e., a hospital-employed physician) performs a procedure, Medicare reduces the PFS price and the facility submits a separate bill under Medicare’s Outpatient Prospective Payment System (OPPS). Thus, Medicare pays a single fee for procedures performed in non-facilities and two separate fees for procedures performed in facilities or for procedures performed by VI physicians. In general, the latter, combined price is higher than the former, single PFS price.

VI physicians do not need to treat patients in a hospital outpatient department to trigger OPPS payment. Medicare reimburses for procedures performed by VI physicians in a non-facility as if the physician performed the procedure in a facility (Gooch 2016). Indeed, acquired physician groups sometimes explain the change in

³The share of procedures performed in hospital-owned sites decreases over the whole period for the private claims, making it impossible to perform an analogous calculation.

billing conventions to consumers, while simultaneously assuring consumers that the care they receive will in no way change.⁴

PFS prices are based on three components: (i) physician time, (ii) malpractice insurance costs, and (iii) practice expenses. Practice expenses have two components: direct and indirect. Direct practice expense is the variable cost of providing a procedure, whereas indirect practice expense covers overhead. Medicare's 2010 price shock affected indirect practice expense.

Medicare relies upon two specialty-level measures to calculate indirect practice expense: the share of practice expenses that are indirect (indirect percent) and indirect practice expense per hour of physician time (PE/HR). Medicare combines these two specialty-level inputs with other procedure-level and procedure-specialty-level data to produce indirect practice expenses. From 2002 until 2010, Medicare obtained indirect percent and PE/HR from a pooled analysis of the 1995–1999 AMA's Socioeconomic Monitoring System surveys (which we refer to as the “old survey”). Beginning in 2010, Medicare estimated the indirect percent and PE/HR with the Physician Practice Information Survey (the “new survey”). Medicare administered the new survey to 3,656 practices spanning 51 specialties in 2007 and 2008. The new estimates of direct percent and PE/HR were more up to date, but given the small sample sizes of both surveys, sampling error may also have contributed to some of the changes.

Our identification strategy relies on two facts about the 2010 price shock. First, it was a substantial shock to Medicare prices. While long-run cost changes may have contributed to the 2010 price shock, it is unlikely that the 2010 price shock was correlated with any unanticipated cost shocks occurring between 2009 and 2010. Second, the 2010 price shock created procedure-level price variation driven by: (i) variation across specialties in the shock to direct percent and PE/HR, (ii) variation in which specialties perform each procedure, (iii) variation in the types of costs for each procedure, and (iv) interactions among these factors.⁵ As it turns out, the 2010 price shock increased facility prices relative to non-facility prices. Because VI enables facility billing, the 2010 price shock incentivized VI.⁶

Providers might respond to the 2010 price shock in other ways. For independent physicians practicing in non-facilities, the 2010 price shock represents a decrease in prices and a change in relative prices for closely related procedures. The impact of a decrease in prices depends on whether physician supply curves slope up or down, an unresolved issue in the literature. Alternatively, physicians might respond to the 2010 price shock by substituting to closely related procedures. As we discuss later

⁴For example, “our diagnostic testing services will still be provided at the same office locations but will be billed as outpatient hospital procedures. Our staff members caring for you in these areas and the services rendered will remain the same. However, services provided in diagnostic testing areas will be billed by Orlando Health as an outpatient hospital based test, while office visits will be billed by Orlando Health Physician Group” (see <https://www.orlandohealth.com/newsevents.htm>, accessed January 12, 2017).

⁵The indirect-practice-expense calculations treat physician labor, nonphysician labor, and non-labor costs differently.

⁶Stark anti-kickback laws prevent hospitals from paying independent physicians directly for patient referrals. Thus, the only way for hospitals to enjoy the higher reimbursements from facility fees is to acquire the independent physicians.

in this paper, our results suggest these responses explain a substantial share of the move from non-facilities to facilities.

II. Data

We estimate the 2010 price shock using publicly available data from Medicare. We then use private claims data to (i) calculate the intensity with which different physicians were treated by the 2010 price shock and (ii) identify physician VI using private claims data and supplemental sources. We use private claims because of data availability and show later in this paper that this should not materially affect our results. With these data, we assess the extent to which the 2010 price shock affected VI. We separately examine whether the 2010 price shock affected where providers bill for procedures, independent of VI status. With this road map in mind, we explain our sampling restrictions on procedures and then describe the data sources.

The bill a physician submits to Medicare contains a Current Procedural Terminology (CPT) code, and we will refer to each code as a procedure. The unit of observation for many of our analyses is the procedure-year for 2007–2013. We use the product of quantities and non-facility prices as a “numeraire” measure of output, and following Medicare’s terminology, we refer to this as relative value units (RVUs). We restrict the procedure-level Medicare analyses, the procedure-level private claims analyses, and the private claims data for calculating the physician-level treatment intensity to a subset of procedures.

We select procedures using insights from a MedPAC (2013) report that examines which procedures could be subject to site-neutral billing. Medicare’s reimbursement rules for procedures physicians must perform in a facility are not relevant to the physician’s integration decision because the facility can bill Medicare under OPPS regardless of the physician’s VI status. Conversely, Medicare’s reimbursement rules could affect VI of physicians who perform procedures in their offices, but for which facility-based billing is more remunerative. MedPAC recommends site-neutral reimbursement only in cases in which the procedure is in fact “similar” regardless of site, in terms of the intensity of the procedure, the use of ancillaries, and patient risk.⁷

We perform a series of restrictions to mimic the spirit of MedPAC’s criteria. We only consider procedures Medicare reimburses in both facilities and non-facilities. We focus on “major” or “separately billable ancillary” procedures, thereby eliminating many inexpensive procedures that are part of a bundle when performed in a facility.⁸ We eliminate certain complex surgical procedures that are only performed

⁷More specifically, MedPAC flags a procedure for site-neutral reimbursement if the procedure (i) is frequently performed in physician offices, (ii) does not usually involve other ancillaries (such as drugs or complementary procedures) that are “packaged” into the outpatient rate, (iii) is infrequently provided in conjunction with an emergency department visit, and (iv) has similar patient severity across the two sites.

⁸Focusing on major procedures abstracts away from the fact that some ancillary procedures are separately reimbursable in a physician’s office but are bundled into the OPPS prices when performed in a facility. The exact implications of this simplification will vary across our analyses, but two effects stand out. First, it will appear more attractive to perform procedures in a facility relative to a non-facility than it actually is. Second, it introduces X-side measurement error into our measures of how each physician is treated by the 2010 price shock. The first implication suggests we should not extrapolate from our analyses to the overall effect of site-specific reimbursement rules. The second implication suggests that our estimates of the effect of the 2010 price shock on physician VI will be biased downward.

in facilities.⁹ Finally, to mimic MedPAC's criteria that the intensity of a procedure, the use of ancillaries, and patient risk are not too different across sites, we eliminate procedures with large differences between 2007 facility and non-facility prices.¹⁰ We limit ourselves to procedures performed on Medicare patients in each year from 2007–2013. We remove a small number of procedures that experienced large quantity changes because of changes to Medicare's procedure definitions. Even after imposing these sampling restrictions, our data may include some patients who receive care in a facility and could not appropriately receive care in a non-facility. The procedure sample covers roughly 17.5 percent of Medicare RVUs in 2007.¹¹

We take a number of steps to reduce the influence of outliers. Unless otherwise noted, we weight analyses by 2007 RVUs (i.e., the product of 2007 quantities and 2007 non-facility prices). We censor weights at the fifth and ninety-fifth percentiles to reduce the influence of the most common procedures. We also censor continuous dependent and independent variables at the fifth and ninety-fifth percentiles.¹²

A. Medicare Pricing

Let PFS_{lpt}^s be the physician fee schedule price for site l (f for hospital outpatient department/facility or o for office/non-facility), procedure p , and survey s (old or new) in year t .¹³ Medicare phased in the new survey from 2010 to 2013, so for 2010 to 2013 actual PFS prices were

$$(1) \quad PFS_{lpt} = \frac{2013-t}{4} PFS_{lpt}^{old} + \frac{t-2009}{4} PFS_{lpt}^{new}.$$

When a physician performs procedure p in a facility in year t (or a VI physician performs the procedure at any site), the facility can charge the price $OPPS_{pt}$ under Medicare's OPPS. Medicare pays $OPPS_{pt} + PFS_{fpt}$ for the procedure, and the percent markup in the facility's Medicare price relative to the non-facility's Medicare price is

$$(2) \quad relprice_{pt} = \frac{OPPS_{pt} + PFS_{fpt} - PFS_{opt}}{PFS_{opt}}.$$

Variation in any of Medicare's *relprice* components may be driven by endogenous factors, such as actual changes in costs. The empirical analysis isolates the variation

⁹We limit to procedures with 2007 Medicare facility shares between 5 and 75 percent.

¹⁰We exclude procedures for which Medicare's 2007 facility and non-facility prices differ by more than 400 percent. We add back to our sample procedures that MedPAC (2013) identified as appropriate for site-neutral reimbursement.

¹¹Online Appendix 6, section (iii) illustrates that the results are robust to alternative sample restrictions and explains why.

¹²For regressions with physician and year fixed effects (procedure and year fixed effects), we censor outliers of the dependent variable at the fifth and ninety-fifth percentiles based upon data that has been de-measured in terms of physician and year fixed effects (procedure and year fixed effects).

¹³A VI physician practicing in an office but billing like a hospital outpatient department has a site of "f."

in prices that arises from the 2010 price shock. In particular, the effect of the 2010 price shock on non-facility prices as a fraction of baseline non-facility prices is

$$(3) \quad \Delta PFS_p^{2010} = \frac{PFS_{op2010}^{new} - PFS_{op2010}^{old}}{PFS_{op2010}^{old}}.$$

Similarly, we compute the shock to the difference between the facility and non-facility prices and report this as the fraction of what 2010 non-facility prices would have been in the absence of the 2010 price shock:

$$(4) \quad \Delta relprice_p^{2010} = \frac{(OPPS_{pt} + PFS_{fp2010}^{new} - PFS_{op2010}^{new}) - (OPPS_{pt} + PFS_{fp2010}^{old} - PFS_{op2010}^{old})}{PFS_{op2010}^{old}} \\ = \frac{(PFS_{fp2010}^{new} - PFS_{fp2010}^{old}) - (PFS_{op2010}^{new} - PFS_{op2010}^{old})}{PFS_{op2010}^{old}}.$$

In other words, $\Delta relprice^{2010}$ is the shock to the facility/non-facility price differential, relative to the baseline, pre-shock non-facility price. Note that OPPS prices appear in the formula for Medicare *relprice* but not the formula for $\Delta relprice^{2010}$ because OPPS prices were unaffected by the 2010 price shock.¹⁴

The histogram of $\Delta relprice^{2010}$ in Figure 1 illustrates that the 2010 price shock generates variation in facility prices relative to non-facility prices.¹⁵ Note in Figure 2 that decreases in ΔPFS^{2010} translate roughly dollar-for-dollar into increases in $\Delta relprice^{2010}$. As a result, we are unable to separately identify the effect of relative price changes and absolute income changes on VI.

Medicare phased in another change to the physician fee schedule from 2007 to 2010. We include 2007 analogs to our 2010 treatment variables as controls in many of our analyses. We call these variables ΔPFS^{2007} and $\Delta relprice^{2007}$. The 2007 price shock has a low, but positive correlation with the 2010 price shock change. The shock affected Medicare PFS prices over the 2007–2010 period, but had no measurable effect on physician VI or site. There are a number of reasons we might not detect any effect of the 2007 price shock on VI. Medicare announced the 2007 price shock in mid-2005, so we lack a pre-period against which to measure any effect. Furthermore, the 2007 price shock generally made VI *less* attractive. Online Appendix 3 presents details on the 2007 price shock and illustrates that our estimates of the effect of the 2010 price shock are robust to a number of alternative methods of controlling for the 2007 price shock.

¹⁴One could alternatively formulate $\Delta relprice^{2010}$ as $(OPPS_{pt} + PFS_{fp2010}^{new} - PFS_{op2010}^{new}) / (PFS_{op2010}^{new} - (OPPS_{pt} + PFS_{fp2010}^{old} - PFS_{op2010}^{old})) / PFS_{op2010}^{old}$. The two formulations have a correlation of 0.78. Estimates of the responsiveness of Medicare facility share and physician VI to relative prices are roughly 25 percent lower when using the alternative measure, but remain statistically significant.

¹⁵Medicare's PFS includes a "budget-neutral" adjuster, so the 2010 price shock has no effect on average PFS prices. We do not incorporate the budget-neutral adjuster when calculating ΔPFS^{2010} and $\Delta relprice^{2010}$. Accounting for the budget-neutral adjuster has only a small effect on $\Delta relprice^{2010}$ because the budget-neutral adjuster has an identical multiplicative effect on both facility and non-facility PFS prices.

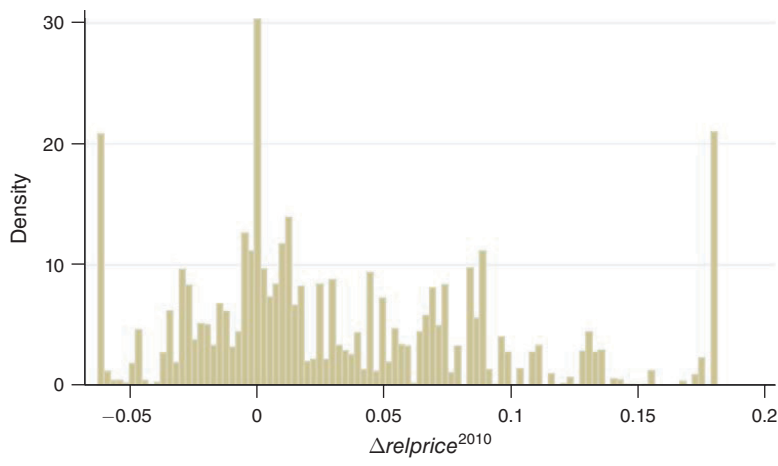


FIGURE 1. DISTRIBUTION OF PROCEDURE $\Delta relprice^{2010}$

Notes: The unit of observation is the procedure with procedures weighted by 2007 RVUs. Outliers are censored at the fifth and ninety-fifth percentiles.

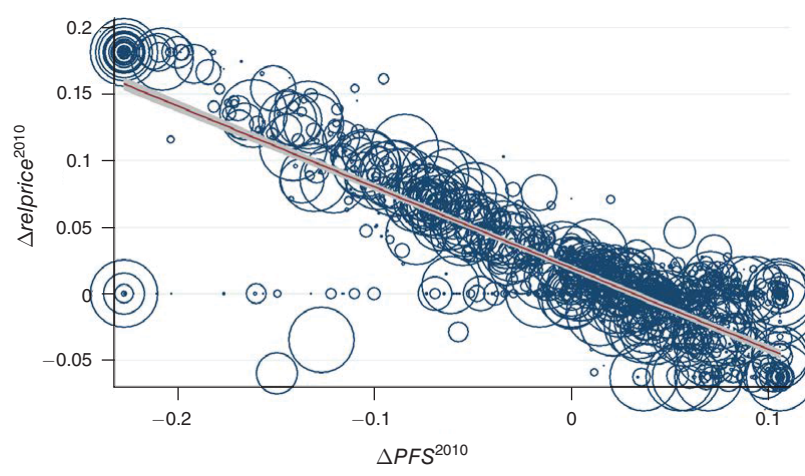


FIGURE 2. DISTRIBUTION OF PROCEDURE $\Delta relprice^{2010}$

Notes: The unit of observation is the procedure with procedures weighted by 2007 RVUs. Outliers are censored at the fifth and ninety-fifth percentiles. The red line is the OLS estimate of relationship, and the gray-shaded area is the 95 percent confidence interval.

B. Private-Payer Claims Data

We use private-payer claims to measure VI and simulate the effect of the 2010 price shock on the relative price differences for physicians. We also use this dataset to examine how the 2010 price shock affected private prices and the procedure site and to confirm that physician VI leads to increased facility billing. Capps, Dranove, and Ody (2017, 2018) relies upon data from the same source. Our data use agreement precludes us from revealing the identity of the data provider, the identity of the

insurer or insurers the data are from, or the specific states the data cover. We are able to disclose the following: the data are from one or more insurers conducting business in at least several states. Overall, the states in Capps, Dranove, and Ody (2017, 2018) cover roughly 12 percent of the US population. We restrict the analyses in this paper to the subset of the metro areas for which we have data in each year from 2007–2013.¹⁶ Enrollees were broadly present across these areas and had almost unfettered choice of physicians. Physicians were reimbursed almost exclusively by fee-for-service and the sample of claims represents a small but meaningful share of physicians' reimbursements. Furthermore, the changes in practice-size distribution in the data closely mirror those in Welch et al.'s (2013) study of the entire United States.¹⁷

We define a physician to be VI if the physician bills under a hospital system's tax identification number (TIN) in the private claims data. We aggregate TINs to the system level using guidance from both the SK&A physician database and from American Hospital Association data because hospital systems bill with multiple TINs.¹⁸

For simplicity, we limit the sample of procedures used to simulate the effect of the 2010 price shock on physicians to those in the Medicare analyses. We also discard inpatient claims because they are not substitutable for non-facility care.

We need to measure the extent to which the 2010 price shock made it more attractive for each independent physician to integrate. To do so, we create a physician-level analog of the procedure-level measure of the effect of the 2010 price shock on relative reimbursements. In particular, let q_{ip2007} denote the number of times physician i performed procedure p in 2007 in the private claims data.¹⁹ We compute the shock as the difference between the facility and non-facility reimbursements, and report this as the fraction of what 2010 non-facility reimbursements would have been in the absence of the 2010 price shock:

$$(5) \quad \Delta relprice_i^{2010} = \frac{\sum_p \Delta relprice_p^{2010} \times PFS_{op2010}^{old} \times q_{ip2007}}{\sum_p PFS_{op2010}^{old} \times q_{ip2007}}.$$

To reduce notational clutter and because we perform the physician-level and procedure-level analyses in different sections, we omit subscripts from both the physician-level and procedure-level versions of $\Delta relprice^{2010}$ and ΔPFS^{2010} .

Physician $\Delta relprice^{2010}$ approximates the effect of the 2010 price shock on the cross-site Medicare price differentials of physicians. However, due to data limitations, the quantity weights used to create physician $\Delta relprice^{2010}$ are from private claims data. We recalculate physician $\Delta relprice^{2010}$ with quantity weights from publicly available Medicare claims data from 2012; the weighted correlation between

¹⁶The states in this sample cover roughly 8 percent of the US population.

¹⁷For the full sample of states in Capps, Dranove, and Ody (2017), 89 percent of the physicians who accepted some private insurance were in network for the "one or more insurers," and the average physician was reimbursed \$40,000 annually in the claims data. Additional details appear in Capps, Dranove, and Ody (2017).

¹⁸Online Appendix 1 provides additional details on how we define physician VI.

¹⁹When constructing this quantity, we censor the quantity of procedures billed for at a single time at the fifth and ninety-fifth percentiles by procedure, although doing so does not substantively affect our results.

these two versions of physician $\Delta relprice^{2010}$ is 0.84.²⁰ We conclude that physician $\Delta relprice^{2010}$ proxies for the shock to Medicare revenues. In other contexts, Medicare prices affect private prices (Clemens and Gottlieb 2017). Section IVA examines whether private insurers adopted the 2010 price shock. If so, the effect of the 2010 price shock on VI is the sum of (i) the direct effect of Medicare price differentials on VI and (ii) the product of the effect of the 2010 price shock on private price differentials and the effect of private price differentials on VI.²¹

A concern with physician $\Delta relprice^{2010}$ is it does not include all physicians or all physician revenues. We restrict to a subset of procedures that are more relevant to some physicians than others. This limits the external generalizability of our results to other procedures and physicians. Physician $\Delta relprice^{2010}$ covers roughly 24 percent of a physician's RVUs for in-sample physicians in the private claims dataset. Physician-level shocks calculated for different subsamples of procedures are likely to be highly correlated because the procedure-level shock depends upon the share of physicians from each specialty performing the procedure and the types of resources the procedure requires, two characteristics that are likely to be correlated across procedures within the same physician.²²

We create two additional variables from the private claims data. Private *facility share* is the share of RVUs at 2007 prices in a facility and is calculated for each procedure-year and physician-year.²³ Finally, we calculate private *relprice* for each procedure-year inserting private claims analogs into equation (2).²⁴ We restrict the private procedure-level analyses to the same procedures in the Medicare procedure-level analyses. Furthermore, we exclude Evaluation and Management visits because the private claims data rarely has facility charges for these claims, a fact we have confirmed with the data provider and discuss further in online Appendix 4.

C. Medicare PFS Quantities

We lack claim-level Medicare data. Instead, we rely upon publicly available data on the quantity of each procedure that Medicare reimburses physicians for by specialty-procedure-site.²⁵ We aggregate the data so that it has one observation per

²⁰ Online Appendix 4 presents evidence on the relationship between the private claims data and Medicare claims data and illustrates that our results are robust to calculating physician $\Delta relprice^{2010}$ with the publicly available Medicare data.

²¹ We lack data from many payers and therefore cannot accurately construct overall (i.e., Medicare plus private) price differentials. This is one reason we do not extrapolate from the effect of the 2010 price shock to the effect of price differentials more broadly.

²² Three versions of physician $\Delta relprice^{2010}$ that we calculate with different procedure samples are highly correlated, and results are robust to the choice of which to use (see online Appendix 6, section (iii) for more details).

²³ We assign physician claims to a facility or non-facility site using two criteria: (i) whether the claim lists a facility or non-facility site and (ii) whether there is a corresponding facility charge for the same procedure, same patient, and same day. We restrict the private procedure analyses to 94 percent of claims for which the categorizations are the same; doing so does not substantively alter our results.

²⁴ For the purpose of constructing non-facility prices, we restrict to claims billed in an office by a physician who is never VI. Before aggregating across bills, we censor the quantity of procedures billed for at a single time and procedure prices at the fifth and ninety-fifth percentiles by procedure; doing so does not substantively alter our results.

²⁵ These files are included on Medicare's website within the notices entitled "Payment Policies Under the Physician Fee Schedule and Other Revisions to Part B." The 2009 file is located at https://urldefense.proofpoint.com/v2/url?u=https-3A__www.cms.gov_Medicare_Medicare-2DFee-2Dfor-2DSERVICE-2DPayment_PhysicianFeeSched_Downloads_CMS-2D1503-2DFC-2D2009-5FUtilization-5FData-5FCrosswalked-5Fto-5F2011.zip&d=DwIFA

procedure-year site with the total quantity billed to Medicare per cell. We create Medicare procedure *facility share*, which is the share of the procedure performed in a facility site.

III. Methods

We develop our empirical evidence as follows. First, we confirm that the 2010 price shock affected Medicare prices and examine the extent to which it affected private prices. We then document increased VI for physicians with larger values of $\Delta relprice^{2010}$ after the 2010 price shock. Next, we show that *facility share* increased after the 2010 price shock for procedures with larger values of $\Delta relprice^{2010}$. Finally, we show that physicians are more likely to bill for procedures in facilities after hospitals employ them.

Many of these analyses use procedure-year data. We describe these regression specifications in a general form here and reference specifics as is appropriate later in this paper. Let Y_{pt} be a dependent variable related to prices or quantities. Our central specification is

(6)
$$Y_{pt} = \alpha_p + \tau_t + \sum_{y \in \{2007, 2010\}} \beta_t^y \times \Delta relprice_p^y,$$

where α_p and τ_t are procedure and year fixed effects, respectively. The term β_t^y is the time-varying effect of procedure $\Delta relprice^y$ on the dependent variable for year t (relative to 2009). The y superscript distinguishes between the 2007 and 2010 price shocks. We also replace the year-by-year coefficients to obtain a single pooled coefficient. To do this, we create a gradual phase-in function that takes the values 0.25, 0.5, 0.75, and 1 over the four years that Medicare phased in the price shock:

(7)
$$PI_p^y = \frac{(t + 1 - y)}{4} \mathbf{1}(t \geq y \text{ and } t < y + 4) + \mathbf{1}(t \geq y + 4).$$

The pooled regressions are therefore

(8)
$$Y_{pt} = \alpha_p + \tau_t + \sum_{y \in \{2007, 2010\}} \beta^y \times PI_p^y \times \Delta relprice_p^y.$$

The phase-in function simplifies the interpretation of the coefficient in the pricing specifications. We do not rely upon these pooled specifications for any of our counterfactual analyses.²⁶

g&c=yHIS04HhBraes5BQ9ueu5zKhE7rtNXt_d012z2PA6ws&r=fmaFcVP_tFbqUu_y2g7RFFXQiFesqrtrtBc2RURYyiMjQDcZHSHo1kZ3wExXr-1I&m=sW_rRu8GWoThwfnwCAwn8N3HIriJsURA3R_cbYKAIQ&s=_tryPRzZxSp3OkS8_AbFO6LMRn0_RKg-saX-Rn4Ksik&e=.

²⁶The effect of $\Delta relprice^{2010}$ on Medicare procedure facility share falls from 0.0919 to 0.0662 but remains statistically significant at the 5 percent level if we replace the gradual phase-in function with a post-period indicator.

IV. Results

A. The Effect of the 2010 Price Shock on Prices

This section confirms that the 2010 price shock changed the relative prices for performing procedures in a facility versus non-facility for Medicare and examines whether the 2010 price shock was transmitted to private prices. In particular, we examine the time-varying effect of procedure $\Delta relprice^{2010}$ on both Medicare and private $relprice$. Medicare phased in the prices from the new survey over the four years from 2010 to 2013. If variation in $\Delta relprice^{2010}$ resulted from variation in facility prices, then the time-varying effect of $\Delta relprice^{2010}$ on Medicare $relprice$ should be zero through 2009, 0.25 in 2010, 0.50 in 2011, 0.75 in 2012, and 1.00 in 2013. In fact, most of the variation in $\Delta relprice^{2010}$ is a result of changes in non-facility prices, which appear in both the numerator and denominator. Based on a simple simulation exercise, we determine that if no other price changes are correlated with the 2010 price shock, then the time-varying effect of $\Delta relprice^{2010}$ on $relprice$ will be zero through 2009, 0.48 in 2010, 0.96 in 2011, 1.44 in 2012, and 1.92 in 2013.

Figure 3 plots the time-varying effect of $\Delta relprice^{2010}$ on Medicare's $relprice$.²⁷ To facilitate interpretation of our results, we plot the anticipated coefficient values in black. The estimated coefficients and their 95 percent confidence intervals are presented in red and are both statistically and economically indistinguishable from the anticipated coefficients. The pooled effect of $\Delta relprice^{2010}$ on Medicare $relprice$, which is presented in Table 1, column 1, is statistically significantly different from zero and is economically and statistically indistinguishable from the anticipated coefficient. This suggests there are no other reasons prices changed over our time period that are correlated with but distinct from the price shock. In turn, this is evidence against endogeneity concerns that would operate through the price mechanism or independently affect prices. The same regression illustrates the 2007 price shock also affected prices, albeit with smaller coefficients.

The 2010 price shock reduced many non-facility prices, but had almost no effect on facility prices. Thus, the shock created two distinct effects—a change in the level of non-facility prices and a change in the facility/non-facility price gap. We are unable to distinguish between the two, highly correlated, effects.²⁸

The effect of $\Delta relprice^{2010}$ on private $relprice$ is imprecisely measured (Figure 4 and column 2 of Table 1), which could be interpreted as evidence Medicare's 2010 price shock did not affect private prices. Online Appendix 5 presents additional analyses suggesting a different interpretation. Specifically, the 2010 price shock was transmitted to private non-facility prices, but the effect of 2010 price shock on private facility prices is noisily measured. As a result, so too is the effect on private $relprice$.

²⁷ Online Appendix 5, Figure 1 presents the effect of Medicare procedure ΔPFS^{2010} on Medicare $\ln(PFS_{opt})$.

²⁸ Online Appendix 5, Table 2 contrasts the effect of ΔPFS^{2010} and $\Delta relprice^{2010}$ on Medicare $relprice$. When we include both $\Delta relprice^{2010}$ and ΔPFS^{2010} as explanatory variables in column (3), the coefficient on $\Delta relprice^{2010}$ ceases to be correctly signed, suggesting we are unable to separately identify variation in relative prices and non-facility prices.

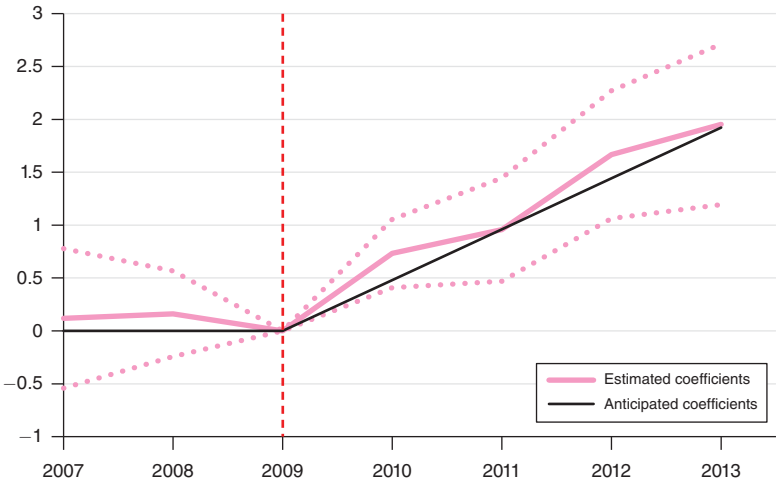


FIGURE 3. TIME-VARYING EFFECT OF PROCEDURE $\Delta relprice^{2010}$ ON MEDICARE $relprice$

Notes: The unit of observation in regression is the procedure-year. Unreported covariates include procedure fixed effects, year fixed effects, and interactions between year and $\Delta relprice^{2007}$. Sampling restrictions are discussed in the text. Medicare $relprice$, $\Delta relprice^{2007}$, and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. Procedures are weighted by 2007 RVUs. Dotted lines represent a 95 percent confidence interval based upon standard errors clustered by procedure.

TABLE 1—EFFECT OF PROCEDURE $\Delta relprice^{2010}$ ON PROCEDURE $relprice$

	(1)	(2)
$\Delta relprice^{2007} \times PI^{2007}$	1.348 (0.148)	1.222 (0.507)
$\Delta relprice^{2010} \times PI^{2010}$	1.980 (0.381)	−1.440 (1.183)
Sample	Medicare	Private
Observations	8,610	4,241

Notes: The unit of observation in regression is the procedure-year. Unreported covariates include procedure and year fixed effects. Sampling restrictions are discussed in the text. Procedure $relprice$, $\Delta relprice^{2007}$, and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. Also, PI^{2007} and PI^{2010} are the gradual phase-in functions described in the text. Procedures are weighted by 2007 RVUs. Standard errors are in parentheses and are clustered by procedure.

Capps, Dranove, and Ody (2018) shows that private insurers follow Medicare’s conventions of (i) allowing hospitals to bill under OPPS for procedures performed by employed physicians and (ii) lowering PFS prices to hospital-employed physicians relative to PFS prices of independent physicians. Given these reimbursement rule conventions, we believe the most natural interpretation of the overall pattern of results is private insurers adopted the 2010 price shock, but that because private facility prices are high, varied, and our sample of them is smaller, we lack the statistical power to precisely measure changes in the gap between private facility and non-facility prices. As we already noted, physician $\Delta relprice^{2010}$ proxies for the effect of the 2010 price shock on Medicare reimbursements, so our identification strategy does not require the 2010 price shock be transmitted to the private sector.

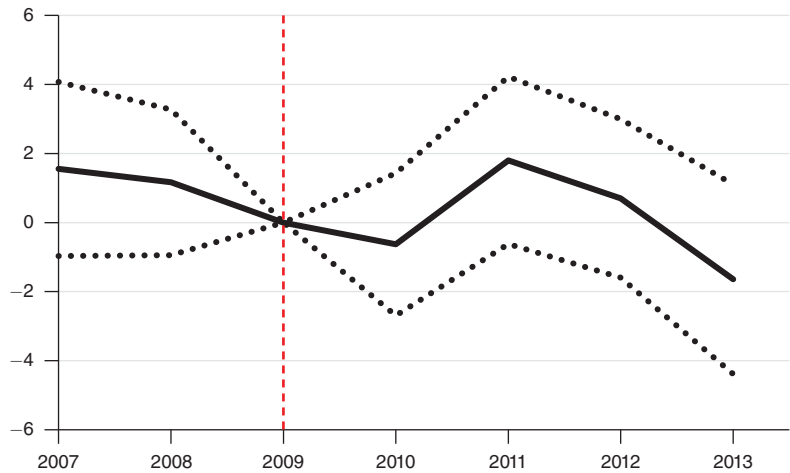


FIGURE 4. TIME-VARYING EFFECT OF PROCEDURE $\Delta relprice^{2010}$ ON PRIVATE $relprice$

Notes: The unit of observation in regression is the procedure-year. Unreported covariates include procedure fixed effects, year fixed effects, and interactions between year and $\Delta relprice^{2007}$. Sampling restrictions are discussed in the text. Private $relprice$, $\Delta relprice^{2007}$, and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. Procedures are weighted by 2007 RVUs. Dotted lines represent a 95 percent confidence interval based upon standard errors clustered by procedure.

B. The Effect of the 2010 Price Shock on Physician VI

This section estimates the effect of the 2010 price shock on hospital/physician VI. We restrict this analysis to physicians who are present in all years from 2007 to 2013 and who had in-sample claims in 2007 for calculating $\Delta relprice^{2010}$.²⁹ The dependent variable VI_{it} indicates whether physician i is vertically integrated in year t . We regress³⁰

(9)
$$VI_{it} = \alpha + \tau_t + \sum_{y \in \{2007, 2010\}} \beta_t^y \times \Delta relprice_i^y.$$

We weigh each observation by the physician’s 2007 RVUs.

Figure 5 presents coefficient estimates of the time-varying effect of $\Delta relprice^{2010}$ on VI. There is a slight upward trend in the coefficients from 2007–2009, followed by a clear break from trend in 2010, which continues until 2012. This trend break indicates that the 2010 price shock affected VI.³¹ Column 1, Table 2 replaces the interactions between $\Delta relprice^{2010}$ and each year with $\Delta relprice^{2010}$ and an

²⁹ We do not include physicians entering after 2007 because we cannot calculate $\Delta relprice^{2010}$ with 2007 data. We also eliminate physicians that exit from the sample. Differential entry and exit of VI will have an effect of procedure site, a point we return to later in this paper. We also drop a small number of physicians that integrate and then disintegrate, although doing so does not substantively affect our results.

³⁰ We do not include physician fixed effects because integration is an absorbing state.

³¹ Online Appendix 2 introduces a more compact method of performing closely related analyses. We introduce this additional format to facilitate comparisons across a larger number of robustness checks.

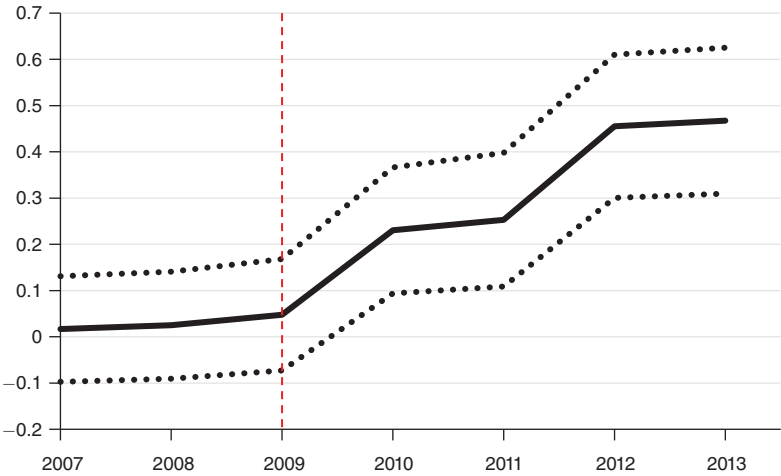


FIGURE 5. TIME-VARYING EFFECT OF PHYSICIAN $\Delta relprice^{2010}$ ON PHYSICIAN VI

Notes: The unit of observation in regression is the physician-year. Unreported covariates include year fixed effects and interactions between year and $\Delta relprice^{2007}$. The sample is restricted to physicians present in all years with in-sample claims in 2007. In this figure, $\Delta relprice^{2007}$ and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. Physicians are weighted by 2007 RVUs. Dotted lines represent a 95 percent confidence interval based upon standard errors clustered by physician.

TABLE 2—EFFECT OF PHYSICIAN $\Delta relprice^{2010}$ ON PHYSICIAN VI

	(1)	(2)	(3)
$\Delta relprice^{2010} \times \mathbf{1}(\text{year} \geq 2010)$	0.322 (0.046)	0.216 (0.068)	0.275 (0.067)
Time fixed effects			
Year	X		
Year-specialty		X	
Year-CBSA		X	
Year-specialty-CBSA			X
Observations	129,234	125,726	124,565

Notes: The unit of observation in regression is the physician-year. Unreported covariates are $\Delta relprice^{2010}$ and interactions between year and $\Delta relprice^{2007}$. Sampling is restricted physicians present in all years with in-sample claims in 2007. In this table, $\Delta relprice^{2007}$ and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. Physicians are weighted by 2007 RVUs. Standard errors are in parentheses and are clustered by physician.

interaction between $\Delta relprice^{2010}$ and a post-period indicator. Columns 2 and 3 of Table 2 control for interactions between the year and some combination of specialty, metro area, and specialty metro area. With more granular time-varying controls, the point estimates become somewhat smaller but remain statistically significant. Given that $\Delta relprice^{2010}$ may be measured with error—and that the treatment was, by design, correlated with specialty—our preferred specification excludes specialty-specific fixed effects.

To gauge the magnitude of this effect, we compare the actual time trend to what we predict would have occurred in the absence of the price shock. Figure 6 shows

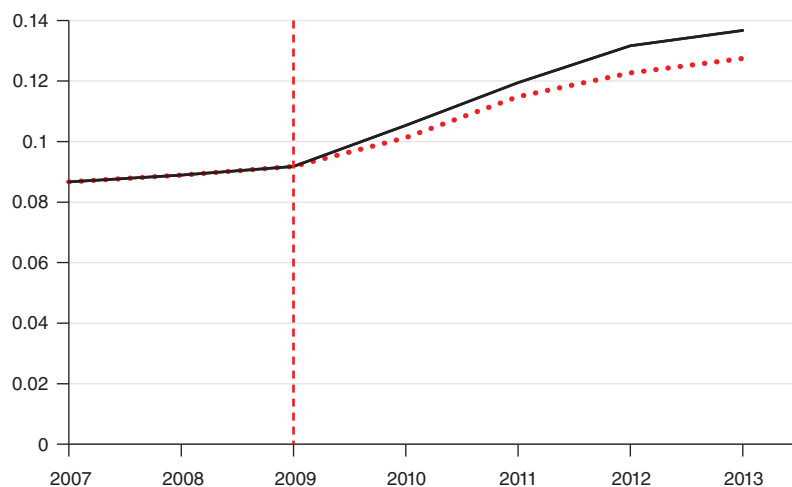


FIGURE 6. ACTUAL PHYSICIAN VI VERSUS COUNTERFACTUAL VI IN ABSENCE OF 2010 PRICE SHOCK

Notes: The counterfactual is based upon the regression in Figure 5. The counterfactual codes years after 2009 so that the effect of $\Delta relprice^{2010}$ is the same as its effect in 2009.

that by 2013, the 2010 price shock had increased VI by 0.9 percentage points or 20 percent of the overall increase from 2009 to 2013.

The results are robust to alternative sampling restrictions, weighting decisions, and definitions of VI, as we show in online Appendix 6. The effect of $\Delta relprice^{2010}$ is similar when we aggregate to the practice level. The relationship between $\Delta relprice^{2010}$ and exit is imprecisely measured; we cannot rule out the possibility that physician exit meaningfully contributed to changes in procedure quantities by treatment site. The effect of $\Delta relprice^{2010}$ on VI remains significant at the 10 percent level when estimated with a Cox proportional hazard model. Finally, VI increased more for physicians in higher quintiles of $\Delta relprice^{2010}$ than for physicians in lower quintiles of $\Delta relprice^{2010}$.

C. The Effect of the 2010 Price Shock on Site

Figure 7 plots the time-varying relationship between procedure $\Delta relprice^{2010}$ and a procedure's facility share. For procedures that became more attractive in a facility because of the 2010 price change, facility share decreases prior to 2010, but increases after 2010. The pattern is qualitatively similar for both Medicare and private facility share, although the magnitudes are larger and the break from trend is cleaner for Medicare facility share.³² If the 2010 price shock corrected for decreases

³² Online Appendix 7, Figure 9 and online Appendix 7, Figure 10 present the time-varying effect of quintiles of procedure $\Delta relprice^{2010}$ on procedure facility share. For both the private and Medicare procedure samples, there are relatively meaningful breaks from trend among procedures in the top quintile of $\Delta relprice^{2010}$. Online Appendix 8, Figure 5 presents results from an identical specification to Figure 7, except without weights. The pattern is qualitatively similar, but at least in part because of a stronger pre-trend the pooled post-period effect is no longer statistically significant.

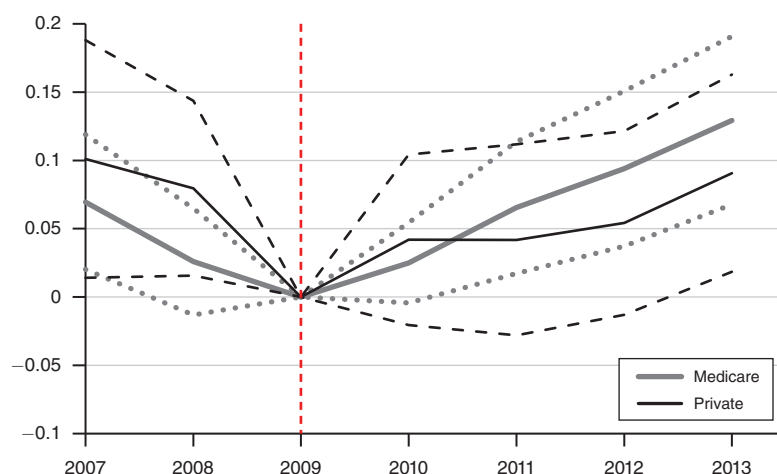


FIGURE 7. TIME-VARYING EFFECT OF PROCEDURE $\Delta relprice^{2010}$ ON PROCEDURE FACILITY SHARE BY PAYER

Notes: The unit of observation in regression is the procedure-year. Unreported covariates include procedure fixed effects, year fixed effects, and interactions between year and $\Delta relprice^{2007}$. Sampling restrictions are discussed in the text. Facility share, $\Delta relprice^{2007}$, and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. Procedures are weighted by 2007 RVUs. Dotted lines represent a 95 percent confidence interval based upon standard errors clustered by procedure.

in non-facility costs that had slowly built up between the years of the old and new surveys and physicians chose sites based in part on those costs, then we would expect this pre-trend pattern.

Table 3 presents pooled versions of the regression results in Figure 7. Panel A, column 1 presents an estimate for Medicare facility share. The magnitude of 0.092 means if a procedure's price was twice as high in a facility relative to a non-facility, then the procedure would be roughly 9 percentage points more likely to be performed in a facility in 2013. To account for the pre-trend in the lags and leads specification, column 2 controls for a linear time trend in $\Delta relprice^{2010}$; the coefficient increases to 0.255, more than twice as large as the baseline estimate. Panel B, column 1 presents an estimate for private facility share. The coefficient for 2013 is statistically significantly different from the coefficient for 2009 in Figure 7, but because of pre-trends, the point estimate in column 1 is small and insignificant. Once we control for the pre-trend in column 2, the coefficient becomes a statistically significant 0.218.

To gauge how large these effects are, we simulate what facility share would have been in the absence of the 2010 price shock.³³ The 2010 price shock increased Medicare procedure facility share by approximately 0.88 percentage points, which is roughly 75 percent of the increase from 2009 to 2013. The 2010 price shock

³³ We base these simulations on the same estimation sample and weighting scheme as in Figure 7. Because of pre-trends in the analyses in Figure 7, we present two counterfactuals, which differ in whether the 2010 price shock is modeled as a break from trend or whether the pre-trend is ignored. This modeling decision affects what the counterfactual facility share is after 2009 in the absence of the price shock. The magnitudes discussed in the text are based on the analyses, which control for a pre-trend.

TABLE 3—EFFECT OF PROCEDURE $\Delta relprice^{2010}$ ON PROCEDURE FACILITY SHARE

	Panel A. Medicare		Panel B. Private	
	(1)	(2)	(1)	(2)
$\Delta relprice^{2007} \times PI^{2007}$	0.002 (0.023)	0.007 (0.025)	−0.034 (0.026)	−0.029 (0.0272)
$\Delta relprice^{2010} \times PI^{2010}$	0.092 (0.038)	0.255 (0.055)	0.006 (0.045)	0.218 (0.102)
$\Delta relprice^{2010} \times \text{year?}$	No	Yes	No	Yes
Observations	8,610	8,610	7,047	7,047

Notes: The unit of observation in regression is the procedure-year. Unreported covariates include procedure and year fixed effects. Sampling restrictions are discussed in the text. Facility, $\Delta relprice^{2007}$, and $\Delta relprice^{2010}$ are censored at the fifth and ninety-fifth percentiles. In this table, PI^{2007} and PI^{2010} are the gradual phase-in functions described in the text. Procedures are weighted by 2007 RVUs. Standard errors are in parentheses and are clustered by procedure.

increased private facility share by about 0.77 percentage points by 2013, nearly as large as the effect for Medicare. Even with the 2010 price shock, private facility share decreases over this same time period.³⁴

An open question is whether the 2010 price shock affected facility share because of substitution across sites of service for the same procedure, substitution within or across sites to related procedures, or whether it decreased non-facility quantities with no offsetting increases to other procedures. Online Appendix 7 illustrates that the 2010 price shock decreased total Medicare procedure quantity, suggesting the effect of procedure $\Delta relprice^{2010}$ on procedure facility share is not driven solely by cross-site substitution. The evidence on the extent of cross-site or cross-procedure substitution is less conclusive, as are the results for private quantities. We estimate, however, that under 20 percent of the increases in Medicare facility share is driven by cross-site substitution.

D. The Effect of Physician Employment on Site

This section shows that hospitals submit more bills for procedures performed by VI physicians than for procedures by independent physicians. Physician *facility share* is the RVU-weighted share of a physician’s in-sample procedures that have an associated hospital charge on the same date. We run a regression of the form

(10) $facilityshare_{it} = \alpha_i + \tau_t + \beta VI_{it}.$

Figure 8 presents lags and leads of the effect of VI on physician *facility share* and illustrates that there is a statistically significant 4.9 percentage point increase in the share of procedures for which hospitals submit a charge post-acquisition. There are two possible explanations for the pattern in Figure 8. Integrating physicians may change billing practices but not change their practice patterns. Alternatively,

³⁴Online Appendix 8, Figure 3 and online Appendix 8, Figure 4 present the effect of the 2010 price shock on Medicare and private facility share, respectively.

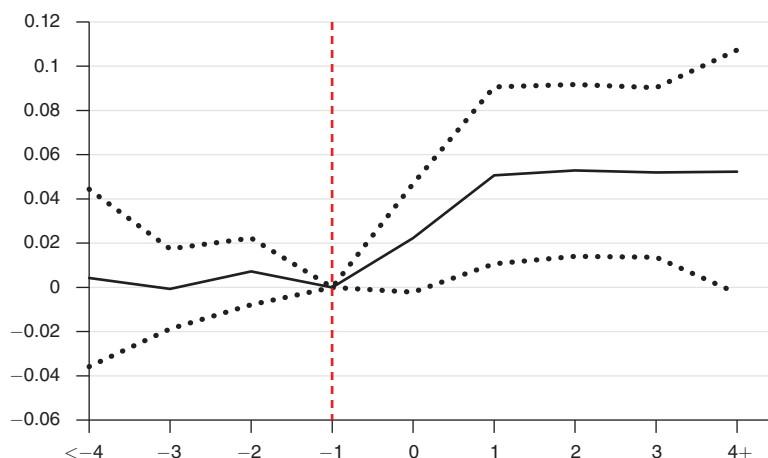


FIGURE 8. EFFECT OF PHYSICIAN VI ON PHYSICIAN FACILITY SHARE

Notes: The unit of observation in regression is the physician-year. Unreported covariates include physician and year fixed effects. The plotted parameter estimates are the effect of lags and leads of physician VI on physician facility share. For consistency, sampling restrictions are identical to Figure 5. Facility share is censored at the fifth and ninety-fifth percentiles. Physicians are weighted by 2007 RVUs. Dotted lines represent a 95 percent confidence interval, where standard errors are clustered so that all physicians in the same practice in all years are in the same cluster.

integrating physicians may treat patients who really require hospital treatment. In the latter case, higher payment levels may be justified. Figure 4 in online Appendix 6 suggests physicians do not change practice patterns post-integration and therefore the increase in hospital charges is likely a result of billing conventions.

E. Does VI Explain the Increase in Facility Share?

The 2010 price shock increased physician VI and procedure facility share. We can combine the effect of the 2010 price shock on VI (presented in Figure 6) with the effect of VI on physician facility share (presented in Figure 8) to estimate how much of the increase in procedure facility share was attributable to physicians who integrated in response to the 2010 price shock. We compare this to the direct estimates of the effect of the 2010 price shock on private procedure facility share (presented in Figure 7). The results suggest physician VI and the resulting change in billing site only explains 5 percent of the 0.77 percentage point effect of the 2010 price shock on private facility share.

There are a number of reasons for this relatively small effect. First, measurement error could be causing attenuation bias.³⁵ Second, it might be that the physicians that integrate because of the 2010 price shock made larger changes in site than integrating physicians in general. Exploratory analysis does not support this

³⁵ There could be measurement error either in our ability to create physician-level treatment measures or in our ability to measure integration in a form that is both necessary and sufficient to allow for the changes in billing practices.

interpretation.³⁶ Furthermore, much of the increase in facility share appears to be a result of decreases in non-facility quantities, rather than substitution to facilities. We are unable to estimate precisely the contribution of physician exit or substitution to alternative procedures in explaining this result. Alternatively, other mechanisms may explain some of the move to facilities. For example, hospitals may have mechanisms to attract independent physicians to practice in a facility. Alternatively, market share of consumers to physicians, rather than of physicians to hospitals could be driving the results. While better understanding these potential mechanisms is a potential avenue for future research, it is beyond the scope of this paper.

V. Conclusion

Vertically integrated delivery systems continue to proliferate and expand. Hospitals employ an increasing share of physicians and physicians perform a growing share of medical procedures in hospital outpatient departments. These changes occurred against the backdrop of insurance reimbursement rules that favor integration. We exploit a plausibly exogenous 2010 update to a survey used to compute physician fees to explore how reimbursement rules may have encouraged vertical integration. We find the 2010 price shock explains approximately 20 percent of the increase in physician-hospital integration during the period 2009–2013 and about 75 percent of the increase in Medicare procedure facility share.

The 2010 price shock exacerbated existing price differentials that favor facilities. We do not extrapolate our findings to estimate what would happen if all differentials disappeared. It is unlikely responses are linear over large changes in relative prices or identical across procedures. Physicians can provide any care in hospital outpatient departments, but the clinical appropriateness of moving the marginal patient from a hospital outpatient department to an office will vary across procedures and depend on the existing facility share.³⁷ While we do not extrapolate to how site of service or physician VI would change in the absence of relative price differentials, we note that because the 2010 price shock was small relative to the existing price differentials that favor facilities, such an effect would be large.

Our results provide empirical support for the claims made by MedPAC (2013) that site-specific reimbursement differentials contribute to the movement toward care that is billed for in facilities. This is a specific example of a more general perverse feature of reimbursing based on a procedure's estimated average costs: health care providers have no incentive to choose lower cost procedures (Clemens, Gottlieb, and Molnár 2017). Furthermore, if the spread between average costs and marginal costs is higher in a facility than non-facility, then current reimbursement schemes incentivize use of facilities. Our results therefore provide some support

³⁶ If physicians induced to integrate by the 2010 price shock were more likely to increase facility share in response to integration, then the effect of physician $\Delta relprice^{2010}$ on physician facility share would be larger than the combination of the effect of $\Delta relprice^{2010}$ on physician VI and of physician VI on facility share (i.e., roughly 0.015). Online Appendix 6, Figure 5 and online Appendix 6, Table 6 illustrate that we are unable to detect any effect of physician $\Delta relprice^{2010}$ on physician facility share directly. Based on the standard errors, we lack the power to detect an effect of roughly 0.015.

³⁷ Responses will also be asymmetric because integrated physicians often sign noncompete clauses with hospitals.

for two policies. The first is a move toward site-neutral reimbursement for procedures that physicians could reasonably perform at either site. The second, which was enacted into law in 2015, limits the ability of newly hospital-employed office-based physicians to bill as if they are part of a hospital outpatient department (Muchmore 2016).

Our research also illustrates that payment rules can fundamentally alter ownership structures. Some “organizational innovations” that occur in the health care system may maximize organization profits, but—because of the mismatch between prices and social value—may not be efficient (Cutler 2010). Indeed, a growing number of studies suggest that ownership in health care markets evolves to maximizing profits in light of reimbursement systems. As already noted, Dafny and Dranove (2009) finds that some hospital systems acquired facilities with unexploited room to upcode. Similar concerns exist in the dialysis industry (Eliason et al. 2018) and with home health agencies (Kim and Norton 2015).

The evidence on ownership and social value in health care is not all somber. Chandra et al. (2016) offers a more positive take on the relationship between performance and allocation, arguing that higher performing facilities gain market share at the expense of lower performing competitors. The distinction between the emphasis in Chandra and the articles cited earlier is that ownership changes can increase profits by lowering costs, increasing demand, or increasing prices. Chandra’s research finds that firms with lower costs or higher quality grow. All of these papers suggest that the market for ownership functions well in the health care sector, insofar as more profitable organizational forms expand. This highlights the need for alternative payment methodologies that align prices and broader measures of value.

Finally, our results should be sobering for supporters of vertical integration, as at least some integration activities are merely efforts to game the system. Hospitals that integrate fundamentally change how health care is delivered and the evidence to date suggests that any systematic efficiencies are thus far elusive. Indeed, most recent studies find that hospital-physician integration leads to higher prices and higher spending (Baker, Bundorf, and Kessler 2014; Robinson and Miller 2014; Neprash et al. 2015; Capps, Dranove, and Ody 2017).³⁸ While systems may eventually discover how to generate efficiencies through coordination and other means, those that integrated to exploit payment rules may cause lasting harm.

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³⁸One exception is Wagner (2016). She finds no effect of VI by primary care physicians on spending or mortality, but finds reductions in adverse events from some conditions treatable in primary care settings.

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