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TRADING SPACES: MEDICARE'S REGULATORY SPILLOVERS ON TREATMENT SETTING FOR NON-MEDICARE PATIENTS

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Trading Spaces: Medicare's Regulatory Spillovers on Treatment Setting for Non-Medicare Patients

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ABSTRACT

Medicare pricing is known to indirectly influence provider prices and care provision for non-Medicare patients; however, Medicare's regulatory externalities beyond fee-setting are less well understood. We study how physicians' outpatient surgery choices for non-Medicare patients responded to Medicare removing a ban on ambulatory surgery center (ASC) use for a specific procedure. Following the rule change, surgeons began reallocating both Medicare and commercially insured patients to ASCs. Specifically, physicians became 70% more likely to use ASCs for the policy-targeted procedure among their non-Medicare patients. These novel findings demonstrate that Medicare rulemaking affects physician behavior beyond the program's statutory scope.

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Medicare covers nearly 60 million individuals and directs roughly a fifth of the United States' more than $3 trillion in annual healthcare spending.[1] Traditional, or fee-for-service (FFS), Medicare's enrollment also eclipses that of most other public or private health insurers. As a dominant payer, Medicare looms large in the US healthcare landscape, with the potential to influence contracting and treatment decisions beyond its insured population and statutory bounds. Indeed, prior research has documented spillover effects from Medicare fee schedules on price negotiations between private insurers and providers as well as on provider behavior toward non-Medicare patient populations.[2]

What is less well studied is how Medicare's *nonprice* regulatory decisions impact the behavior of providers outside of the Medicare market. By nonprice, we mean Medicare rulemaking that is separate from service fee-setting and includes decisions such as which procedures and equipment are covered for Medicare patients, which facilities or providers can administer certain services, whether providers can balance bill, and so on. Recognizing and measuring externalities from such rules is important for formulating optimal Medicare policy and other healthcare regulation. In addition, studying whether and how Medicare's nonprice regulatory decisions spill over onto physicians' non-Medicare treatment decisions has the potential to shed new light on the formation and evolution of physician treatment styles, which is an area of longstanding interest (Phelps 2000; Grytten and Sørensen 2003; Epstein and Nicholson 2009; Currie, MacLeod, and Van Parys 2016; Molitor 2018; Cutler *et al*. 2019)—including how a given physician's treatment

[1] These and related statistics from the Centers for Medicare & Medicaid Services can be found here: https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/nationalhealthexpenddata/nhe-fact-sheet.html.

[2] More specifically, the former characterizes the linkage between the Medicare fee schedule and negotiated service prices in the commercially insured market—e.g., White (2013), Clemens and Gottlieb (2017), Clemens, Gottlieb, and Molnár (2017), Trish *et al*. (2017), and Cooper *et al*. (2019). The latter examines the influence of Medicare payment changes on providers' treatment approaches for the rest of their patient panel—e.g., Sloan, Morrisey, and Valvona (1988), Yip (1998), He and Mellor (2012), and White (2014).

style converges or diverges across patients with different insurance (Newhouse and Marquis 1978; Glied and Graff Zivin 2002; Frank and Zeckhauser 2007).

In this paper, we investigate Medicare's regulatory externalities on physicians' medical decision-making for their non-Medicare (i.e., commercially insured) patients. In January 2008, Medicare reversed a prior regulatory stance that banned a specific surgical procedure from taking place within an ambulatory surgery center (ASC) for FFS Medicare patients. ASCs, also known as outpatient surgery centers or same-day surgery centers, are stand-alone, non-hospital facilities that are typically lower cost treatment setting options for procedures not requiring an inpatient stay. Prior to 2008, Medicare would only pay for laparoscopic cholecystectomy surgeries (i.e., minimally invasive gallbladder removals) if these were administered within a hospital outpatient or inpatient department—effectively prohibiting Medicare cases within ASC settings.

The 2008 policy change by Medicare provides an ideal quasi-experiment to investigate spillovers from Medicare's (nonprice) regulation. As we describe below, the roll-back of Medicare's ban was purely an administrative change. It was not a response to changes in medical technology, perceived patient clinical benefits, or physician preferences. The original Medicare ban existed without a clear evidence-base and did not necessarily align with care delivery parameters stipulated by other payers. The narrow application of the ban (laparoscopic cholecystectomy surgeries) also meant that only surgeons performing this specific operation were plausibly affected by its removal, which generates well-defined treatment and control physician groups. These features of the quasi-experiment, along with the sharp timing of the deregulation event, are useful in disentangling policy effects from underlying trends and allow us to ask whether a change to the permissible service delivery setting for Medicare patients ultimately impacts

physicians' choice of setting for *non-Medicare*, commercially insured patients receiving the same procedure.

As we describe in more detail below, there are several reasons to expect that a physician's decision to use ASCs for her Medicare patients might be jointly made with her decision to use ASCs for some patients with other insurance coverage.[3] This is especially relevant for procedures with moderate complexity where the key physician decision margin is whether to assign any of her lower risk patients to an ASC setting and consequently rely on both ASCs and HOPDs when performing the same procedure for different patients.[4] To help illustrate this possibility, we note an empirical regularity: a physician's pattern of facility utilization for her Medicare outpatient procedures is highly correlated with her pattern of facility utilization for her commercially insured outpatient procedures. In our data (described below) and across all unique physician-procedure combinations in 2007, we observe that 34% of commercial outpatient procedures are performed in both HOPD and ASC settings, and importantly, we see that such a treatment style has a close correspondence within-physician (Figure 1).[5] Conditional on a physician using both delivery setting options for a given Medicare procedure (i.e., 'splitting' her Medicare volume between HOPDs and ASCs), the probability that the same physician also divides her corresponding commercial procedure volume between HOPDs and ASCs is high (88%).[6] Conditional on a

[3] For instance, block scheduling different patients within the same facility (i.e., performing Medicare and non-Medicare surgeries back-to-back) could minimize travel costs between facilities.

[4] In other words, as we detail in the next section, a physician would be highly unlikely to shift all of her patients into an ASC since some portion of her patients would be too high-risk.

[5] Authors' cross-sectional calculation from the universe of outpatient procedure records in Florida during 2007. Full data details are provided in Section III. This subset of outpatient procedures is most likely to be comprised of procedures (e.g., surgeries) that can be safely performed in an ASC for lower risk patients but not for patients with higher risk factors for complications and/or expected greater operative and post-operative resource needs.

[6] We also note that physician decision-making with respect to outpatient procedure facility utilization as well as physicians' behavior as a "splitter" for outpatient procedures and surgeries have been the focus of other recent economics research (e.g., see David and Neuman (2011) and Munnich and Parente (2018)).

physician *not* using both delivery setting options for a given Medicare procedure, the probability that she nonetheless does so for the same procedure when reimbursed by commercial insurers is low (16%). In principle, this within-physician, cross-payer correlation in surgical practice style could entirely reflect physician and patient preferences or the underlying complexity of the procedures with no feedback or spillovers to or from the Medicare program. Yet, in this paper, we show that this is not the case. We find that Medicare rules have a large causal impact on the care delivery setting chosen for non-Medicare patients, holding physicians and procedures fixed.

We establish the spillover effects of Medicare's deregulation change in the universe of outpatient procedure discharge records from Florida from 2005 through 2011. Our analysis focuses on the physician's decision to perform the policy-targeted procedure at both available treatment settings. We first show a sharp uptick in the likelihood of allocating some FFS Medicare laparoscopic cholecystectomy surgeries to ASCs once Medicare removes the ASC ban for these surgeries.[7] The impact is clearly visible in a simple difference-in-differences plot that compares surgeons who perform the procedure to other physicians over the relevant timeframe. This tendency to begin splitting the targeted Medicare surgeries between outpatient delivery settings (i.e., HOPDs and ASCs) is a direct and expected first-order policy effect and is consistent with physicians reoptimizing their choice of setting for Medicare patients after Medicare permits a new procedure-location combination. The physicians responding to the 2008 deregulation decision move roughly a quarter of their total Medicare surgical volume for the targeted procedure into an ASC setting over the following four years.

[7] Throughout, we use Medicare to denote fee-for-service Medicare. The Medicare Advantage (MA) market is also of interest within our conceptual and analytic framework and the MA source of insurance is identifiable in the discharge records. However, on a practical level, the volume of relevant procedures for this group in the early years of our data is low, and especially at the individual physician level. We therefore lack the ability to credibly estimate spillover effects for MA patients in this specific context.

After establishing the direct policy effect, we investigate our spillover effect of interest: physician-level treatment setting choices for *non*-Medicare patients requiring the same surgical procedure. We do so by restricting to non-elderly commercially insured outpatient procedures and again capturing the main result in a simple difference-in-differences plot over time between physicians who perform the surgical procedure targeted by the regulation and physicians who do not. We show a 25% increase over pre-policy levels in the probability of a physician performing some of her *commercially insured* laparoscopic cholecystectomy surgeries at ASCs during the first year of the *Medicare* rule change. The effect grows and stabilizes to a 70% increase by the third post-policy year. The estimate of Medicare's spillover effect is precise and robust to alternative methods for defining the control group. Within supplementary analyses, we examine whether the Medicare deregulation spills over to untargeted procedures performed by affected physicians within the Medicare and commercial markets. We are unable to detect a causal impact along these margins, though some ancillary patterns among a subset of physicians suggest the possibility of more diffuse externalities tied to the narrow Medicare rule change.

Our paper directly contributes to an active literature on the externalities from public health insurance programs for the wider healthcare economy. This includes work on public insurance payments influencing private insurer payments (e.g., White (2013), Clemens and Gottlieb (2017), Clemens, Gottlieb, and Molnár (2017), Trish *et al*. (2017), and Cooper *et al*. (2019)), public insurance payments influencing physician behavior toward other patient groups (Sloan, Morrisey, and Valvona (1988), Yip (1998), He and Mellor (2012), and White (2014)), and public payer reimbursements influencing drug development (Yurukoglu *et al*. 2017), among other outcomes. In

contrast with prior work that has largely focused on administrative pricing,[8] we provide novel evidence of Medicare's own- and cross-market effects from nonprice regulation.

We also view our results as complementing a long literature on physician behavior and decision-making in a multi-payer environment (McGuire and Pauly 1991). These works include within-Medicare spillovers from greater Medicare Advantage penetration (Chernew, DeCicca, and Town 2008; Baicker, Chernew, and Robbins 2013; Baicker and Robbins 2015; Callison 2016) as well as studies of public and private payer demand shocks within the mixed economy for physician services (Garthwaite 2012; Bond and White 2013; Joynt *et al*. 2013, 2015; He, McInerney, and Mellor 2015; McInerney, Mellor, and Sabik 2017; Glied and Hong 2018; Richards and Tello-Trillo 2019; Carey, Miller, and Wherry 2020). Some of this research has documented physician tendencies toward similar treatment styles for patients, regardless of payer (Glied and Graff Zivin 2002), as well as the use of behavioral heuristics and norm following in physician decision-making (Frank and Zeckhauser 2007). Extending this prior literature, our findings indicate that the regulatory environment interacts with physician decision-making even when the regulations do not directly bind. Our work consequently reveals the long reach of Medicare rulemaking and its ability to shape physician behavior and healthcare delivery beyond the statutory scope of the regulation.

[8] Barnett, Olenski, and Sacarny (2020) is a notable exception. This recent study offers evidence on non-price externalities by showing how letters from Medicare warning physicians against overuse of antipsychotic drugs also reduced prescribing to privately insured patients for these same drugs.

I. Background

A. *Physicians and Outpatient Surgery Care*

Absent a regulatory constraint, ASCs directly compete with hospitals for a variety of outpatient procedures (Bian and Morrisey 2007; Courtemanche and Plotzke 2010; Carey, Burgess, and Young 2011; Carey 2017; Whaley and Brown 2018; Baker, Bundorf, and Kessler 2019). Hospitals are medically appropriate for higher risk patients and procedures, but physicians may prefer using ASCs for at least some patients and procedures.[9]

A key institutional feature in this context is that, when permitted by the relevant payer, physicians often divide their patients receiving the same outpatient surgical service between HOPD and ASC delivery settings, rather than operate solely within one. Physicians' decisions to make use of both treatment setting options is likely to be less common for low complexity outpatient procedures (e.g., diagnostic tests like colonoscopies or endoscopies), for which there may be little or no need for the higher intensity and higher resourced HOPD facilities. Likewise, physicians may be less likely to rely on ASCs for certain high-complexity procedures that carry greater risk of adverse events and are therefore best suited for hospital-based delivery. For surgeries of moderate complexity, such as the laparoscopic cholecystectomy procedure we examine, only a subset of patients is likely to be medically appropriate for the lower-intensity ASC setting—making the choice to utilize both treatment settings (i.e., 'split' patients between HOPDs and ASCs) the relevant physician decision-making margin.

[9] Empirical research also supports that ASCs offer equivalent care to HOPDs that is often more convenient and lower cost for patients (Paquette, Smink, and Finlayson 2008; Grisel *et al*. 2009; Munnich and Parente 2014; Weber 2014; Carey 2015; Munnich and Parente 2018; Aouad, Brown, and Whaley 2019; Sood and Whaley 2019), which gives physicians' choice of setting welfare implications for patients as well as earnings implications for these rival outpatient facilities.

The factors that lead physicians to schedule some of their patients at ASCs for a given outpatient surgery are also likely to be common across payers, within the same physician. For example, the ASC might provide physician amenities (such as specialized staffing and administrative support services) as well as preferential scheduling. Physicians may also have heterogeneous beliefs about or concern for how the treatment setting impacts patient convenience and clinical outcomes. Financial incentives could apply as well, at least for the minority of physicians with direct ownership stakes in the ASC industry (Lynk and Longley 2002; David and Neuman 2011; Plotzke and Courtemanche 2011; Dyrda 2017; Munnich *et al*. 2020). Such considerations, along with other idiosyncratic physician factors, might drive a cross-sectional correlation between ASC use for a given procedure type inside and outside of Medicare (as in Figure 1) without any causal spillover from Medicare policy.

However, other factors would imply a joint decision process for physicians, across their Medicare and non-Medicare patients—and hence the possibility of cross-payer spillovers. For example, opportunities to block-schedule patients within the same facility (i.e., perform Medicare and non-Medicare surgeries back-to-back) could minimize travel costs between facilities and perhaps promote more efficient care delivery (e.g., minimize operating room turnover time between patients and/or facilitate better surgical team performance through consistent staffing over the course of the day). Effects could, in principle, operate in the opposite direction as well, via capacity constraints. More specifically, as Medicare patients begin receiving treatment at ASCs, commercially insured patients could be crowded out. With these factors in mind, it is plausible that physicians would consider both payer types (i.e., Medicare and non-Medicare) when deciding to use the ASC option for either. We formalize this potential cross-payer influence in Section II.

B. *Medicare's Rule Change*

Medicare has reimbursed physicians and facilities for procedures performed within ASCs for over three decades. More than 5,000 ASCs are currently operational and Medicare certified across the US, and the ASC industry has annually collected over $4 billion in Medicare revenue during recent years (MedPAC 2019). The associated fee schedule has evolved at different times—see He and Mellor (2012, 2013) and Munnich and Parente (2018) for detailed histories—but importantly, Medicare patients and their physicians are accustomed to care delivered within ASC settings. However, not all procedures for Medicare patients are allowed to take place within an ASC, which provides an opportunity to exploit a targeted Medicare rule change concerning ASCs for our identification strategy.

Effective January 1 2008, Medicare amended its rules to allow laparoscopic cholecystectomy surgeries to be performed at ASCs for Medicare FFS patients for the first time.[10] The decision followed a Government Accountability Office (GAO) study of ASCs mandated by the Medicare Modernization Act (MMA) of 2003 that was completed in November 2006 and laid the basis for the subsequent reforms to the Medicare ASC facility fee schedule. The finalized changes were published in the Federal Register the following November (2007) so that they could be implemented at the start of 2008.[11] Importantly, the pre-2008 refusal to reimburse for this specific procedure performed within an ASC is typically characterized as an administrative

[10] Recall, this surgery is a minimally invasive gallbladder removal. The laparoscopic cholecystectomy technique globally entered mainstream medicine in the mid- to late-1980s and soon became the norm. Its popularity stems from its many advantages over open cholecystectomy surgery, including less postoperative pain, shorter hospital stays, and more rapid recovery. The development and spread of the laparoscopic cholecystectomy technique has even been described as a watershed moment for minimally invasive surgery applied to many other human organs (Polychronidis *et al*. 2008).

[11] Detailed historical information can be found here: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/ASCPayment/downloads/ASC_QAs_03072008.pdf as well as here: https://www.cms.gov/Regulations-and-Guidance/Regulations-and-Policies/QuarterlyProviderUpdates/downloads/cms1392fc.pdf

oversight, rather than a prudent concern for beneficiaries' safety (Meredith 2008; *OR Manager* 2007).[12] For example, among non-Medicare patient populations, laparoscopic cholecystectomy surgeries performed within ASCs had been shown to be equally safe and successful as HOPDs and were associated with lower charges (Paquette *et al*. 2008). In short, the nature and timing of this nationwide policy change was plausibly the result of a GAO study (mandated by Congressional action), rather than changes in the underlying technology, medical science, or physician and patient preferences. We are also able to examine this exogeneity argument empirically below by analyzing how surgeons' ASC use for non-Medicare, commercially insured patients requiring this specific surgery was evolving in the years leading up to the targeted Medicare regulatory change. If treatment setting choices among non-targeted patients were trending toward greater ASC use, this could indicate that Medicare administrators were responding to changing preferences among the relevant physicians or patients, rather than introducing an unanticipated, narrow regulatory change that was independent of broader trends. We show the absence of any such differential pre-trends below.

Table 1 briefly describes the case characteristics for this specific surgery, compared to all other outpatient procedures in our data. Across payer types (i.e., commercially insured and traditional Medicare), laparoscopic cholecystectomy surgery patients tend to be younger, on average, and are more likely to be female. This specific surgery is also more common among non-Medicare populations, with commercial cases outnumbering Medicare cases in our data by 250%.[13] We also note that while commercial insurers may adopt Medicare regulatory positions,

[12] For example, the 2008 decision was not based on recent clinical trial data or technological breakthrough pertaining to the LC technique within ASC settings.

[13] Authors' calculations based on the universe of ambulatory procedure data from Florida (fully described within Section III).

they are not required to. In fact, we observe commercially insured laparoscopic cholecystectomy surgeries taking place within ASCs prior to 2008.[14]

II. Conceptual Model for Public Payer Regulatory Externalities

In order to guide our empirical investigations, we first model how physicians decide whether to perform a given procedure at an ASC for at least some of their patients, with exclusive use of the HOPD setting serving as the outside option. Surgeons are typically multiproduct firms that supply a variety of services (i.e., procedures) to patients. For example, a general surgeon that performs laparoscopic cholecystectomies also typically performs many other procedures—e.g., surgical excisions, colonoscopies, upper endoscopies, hernia repairs, etc. These surgeons also tend to sell the same service to multiple payers (e.g., Medicare, Medicare Advantage, Medicaid, and non-elderly commercial (private) insurers).

We begin by indexing procedure-by-payer combinations as $j \in J$—e.g., spinal injections paid by Medicare or colonoscopies paid by commercial insurance. For the purpose of the model (and aligning with the empirical implementation below), we combine all non-Medicare Advantage and non-Medicaid commercial insurance payers into a single payer grouping.[15]

Next, let R^j indicate whether the payer-procedure combination is permitted in the ASC setting. More precisely, R^j indicates whether the payer will reimburse the facility fee portion of the associated claim if the procedure is performed within an ASC. As previously remarked, Medicare would not pay facility fees for ASC-delivered laparoscopic cholecystectomy (hereafter

[14] As described in Section V, roughly one out of five our analytic sample's policy-exposed surgeons uses ASC settings for commercially insured patients needing this specific surgery prior to the Medicare rule change.

[15] Among ASC firms during our study period, the vast majority of cases belong to two payer types: nonelderly commercial and traditional (FFS) Medicare. Other payers, such as Medicaid, receive vanishingly small shares of ASC output. This is also true outside of Florida and across the US—see Hall *et al*. (2017).

'LC') surgeries prior to 2008, which amounted to a *de facto* ASC ban for this surgical procedure for FFS Medicare patients.

Consider a procedure, like LC surgeries, for which some patients or patient types will always receive care in a HOPD setting, so that a physician's decision to use an ASC for some other patients is equivalent to the decision to divide her caseload across the two treatment settings. We model a physician's discrete choice to perform a procedure at an ASC for at least some of her patients as a function of the reimbursement rule for the payer-procedure combination (R^j), physician preferences, patient preferences, and the physician's extensive margin use of ASC's for other payer-procedure combinations:

$$ASC_i^j = f\left(R^j, \upsilon_i^j, \left\{ASC_i^{-j}\right\}\right) \tag{1}$$

Here, ASC^j is an indicator for whether the physician delivers *any* of her *j*-type services at an ASC, and *i* indexes individual physicians. The term υ_i^j combines all information on the physician's preferences and her patients' characteristics as these relate to providing service *j* at an ASC. Examples of such considerations include the distribution of medical appropriateness for ASC use among the physician's patients, the physician's beliefs about patient convenience of ASCs versus HOPDs, idiosyncratic physician treatment preferences, and so on. We do not further decompose or specify this composite term as it will ultimately be held constant (i.e., differenced out) in the quasi-experiment that we exploit below in the empirical analysis.

Importantly, for explaining the possibility of spillovers from Medicare rulemaking onto the commercially insured patient population, we allow ASC_i^{-j} —the physician's' decision to use

ASCs at all for other payer-procedure combinations (denoted via *–j*)—to enter the discrete choice for procedure *j*. This term allows for spillovers across procedure types and/or payers. For example, it could be that scheduling a given surgery for commercially insured patients at an ASC becomes more attractive once the physician can schedule Medicare patients for the exact same surgery at an ASC. Such interactions, which depend on the physician's choices over *–j,* are distinct from underlying physician preferences over ASC use for procedure *j*, which is captured in υ_i^j.

Because we ultimately investigate what fraction of physicians change behavior by beginning to divide their place of service between ASCs and HOPDs in response to a Medicare policy change, it is useful to aggregate Equation (1) over the population of physicians. We denote the across-physician mean of the ASC indicator function with $\overline{ASC^j}$, where the physician subscript *i* has been removed. This aligns with the empirical exercise below and smooths the discrete choice function, making it differentiable for the purpose of considering comparative statics.

Consider the simple case of just two payer-procedure combinations: *j* denoting a particular procedure paid for by a commercial insurer, and *-j* denoting the *same* procedure paid for by Medicare. The impact of changing R^{-j} (the Medicare reimbursement rule) on $\overline{ASC^j}$ (the provision of the procedure for commercially insured patients) can be expressed as:

$$\frac{\partial \overline{ASC^j}}{\partial R^{-j}} = \frac{\partial \overline{ASC^j}}{\partial \overline{ASC^{-j}}} \times \frac{\partial \overline{ASC^{-j}}}{\partial R^{-j}} \tag{2}$$

In practice, with an appropriate exogenous shock that manipulates R^{-j}, we can estimate $\frac{\partial \overline{ASC^{j}}}{\partial R^{-j}}$ and $\frac{\partial \overline{ASC^{-j}}}{\partial R^{-j}}$, where $j = Commercial \times LC$ and $-j = Medicare \times LC$. We do so below. Conditional on these estimates, $\frac{\partial \overline{ASC^{j}}}{\partial \overline{ASC^{-j}}}$ is pinned down by Equation (2). Recovering $\frac{\partial \overline{ASC^{j}}}{\partial \overline{ASC^{-j}}}$ reveals the extent to which Medicare's regulatory prohibition against ASCs for a certain type of surgery affects the treatment of non-Medicare patients receiving the same procedure. If $\frac{\partial \overline{ASC^{j}}}{\partial \overline{ASC^{-j}}} > 0$, then Medicare newly allowing ASC facilities for service delivery crowds in privately insured (commercial) patients. If $\frac{\partial \overline{ASC^{j}}}{\partial \overline{ASC^{-j}}} < 0$, the opposite would prove true—i.e., Medicare's regulatory decision ultimately crowds out privately insured (commercial) patients. More broadly, a non-zero result for $\frac{\partial \overline{ASC^{j}}}{\partial \overline{ASC^{-j}}}$ indicates that there are linkages that operate across payers to impact physician decision-making for non-targeted payer-procedure combinations.

As previously remarked, quasi-experimental manipulation of R^{-j} is required to identify such spillover effects because observed values of ASC_i^j and ASC_i^{-j} could be correlated within physicians for many reasons, including physician preferences or sorting of patient types across physicians. Given quasi-experimental manipulation of R^{-j}, the key underlying assumption for identifying $\frac{\partial \overline{ASC^{j}}}{\partial \overline{ASC^{-j}}}$ is that there is no direct effect of R^{-j} on $\overline{ASC^{j}}$. We return to this possibility and assess available empirical evidence related to it in Section VI.

Because both payers and procedures vary across the index *j*, Equation (2) implies the possibility of within-physician spillovers across surgery types (within a payer) as well as across

payers (within a surgery type). For example, the expanded ability to schedule a Medicare surgery at an ASC could generate new take-up of ASC use for other Medicare-reimbursed procedure types at ASCs, even without a change in Medicare policy that directly affects these other procedures. This means that a narrow Medicare regulatory change targeting LCs could in theory influence physicians' treatment setting decisions for three broad categories of payer-procedure combinations: 1) non-Medicare LCs 2) Medicare non-LCs and/or 3) non-Medicare non-LCs. For the purposes of the model, we have been assuming that each physician performs every $j \in J$ payer-procedure combination, though in what follows, we use physicians who are not exposed to the regulatory change (i.e., who never perform the Medicare policy-targeted LC surgery) as a control group for measuring the size of spillovers. Additionally, the magnitude of $\frac{\partial \overline{ASC^j}}{\partial \overline{ASC^{-j}}}$ may vary across the specific *j* and *–j* being considered. Our subsequent empirics investigate each of these possibilities and hence the size and reach of the spillover effect from the 2008 Medicare policy change.

Finally, we note that the possibility of $\frac{\partial \overline{ASC^j}}{\partial \overline{ASC^{-j}}}$ being nonzero is consistent with a family of explanations for the spillover mechanism. For instance, it subsumes the possibility that the physician's cost of ASC treatment setting scheduling is falling in the variety of procedures available to be performed at ASCs. It also subsumes a kind of "norms hypothesis" for physician behavior, which argues that tangible and cognitive costs can lead physicians to adopt similar treatment styles for different patients—i.e., limit treatment customization for a given medical problem (Newhouse and Marquis 1978; Glied and Graff Zivin 2002; Frank and Zeckhauser 2007). Applied to our context, forces related to physician norms or coordination costs do not affect the

choice of treatment (i.e., the procedure to be performed) but instead influence where treatment takes place.

III. Empirical Strategy for Own and Spillover Medicare Deregulation Effects

A. *Data*

Our set of analyses leverages the universe of ambulatory (i.e., outpatient) procedure discharge records from the state of Florida, which we obtained from the Florida Agency for Health Care Administration (AHCA). Florida is home to a large share of the nation's Medicare population—3 to 4 million beneficiaries in recent years, which is second only to California.[16]

Although discharge records lack the kind of reimbursement information typically found in claims data—meaning we cannot observe whether and how commercial reimbursement amounts evolve following the Medicare rule change—the discharge records possess the key advantage (for our purposes) of complete and consistent physician longitudinal identifiers across records, payers, and treatment settings. Specifically, the discharge records clearly indicate whether a given ambulatory case was performed within a HOPD or ASC setting and contain the Florida medical license belonging to the physician performing the case.[17] These features, coupled with the ability to observe cases among all payers within the state, allow us to completely track physicians' allocations of procedures across these two treatment settings for our two payer groups of interest:

[16] State-specific Medicare population sizes are available here: https://www.kff.org/medicare/state-indicator/total-medicare-beneficiaries/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D).

[17] We intentionally ignore cases belonging to highly specialized points of care (e.g., lithotripsy centers and cardiac catheterization centers) that are not relevant to our analytic context and research questions. These cases also account for less than 1% of discharges in a typical year.

traditional Medicare and the (non-Medicare) commercially insured.[18] Having these multiple and comprehensive pieces of information—which would typically be unavailable in claims data—is critical to addressing our research question.[19]

Our administrative data span the first quarter of 2005 through the fourth quarter of 2011, which consequently captures ambulatory procedure market activity several years before the Medicare rule change as well as several years after the policy's debut. These detailed records include a rich set of variables, such as patient demographic information and associated diagnosis and procedure codes.[20] The discharge record procedure codes, specifically, are Current Procedure Terminology (CPT) or Health Care Common Procedure Coding System (HCPCS) codes.

In what follows, we exploit these data features to construct a time series of physician behavior that reflects the use of ASC and HOPD treatment settings. In most cases, the unit of analysis is at the physician by procedure by payer by time period level.

B. *Estimation Procedure*

We begin by estimating the first-order (direct) effect of the Medicare ASC regulatory policy change. This is both an important policy response to document in itself and a natural precondition

[18] These are the two payers that makeup the overwhelming majority of outpatient procedure cases, especially for ASCs in our data. Other specific payers (e.g., Medicaid) are vanishingly small components of the typical Florida ASC's payer mix. We also note that nationally more than 80% of ambulatory (outpatient) surgeries are estimated to have either commercial insurance or Medicare as the main payer (Hall *et al*. 2017).

[19] No all-payer claims database exists that covers our period of study (2005-2011) and contains consistent physician identifiers over time. Having this latter element as well as having it available across public and private payers are critical to tracking the physician response that we study.

[20] We also note that 2.9% of the 113,524 commercially insured laparoscopic cholecystectomy surgeries taking place over this time period in Florida report an age of 65 or higher on the discharge record. These could be age reporting errors or reflect the small subset of individuals that either opt to delay Medicare benefits as they continue to work and receive employer-sponsored coverage and/or is ineligible for Medicare benefits. The mean and median age for these specific surgical patients is 45, however. Additionally, Medicare Advantage coverage is separately indicated on the discharge records—making these patients distinct from those with commercial (non-Medicare) coverage.

for certain types of spillover channels from Medicare onto commercial patients—e.g., via convenience complementarities or capacity-constraint-driven crowd out. We then use an analogous approach (fully described next) to estimate the indirect effect of the Medicare deregulation change on treatment setting choices for commercially insured patients.

When estimating the policy's direct and indirect effects, we rely on a difference-in-differences (DD) design. The narrowly targeted nature of the Medicare rule change lends itself to a well-defined treatment versus control group setup. Specifically, we define the treatment group as LC surgeons—that is, surgeons who perform LC procedures—and their LC procedures.[21] We classify a physician as an LC surgeon if she performs at least one LC case for the relevant payer type (i.e., Medicare or commercial insurance) within each half year. We aggregate the quarterly data to the half-year level because procedures can have few or no cases for a given physician-payer combination in a given quarter. For instance, even among our treatment group of LC surgeons, the share of their outpatient procedures made up of LC surgeries is only around 10%.[22] Following these steps, we are left with 165 unique LC surgeons for the Medicare market analyses (i.e., the direct policy effect) and 387 unique LC surgeons for the commercial market analyses (i.e., the indirect or spillover effect) that are observed in each of our 14 half-year periods spanning our 2005-2011 time frame.[23]

[21] Recall, we are using the 'LC' abbreviation as convenient shorthand for laparoscopic cholecystectomy surgeries. We maintain this abbreviation in Sections IV and V as well to clearly demarcate affected and unaffected physicians as well as targeted and untargeted outpatient procedures.

[22] The typical LC surgeon most likely trained as a "general surgeon" during the required post-medical school residency program; therefore, it would be rare to exclusively perform LC surgeries among this group of physicians.

[23] Balance here means that the LC surgeon is performing LC procedures in every single half year increment of the sample period. Physicians inconsistently performing LC procedures are dropped from the analytic sample—i.e., neither included as a treatment or control group observation.

We are interested in whether the Medicare policy change causes some physicians to begin using ASCs for the relevant procedure. We define a surgeon as adopting the "splitter" treatment style in a given half-year if she divides her LC patients between ASC and HOPD settings for a given payer in that half-year. The variable is therefore binary in its construction and is virtually synonymous with extensive margin ASC use for this specific surgery among our treatment group physicians.[24]

We rely on non-LC physicians—that is, physicians who never perform the policy-targeted procedure at any point for any payer in our data—to provide our DD control group. Importantly, it would be inappropriate to include the non-LC procedures of treatment group physicians in our control group because our conceptual framework from Section II suggests that the Medicare policy targeting LCs could affect how LC physicians organize care for their other procedures. We explicitly examine this possibility in Section V. We then use all possible remaining physician-procedure combinations within a payer (i.e., Medicare or commercially insured) to construct analogous time series tuples (physician × procedure × payer × period) that capture the presence or absence of combined ASC and HOPD use at a given point in time. Including all procedures by all non-LC physicians is a natural way to form the control group, given the targeted nature of the Medicare policy change, and has the added benefit of avoiding any arbitrary selection of a specific procedure to serve as the comparison group.

To classify what constitutes a control procedure, we include only the "principle CPT code" (i.e., the primary service the patient is receiving as an outpatient procedure) within the discharge

[24] Only a few (and very low volume) LC surgeons transition from 0% to 100% ASC use for LC patients.

records.[25] This step deliberately avoids including in our estimation any ancillary procedures (e.g., blood tests, imaging tests, or transfusions) that are merely incident to the main outpatient services delivered to patients. Because observations are at the physician × procedure × payer × period level, a control group physician may comprise multiple physician-procedure tuples, if they consistently supply more than one unique procedure for the relevant payer over the 2005 to 2011 period. This is likely since most physicians are multiproduct firms for a given payer. We end up with roughly 7,000 unique physician-procedure combinations (q) within our control group for our analysis of the direct effects within Medicare and approximately 11,000 unique combinations for our analysis of spillover effects on commercially insured patients.

We first estimate a simple pre-/post- DD equation separately for our two main analytic samples (i.e., the Medicare and commercial markets):

$$Splitter_{qt} = \zeta Post_t + \delta\left(\mathbf{1}\left(Post_t\right) \times \mathbf{1}\left(LCSurgeon_q\right)\right) + \theta_q + \varepsilon_{qt} \tag{4}$$

The *Splitter* outcome variable captures our physician treatment style behavior of interest and is binary and payer specific. It is set equal to one when the physician performs a given procedure type within the two treatment setting options (i.e., ASCs and HOPDs) in a given half-year interval. It is otherwise zero. The *Post* variable is equal to one for all half-years after and including the beginning of 2008 (when Medicare removes the ASC ban for LC surgeries). *LCSurgeon* is time-invariant and equal to one for LC surgeons—those directly exposed to the Medicare policy change.

[25] The set of principle CPT code candidates is drawn from the 2007 discharge data. The principle CPT is also a distinct data field in the discharge records (i.e., it is separate from additional CPT code variable columns, which can be used for recording ancillary services incident to the principle procedure performed during the encounter).

We also include a full vector of physician-procedure pair fixed effects (θ), which subsume the *LCSurgeon* main effect.[26] The δ parameter generates the standard two-by-two DD estimate, which summarizes the overall post-period effect from the policy change.

To enhance the flexibility of the model and to allow for examination of pre-trends, we adapt our DD analytic setup to an event study framework:

$$Splitter_{qt} = \sum_{\substack{m=-6 \\ m\neq -1}}^{7} \gamma_m \left(\mathbf{1}\left(t+m\right)\right) + \sum_{\substack{n=-6 \\ n\neq -1}}^{7} \delta_n \left(\mathbf{1}\left(LCSurgeon_q\right) \times \mathbf{1}\left(t+n\right)\right) + \theta_q + \varepsilon_{qt} \quad (5)$$

Equation (5) introduces a vector of half-year indicator variables (γ_m) for our full study period (2005-2011). The omitted, reference time point is the second half of 2007 (t – 1), which immediately precedes the Medicare regulatory change. The series of (δ_n) coefficients allows us to examine the pre-policy (t – 6 through t – 1) trends of LC surgeons relative to the control group. Non-parallel differential pre-trends would suggest a possible violation of the identifying assumption that the treatment and control group outcomes would have evolved similarly in the absence of the regulatory shock to the treatment group. The set of $\left[\delta_t - \delta_{t+7}\right]$ coefficients flexibly allows for dynamics in the policy response over the subsequent 4-year period for the direct (Medicare) and indirect (commercial) analyses.

Finally, our standard errors are clustered at the physician-procedure (q) level throughout the main DD and sensitivity analyses (described in Section IVB). The choice of clustering level is motivated over concerns about standard error under-estimation due to uneven cluster group sizes

[26] Note, for the treatment group (LC surgeons), it is ultimately a physician fixed effect since all of their other (non-LC) procedure activity is deliberately excluded from the analytic sample.

(e.g., see MacKinnon and Webb 2017) that would result from clustering at the higher, physician level. For completeness, we have re-estimated our core DD models clustering at the physician level, rather than the physician-procedure level, and found that the standard error estimates do not depart from our preferred approach until the fourth decimal place. See Appendix Table A1 and Appendix Table A2.

IV. Results for Own and Spillover Deregulation Effects

A. *Main Results*

We begin with the DD results for Medicare's policy effect on care delivery for its own enrollees, where the post-policy differential effect is summarized in a single coefficient (see Equation (4) in Section III). In column 1 of Table 2, we identify a large and highly significant 11-percentage point uptick in the likelihood of surgeons relying on both treatment settings (i.e., ASCs and HOPDs) for their Medicare LC patients. This DD result is the direct effect of the policy change whereby Medicare rulemaking affects the provision of the Medicare-reimbursed service targeted by the regulation (in the expected direction).

Column 2 of Table 2 and Figure 2 display the corresponding event study results using Equation (5), which more flexibly fits the data and allows for examination of pre-trends. For the Medicare (direct) effect of deregulation, the pre-policy coefficients are close to zero in magnitude and never statistically different from it. This is consistent with the pre-2008 Medicare policy amounting to a ban on LCs being performed for its beneficiaries in the ASC setting. With the introduction of the Medicare rule change, however, there is a sharp and precisely estimated 6-8 percentage point uptick in the probability that LC surgeons splitting their Medicare LC patients

across treatment settings within the first post-policy year (i.e., time t and $t + 1$).[27] The policy response grows throughout the post-implementation period, with the effect size nearly twice as large (i.e., a roughly 14 percentage point differential increase) at its peak when compared to the initial year after the deregulation intervention. We therefore interpret the DD result from Table 2 and the corresponding event study results (Table 2 and Figure 2) as offering strong evidence of a direct and presumably intended policy effect: surgeons exposed to the deregulatory change took advantage of the new delivery setting opportunity after the Medicare administrators approved the use of ASC treatment settings.

We now turn to spillover effects. Recall that the samples used in this spillover analysis include only observations for procedures paid for in the non-Medicare (and non-Medicaid) commercially insured market. The treatment group is composed of all LC surgeons consistently observed over our 2005-2011 period. Their non-LC procedures are omitted (and investigated separately below). The control group includes the commercial market procedure × physician observations for physicians never performing an LC surgery. Note that there can be no "direct" effect of the policy in the spillover sample because there is no statutory connection between Medicare's payment policy and the treatment setting choices for non-Medicare patients.

Within column 1 of Table 3, we find a 6.5-percentage point increase in the likelihood of LC physicians using ASCs for some of their commercial payer LC patients—indicative of a spillover effect from the Medicare policy change. The estimate is also precise and translates to a 52% increase over the pre-period propensity to use both surgical setting options for these patients.

Column 2 of Table 3 and Figure 3 display the corresponding flexible, event-study difference-in-differences version of the spillover result, following Equation (5). The figure also

[27] Recall, this difference-in-differences effect is relative to any changes in splitter status among non-LC physicians performing non-LC Medicare procedures.

parallels the direct effect analysis reported in Figure 2. We see no evidence of a differential trend toward adopting a splitter treatment style between our treatment and control groups during the three years we can observe prior to the Medicare rule change ($t - 6$ through $t - 1$). The pre-policy coefficients are close to zero and nowhere near statistically different from zero at conventional levels. The absence of a differential pre-trend prior to the Medicare policy change is consistent with the identifying assumption that the probability of allocating patients to both ASCs and HOPDs for a specific procedure would have continued to evolve in parallel across our treatment and control groups had it not been for the Medicare regulatory intervention in 2008. The differential behavior change for the policy-exposed surgeons begins only in the first post-implementation year, which then stabilizes at an elevated level by $t + 4$ (i.e., the start of 2010).

More specifically, the event-time estimates in Table 3 and Figure 3 reveal that lifting the Medicare ASC prohibition for LC surgeries induced an approximately 3-percentage point increase in the probability that LC surgeons used ASCs and HOPDs for their commercial LC patients by the end of the first deregulation year ($t + 1$), which more than doubled over the next two post-policy years to an 8-9 percentage point positive spillover effect. Compared to the pre-policy prevalence (12.4%) of a splitter treatment style for policy-exposed (treatment group) physicians, the peak effect translates to an approximately 70% relative increase attributable to the Medicare rule change.

In Appendix Figure A1, we decompose the event study results from Figures 2 and 3 by separately estimating a version of Equation (5) for the treatment and control groups in isolation for each payer. Doing so reveals the time series for the outcomes for each of the respective DD groups. Figure A1 shows that the differential changes captured in Figures 2 and 3 are overwhelmingly driven by level changes among our policy exposed surgeons (i.e., the treatment

group). In particular, with respect to the direct effect, Appendix Figure A1 shows event study estimates that are close to zero for the Medicare control group over our full analytic window, and the coefficients are typically a small fraction of the magnitudes found among the Medicare treatment group during the post-policy period. Therefore, the control group, while important in principle, is not in this case differencing-out strong underlying trends. With respect to the spillover effect, the commercial payer control group likewise demonstrates limited trending from 2005-2009, with slight declines in splitter prevalence during 2010 and 2011. Taken together, the time patterns of Figures 2 and 3 mirror each other, consistent with a direct effect of the Medicare policy spilling over onto the commercial market.

B. *Robustness*

Our DD estimation applies relatively few restrictions to the analytic sample, especially with respect to which observations are included in the physician-procedure pairs that make up the control group. However, if an underlying trend in a particular control group procedure were driving the difference-in-differences result, this could be a cause for concern with the strategy. The flat pre- and post-trends in the pooled control group procedures in Appendix Figure A1 indicate that this is unlikely. Nonetheless, for completeness, we evaluate the possibility more systematically here.

To do so, we first repeat our DD estimation for the direct (Medicare) and spillover (commercial) effects by systematically leaving out one of the non-LC procedures from the control group at a time and then re-estimating Equation (4). This process leads to 358 unique DD estimates for our coefficient of interest for the direct Medicare effects and 540 unique DD estimates for our coefficient of interest for the indirect, spillover effects onto the commercial payer market. We also

perform a variant on this re-estimation approach with a randomly drawn set of control observations for each of our payer groups. Specifically, we implement bootstrap draws of a 50% sample (without replacement) of the available non-LC procedures belonging to the relevant payer group and then estimate Equation (4) using this subsample of non-LC control procedures. We repeat this sampling process for 1,000 iterations each for the direct and spillover results.

Figures 4 and 5 display the resulting DD estimate distributions for each exercise stratified by payer type. For Medicare (Figure 4), systematically excluding a control group procedure leaves the DD coefficients largely unchanged—even when the analytic sample sizes change by as much as 10,000 observations in some re-estimations (see Appendix Figure A2). The mass of the distribution in panel (a) of Figure 4 is almost entirely contained within [0.108, 0.112], a tight range around our 11-percentage point estimate (column 1 in Table 2). Likewise, using a randomly drawn subset of control group procedures (panel (b), Figure 4) creates a unimodal distribution of DD estimates around the observed effect from column 1 in Table 2. The analogous robustness exercises for the commercially insured offer an identical pattern in Figure 5. When excluding non-LC procedures one-by-one (panel (a)) or bootstrapping random samples of control procedures (panel (b)), the DD estimates are tightly centered on the estimate from column 1 in Table 3 (i.e., a 6.5-percentage point effect).

The results displayed in Figures 4 and 5 therefore do not suggest that the presence or absence of any particular non-LC procedure in the control group has any meaningful impact on our main findings.

V. Secondary Spillover Effects

A. *Estimation Procedure*

Tables 2 and 3, along with Figures 2 and 3, provide strong evidence that Medicare's 2008 policy change targeting LC surgeries affected the behavior of physicians performing the same surgery for non-Medicare (i.e., commercially insured) patients. However, Section II raised the possibility that the complementarities for physicians could extend beyond the focal (i.e., policy-targeted) procedure. For example, the convenience of scheduling a slate of procedures to be performed at a given ASC (e.g., over the course of an afternoon or entire day), rather than traveling between multiple facilities could influence physicians' willingness to newly allocate some of their untargeted procedures (e.g., tissues biopsies, colonoscopies, endoscopies, hernia repairs, etc.) to ASC treatment settings. Here we empirically test the possibility of "secondary spillovers" from removing the narrow Medicare ban on ASC-delivery for LC surgeries.

To do so, we turn our attention to all non-targeted outpatient procedures—i.e., everything other than LC surgeries. We maintain the same treatment-control designations of physicians as before, and we estimate specifications that parallel Equations (4) and (5) in structure and notation:

$$Y_{it} = \zeta Post_t + \delta\left(\mathbf{1}\left(Post_t\right) \times \mathbf{1}\left(LCSurgeon_i\right)\right) + \lambda_i + \varepsilon_{it} \tag{6}$$

$$Y_{it} = \sum_{\substack{m=-6 \\ m\neq -1}}^{7} \gamma_m \left(\mathbf{1}\left(t+m\right)\right) + \sum_{\substack{n=-6 \\ n\neq -1}}^{7} \delta_n \left(\mathbf{1}\left(LCSurgeon_i\right) \times \mathbf{1}\left(t+n\right)\right) + \lambda_i + \varepsilon_{it} \tag{7}$$

The key difference here is that rather than examining the LC surgeries of LC physicians and excluding their non-LC procedures, we examine their non-LC procedures and exclude their LC procedures. The sample restriction in terms of physicians is exactly the same as above (i.e., the

main spillover analysis in Table 3). To construct the dependent variable, we group together all non-LC procedures within a physician. If a given physician (*i*) in a given half-year (*t*) has a positive case volume for the relevant payer's non-LC procedures within both ASC and HOPD settings, then the physician-by-time period observation is coded as a one and is zero otherwise. Given this construction, observations are at the physician-by-time level, and we use physician fixed effects (λ_i) rather than procedure-physician pair fixed effects (θ_p). Standard errors are clustered at the physician, and regressions are run separately for the two payer types.

We also construct an alternative formulation motivated by the recognition that not all ASCs have the technical capacity to perform laparoscopic surgeries. It is therefore possible that the Medicare policy affected the type of ASC used (in terms of available surgical technology) by encouraging the policy exposed physicians to migrate their non-LC procedures to facilities where LCs can be performed—even if they had already adopted a splitter treatment style for their non-LC procedures prior to 2008. For example, they might have started doing tissue biopsies at a laparoscopy-equipped ASC in place of a different ASC, even though that procedure would not require such equipment. We investigate this possibility by constructing an additional variant on the binary outcome. Specifically, we set this variable equal to one only if the physician performs any non-LC procedures within an ASC that has laparoscopic surgery technology.[28] This second outcome could show secondary spillover effects even if the other outcome does not. The treatment group surgeons could alter the type of ASC that they use for non-LC procedures without changing

[28] We are able to identify ASCs with this technology by leveraging our all-payer universe of outpatient procedures and a list of CPT codes for laparoscopic surgeries (all types) to determine if a given ASC in a given year has the technology. Of note, only 26% of Florida ASCs perform any laparoscopic surgery cases (of any type for any payer) during the 2005-2011 period.

their underlying propensity to simultaneously use ASCs and HOPDs for their Medicare and commercially insured patients.

B. *Secondary Spillover Results*

Table 4 displays the estimates for secondary spillover effects, by payer type. Looking across all four columns in Table 4, we find no evidence that Medicare's targeted policy alters the treatment setting choices for affected physicians' untargeted procedures. The DD estimates are uniformly small in magnitude (less than a percentage point), statistically insignificant, and negatively signed. To put these magnitudes in context of the size of the baseline mean, during the pre-period years (2005-2007) 46% and 57% of LC surgeons divided their non-LC patients' procedures between both outpatient treatment settings for the Medicare and commercial markets, respectively. Similarly, just under half of LC surgeons performed non-LC procedures within ASCs that had laparoscopic surgical capabilities prior to 2008 Medicare rule change.

Appendix Figure A3 offers the corresponding event study difference-in-differences results. There is no clear differential behavior by the policy-exposed (i.e., treatment group) physicians before or after the 2008 policy shock. Coupled with our findings from Section IV, our research design demonstrates a clear direct effect on Medicare utilization of ASCs for the regulation targeted surgery, a clear within-procedure and across-payer (primary) spillover effect from Medicare rulemaking on commercially insured patients needing the same surgery, but no detectable (secondary) spillover effect that extends to other (non-LC) procedures.

C. *Supplementary Descriptive Results*

Before concluding Section V, we produce a more nuanced but necessarily descriptive set of facts for the same outcomes examined in Section VB. Specifically, we plot trends in the two outcomes (per payer type) for three mutually exclusive subsets of the treatment group surgeons: those who began splitting commercial LC procedures across HOPD and ASC settings before the Medicare policy change, those who began doing so only after the policy change, and those who never relied on both treatment settings for commercial LC patients during our sample period. The "never" group captures the largest share (60%) of our treatment group physicians in the data. The remaining 40% is nearly evenly divided between the other two classifications. Having this mutually exclusive categorization of LC surgeons subsequently allows us to narrow our attention to the minority of these physicians who plausibly changed their behavior due to the policy.

With these definitions, we can ask whether the physicians who appear to have responded to the Medicare policy in terms of ASC use for commercial LCs also respond in other ways. Examining the behavior of this subgroup more precisely may be informative but requires more subtle attention to interpretation because we are essentially conditioning on the dependent variable from our primary spillover analysis.

Figures 6 and 7 plot the trends in the outcomes reported in Table 4 for each of these three physician subgroups according to payer type. In each panel of Figure 6, surgeons splitting their commercial LC provision in the pre-period have high rates of doing likewise for their non-LC procedures, and this remains level across the 2008 policy change. Similarly, surgeons who never split their commercial LCs consistently tend to not do so for other (non-LC) commercial and Medicare procedures. Unremarkable trends (with similar level differences) are also seen for these two treated physician subgroups when examining their propensity to have a non-zero amount of

non-LC procedures performed in ASCs equipped with laparoscopic surgical technology (Figure 7).

The more interesting patterns in Figures 6 and 7 belong to the subgroup of surgeons that are newly using both HOPD and ASC treatment settings for their commercial LC patients once the Medicare deregulation event has taken place. Their probability of using both ASCs and HOPDs for non-LC procedures increases over time, with the most dramatic increases following the Medicare rule change (Figure 6). A similar trend change is evident for the proportion using ASCs with laparoscopic technology for their non-LC procedures (Figure 7). These descriptive patterns could be because the rule change altered their decision making on treatment setting for non-LC procedures as a secondary spillover effect, or it could be because the physicians who ultimately responded to the rule change (reflected in our causal estimates in Tables 2 and 3) were disproportionately drawn from physicians who were closer to the threshold for initiating ASC use for many of their services. It is not possible to distinguish between explanations in these data, but it does raise the possibility of more diffuse spillovers beyond the procedure narrowly targeted by Medicare's regulatory change.[29]

VI. Discussion

It is well-established that the Medicare public insurance program is an influential force within the US healthcare system, affecting private medical markets in a variety of ways. Empirical attention to Medicare spillover effects has largely been devoted to provider responses to changes in Medicare financial incentives and to commercial plan price schedules for provider services. We

[29] For example, it is possible that a regulatory shock that applied to a more common procedure and/or a larger share of physicians could generate a detectable effect along these lines—something future, related research may wish to consider.

examine a related but distinct question, regarding the capability of Medicare rulemaking (in this case, a prohibition) to distort care delivery for non-Medicare patients.

We show that surgeons performing laparoscopic cholecystectomy procedures are sharply more likely to divide their relevant Medicare patients between ASCs and HOPDs once the ASC-delivery ban is lifted in 2008, with a growing effect over the subsequent three years. The adoption of this treatment style is indicative of physicians being aware of the Medicare regulatory reversal and altering their treatment setting choices for beneficiaries in response to it. When examining the total number of policy-targeted procedures performed within ASCs by physicians responding to the Medicare rule change in our analytic sample, we find that they shift 25% of their surgical volume into an ASC over the 2008-2011 period.[30] Importantly, each outpatient procedure treatment setting substitution made for Medicare beneficiaries (i.e., exchanging the HOPD option for ASC delivery) reduces financial outlays for the public insurer since, by statute, Medicare caps ASC facility payments at 59% of the HOPD rate for an identical procedure.[31]

Our key contribution, however, is demonstrating a Medicare regulation externality for the commercially insured market. The Medicare rule change crowds in (rather than crowds out) commercial laparoscopic cholecystectomy surgeries performed in ASCs, with affected physicians becoming up to 70% more likely to simultaneously use both treatment setting options for their commercial patients needing the procedure shortly after the procedure-specific Medicare policy is implemented. The descriptive data in Section VC further suggest that the subset of our treatment

[30] A similar calculation is not possible for the commercial laparoscopic cholecystectomy case allocations since we cannot cleanly separate 'policy compliers'—meaning the specific surgeons that began dividing their commercial procedures between settings *because* of the Medicare policy change—from individual surgeons that eventually would have adopted this behavior even in the absence of the Medicare policy shock. In other words, Table 3 and Figure 3 are identifying aggregate, intent-to-treat effects for the relevant physician population (i.e., LC surgeons).

[31] Physicians are paid the same amount for performing the procedure, irrespective of using a HOPD or ASC setting.

group physicians newly adopting ASC use for some patients during the post-policy period may have altered their treatment setting decisions for untargeted procedures in conjunction. These physician behavior changes align with the cross-payer complementarity interpretation and reveal restrained ASC use for non-Medicare patients when Medicare imposes targeted restrictions on these facilities.[32]

That said, another plausible and not mutually exclusive explanation for our findings is that commercial insurers voluntarily adopt the regulatory stance of Medicare, first disallowing reimbursement for the relevant procedure at ASCs and then allowing it after January 2008. Complementarities and convenience explanations rely on physician agency; however, 'rule following' would be under the control of private insurers. Adapting the rule following concept to the notation of our physician discrete choice model (Section II), the binary decision to begin dividing a specific commercial surgery between HOPDs and ASCs for physician (*i*) could be represented as $ASC_i^j = f\left(R^j\left(R^{-j}\right), \upsilon_i^j, \left\{ASC_i^{-j}\right\}\right)$, where $R^j\left(R^{-j}\right)$ applied to our context would allow for the possibility that the commercial payer sets its rules in response to Medicare's rules. This is in contrast to the earlier formulation, in which the rule (R^{-j})adopted by Medicare entered only indirectly, via its effects on the physician's treatment style for the other payer-procedure combination (*–j*). Such rule following could be driven by contracting efficiencies (i.e., simply borrowing from the Medicare regulatory apparatus) and/or perceived increased liability risk from steering enrollees to treatment settings explicitly forbidden by a dominant payer. In either circumstance, a reversal of the targeted ASC ban by Medicare in 2008 would then be the impetus

[32] We also note that there is no market expansion within any payer group for laparoscopic cholecystectomy surgeries following the Medicare policy change (Appendix Figure A4). This is not surprising since this is an invasive treatment for an acute medical condition.

for a contemporaneous, similar rule change among commercial insurers—akin to Medicare price following documented elsewhere (White 2013; Clemens and Gottlieb 2017; Clemens, Gottlieb, and Molnár 2017; Trish *et al*. 2017; Cooper *et al*. 2019).[33] For these reasons, coverage—and hence noncoverage—alignment between public and private insurers with respect to where a given surgery can be performed seems plausible a priori.

In principle, a test of whether policy-exposed physicians who *never* treat Medicare patients with the targeted procedure still change behavior for their commercial patients could help differentiate between physician-driven complementarities versus insurer-driven rule following explanations. Complementarities between Medicare and non-Medicare treatment decisions cannot exist among surgeons that do not participate in the Medicare market. In practice, none of our treatment group physicians in our analytic sample have zero Medicare business for the affected procedure, rendering such a falsification exercise infeasible.[34]

In Appendix B, we take a different approach. We leverage a supplementary claims-level database (Marketscan) of more than 640,000 laparoscopic cholecystectomy surgeries paid for by employer-sponsored health insurers across the US from 2005 to 2012. These data, in which individual carriers and plans are separately identifiable, offer no indication that carriers or plans newly permit ASC delivery for this specific surgery after Medicare's 2008 rule change. Further physician-level analyses using the Florida discharge data and focusing on post-policy

[33] Related evidence exists for commercial and public insurer interdependence tied to evaluations and coverage determinations for advancements in care delivery and medical technology (e.g., see Garber 2001; Chambers *et al*. 2015). Examples also exist of patient advocacy efforts centered around securing Medicare coverage for a specific treatment in order to spur commercial coverage of the same treatment for the nonelderly population (e.g., see Kaiser Health News 2019), and previous research even posited that commercial payers might eschew ASC-delivery for laparoscopic cholecystectomies, specifically, due to Medicare's pre-2008 regulatory stance and the implied safety concerns (see Paquette *et al*. 2008).

[34] In other words, 100% of the surgeons in our analytic sample pertaining to the spillover (commercial payer) analyses have non-zero Medicare laparoscopic cholecystectomy surgeries at some point during our study period.

concordance/discordance in ASC use within the same physician performing the surgery for Medicare and commercial patients also reinforces the complementarities interpretation (Appendix B). In short, we fail to find any empirical evidence supporting a rule-following interpretation; the evidence instead suggests that the direct result (Figure 2) and the spillover result (Figure 3) are driven by the same physicians.[35]

Irrespective of the underlying mechanism or mechanisms in play, we offer novel evidence of substantive spillover effects on physician behavior from regulatory decisions made by the Medicare program. Restrictions imposed by the public insurer are capable of limiting treatment setting options for Medicare and non-Medicare patients alike, which may be at odds with non-Medicare patients and payers underlying preferences. Our findings also shed light on an important, but underexplored determinant of physician practice patterns and treatment styles: nonprice public insurer regulations. Such externalities deserve greater attention as future Medicare policy debates unfold and are likely to become more prevalent as the Medicare program continues to adjust regulatory parameters tied to a variety of outpatient care delivery contexts in order to promote more convenient and lower cost treatment options for Medicare beneficiaries—e.g., proposed changes to the Medicare "inpatient only" (IPO) list and related ASC permissions.[36] While Medicare rulemaking does not explicitly account for externalities on non-Medicare patients, our findings suggest that effects on other payer groups are significant and could influence the overall costs and benefits of such contemporary policy decisions.

[35] However, we acknowledge that we cannot definitively exclude the possibility of a rule-following mechanism.

[36] See Meyer (2017) and Brady (2020), for example. Related and additional information from the Centers for Medicare & Medicaid Services (CMS) on the CY 2021 Medicare Hospital Outpatient Prospective Payment System and Ambulatory Surgical Center Payment System Final Rule (CMS-1736-FC) can be found here: https://www.cms.gov/newsroom/fact-sheets/cy-2021-medicare-hospital-outpatient-prospective-payment-system-and-ambulatory-surgical-center-0.

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MAIN RESULTS

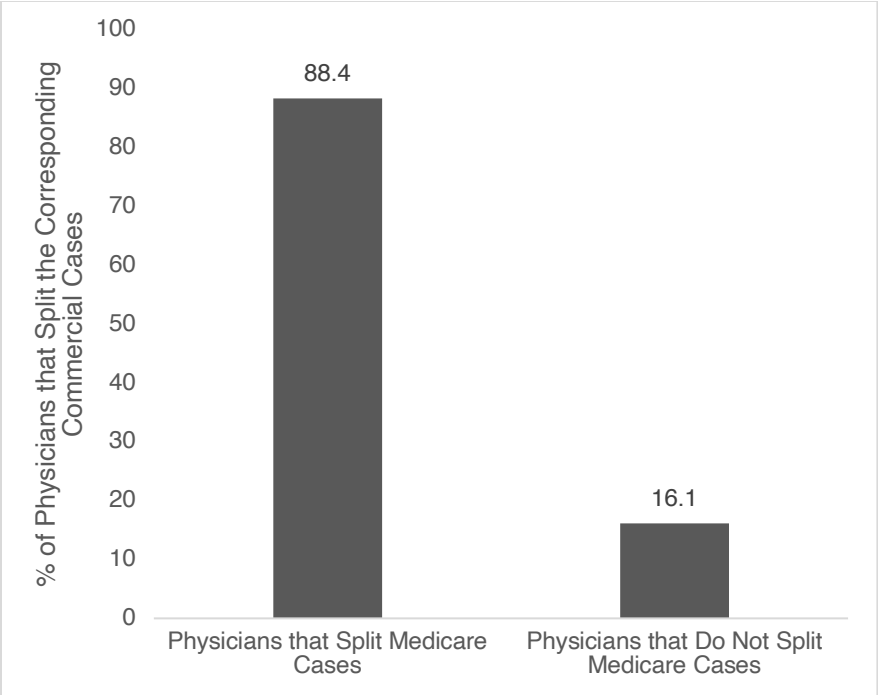


FIGURE 1. CROSS-SECTIONAL CORRESPONDENCE IN SPLITTING CASES BETWEEN ASCs and HOPDs WITHIN-PHYSICIANS, ACROSS THEIR MEDICARE AND COMMERCIAL PATIENTS

Notes: The data are from the universe of ambulatory procedure discharge records in Florida, and observations are at the physician-by-procedure level. Splitting is defined as having positive volume at both ASC and HOPD treatment settings for the physician-procedure pair. The data are restricted to 2007 and principle procedures recorded in the discharge records.

TABLE 1—SUMMARY STATS BY PROCEDURE AND PAYER TYPE

	Laparoscopic Cholecystectomy		All Other Procedures	
	Commercial	Medicare	Commercial	Medicare
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age	44.8 (12.6)	69.3 (10.8)	48.8 (16.7)	72.8 (10.2)
Number of Comorbidities	2.1 (2.2)	4.1 (2.8)	1.6 (1.9)	2.0 (2.5)
	(%)	(%)	(%)	(%)
Female	77.5	66.4	57.6	55.0
White	77.3	85.8	76.3	85.8
N	113,524	32,201	9,242,328	7,200,586

Notes: Summary statistics include all ambulatory (outpatient) procedural discharge records from Florida during the 2005-2011 period. The data are stratified by payer type (i.e., Commercial versus Medicare) but not setting type (i.e., ASC versus HOPD). The commercial payer group excludes Medicare Advantage, and the Medicare payer group is restricted to traditional (fee-for-service) Medicare patients. Examples of highly common, non-LC outpatient procedures include: cataract removals, colonoscopies, endoscopies, hernia repairs, skin biopsies, and spinal injections.

TABLE 2—DIFF-IN-DIFF ESTIMATES FOR THE DIRECT EFFECT OF MEDICARE REGULATION ON THE LIKELIHOOD OF USING BOTH ASC AND HOPD TREATMENT SETTINGS FOR MEDICARE PATIENTS

	Pr(Splitter)	**Pr(Splitter)**
	(1)	(2)
Post × LC Surgeon	0.110***	
	(0.019)	
($t-6$) × LC Surgeon		–0.024
		(0.014)
($t-5$) × LC Surgeon		–0.006
		(0.015)
($t-4$) × LC Surgeon		–0.013
		(0.015)
($t-3$) × LC Surgeon		–0.002
		(0.014)
($t-2$) × LC Surgeon		0.001
		(0.013)
($t+0$) × LC Surgeon		0.057**
		(0.023)
($t+1$) × LC Surgeon		0.077***
		(0.025)
($t+2$) × LC Surgeon		0.100***
		(0.026)
($t+3$) × LC Surgeon		0.094***
		(0.029)
($t+4$) × LC Surgeon		0.119***
		(0.026)
($t+5$) × LC Surgeon		0.143***
		(0.029)
($t+6$) × LC Surgeon		0.094***
		(0.025)
($t+7$) × LC Surgeon		0.144***
		(0.029)
Physician-Procedure FE	Yes	Yes
Half-Year FE	No	Yes
Unique Physician-Procedure Pairs	7,512	7,512
Observations (N)	105,168	105,168

Notes: "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings to their Medicare patients. It is effectively synonymous with the extensive margin ASC use for the LC surgeons in our context. "LC Surgeon" is our treatment group (i.e., laparoscopic cholecystectomy surgeons). The control group is composed of all provider-procedure combinations among non-LC physicians observed over our analytic window.

** P value at 0.05 *** P value at 0.01, standard errors clustered at the physician-procedure level

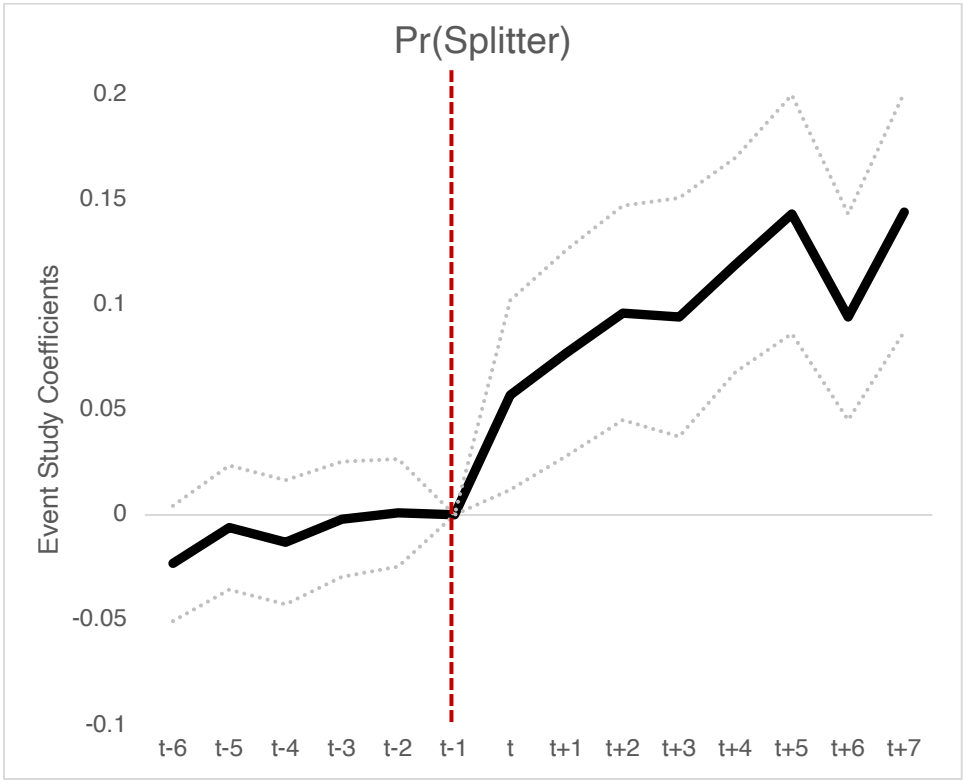


FIGURE 2. DIRECT EFFECT OF MEDICARE POLICY CHANGE THAT ALLOWED LC SURGERIES IN ASC SETTINGS

Notes: The treatment group is all LC surgeons consistently observed over our 2005-2011 period. "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings. It is effectively synonymous with the extensive margin ASC use for the LC surgeons in our context. The control group is composed of all provider-procedure combinations among non-LC physicians observed over our analytic window. Time periods are in half-year increments. The variables are constructed based only on traditional Medicare (i.e., fee-for-service) cases for the physicians in the sample. N = 105,168, unique provider-procedure fixed effects = 7,512.

TABLE 3—DIFF-IN-DIFF ESTIMATES FOR THE SPILLOVER EFFECT OF MEDICARE REGULATION ON THE LIKELIHOOD OF USING BOTH ASC AND HOPD TREATMENT SETTINGS FOR COMMERCIAL PATIENTS

	Pr(Splitter)	**Pr(Splitter)**
	(1)	(2)
Post × LC Surgeon	0.065***	
	(0.013)	
($t-6$) × LC Surgeon		–0.008
		(0.017)
($t-5$) × LC Surgeon		0.006
		(0.018)
($t-4$) × LC Surgeon		0.005
		(0.016)
($t-3$) × LC Surgeon		–0.014
		(0.016)
($t-2$) × LC Surgeon		0.005
		(0.014)
($t+0$) × LC Surgeon		0.015
		(0.013)
($t+1$) × LC Surgeon		0.036**
		(0.016)
($t+2$) × LC Surgeon		0.051***
		(0.016)
($t+3$) × LC Surgeon		0.063***
		(0.018)
($t+4$) × LC Surgeon		0.083***
		(0.019)
($t+5$) × LC Surgeon		0.089***
		(0.020)
($t+6$) × LC Surgeon		0.088***
		(0.020)
($t+7$) × LC Surgeon		0.088***
		(0.021)
Physician-Procedure FE	Yes	Yes
Half-Year FE	No	Yes
Unique Physician-Procedure Pairs	11,465	11,465
Observations (N)	160,510	160,510

Notes: "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings to their commercially insured patients. It is effectively synonymous with the extensive margin ASC use for the LC surgeons in our context. "LC Surgeon" is our treatment group (i.e., laparoscopic cholecystectomy surgeons). The control group is composed of all provider-procedure combinations among non-LC physicians observed over our analytic window. During the pre-period, the splitter prevalence rate for LC surgeons and LC commercial cases in our analytic sample is 12.4%.
** P value at 0.05 *** P value at 0.01, standard errors clustered at the physician-procedure level

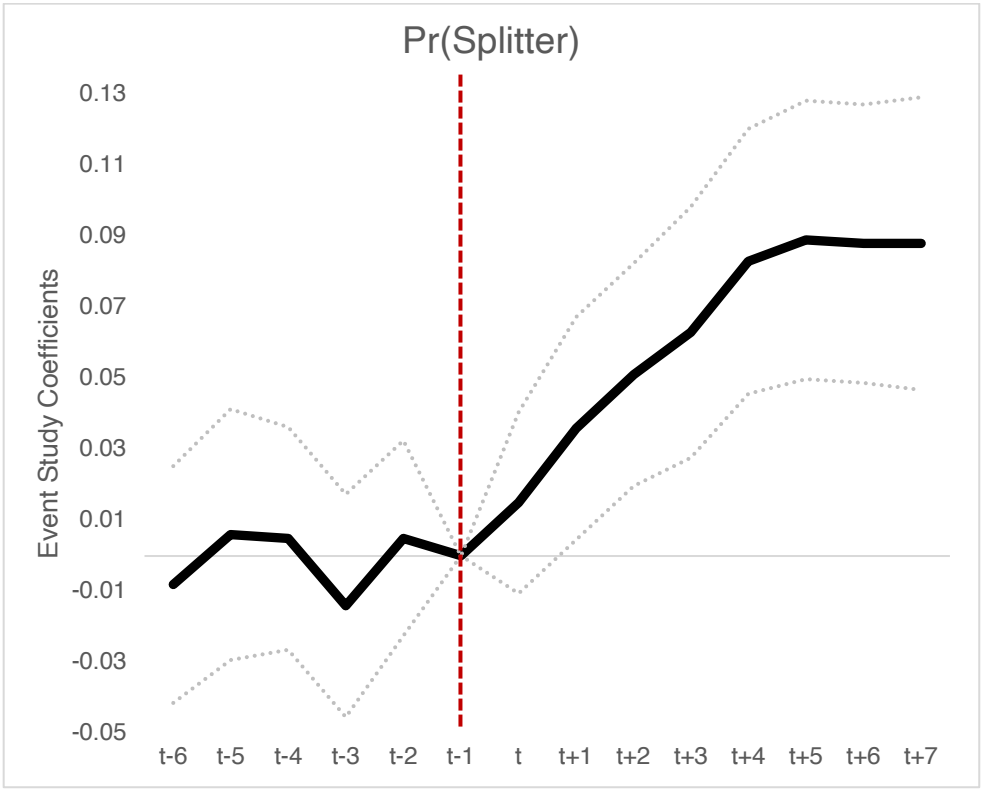
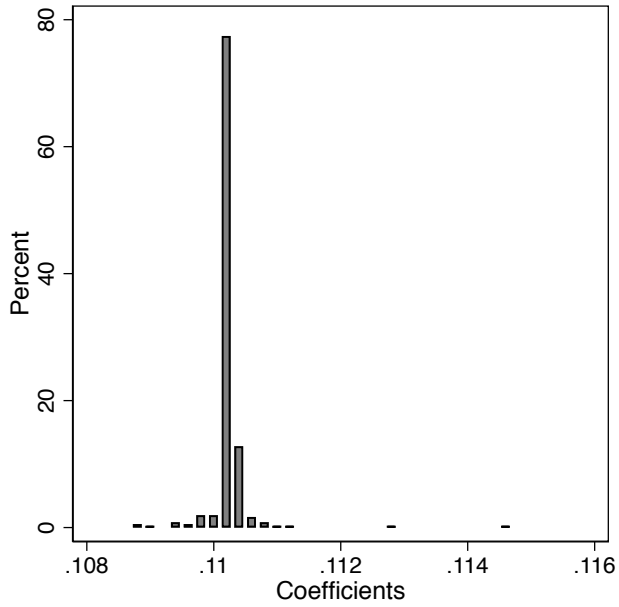
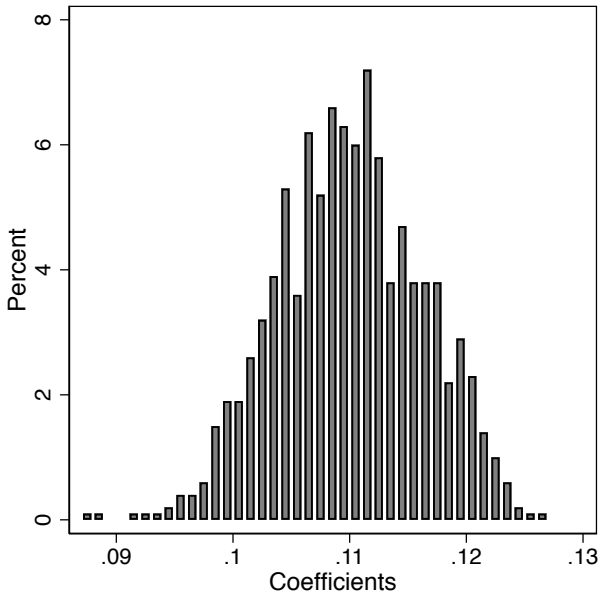


FIGURE 3. SPILLOVER EFFECT OF MEDICARE POLICY CHANGE FOR NON-MEDICARE LC PATIENTS

Notes: The treatment group is all LC surgeons consistently observed over our 2005-2011 period. "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings. It is effectively synonymous with the extensive margin ASC use for the LC surgeons in our context. The control group is composed of all provider-procedure combinations among non-LC physicians observed over our analytic window. Time periods are in half-year increments. The variables are constructed based on only commercially insured (i.e., private, non-Medicare payer) cases for the physicians in the sample. N = 160,510, unique provider-procedure fixed effects = 11,465. During the pre-period, the splitter prevalence rate for LC surgeons and LC cases in our analytic sample is 12.4%.



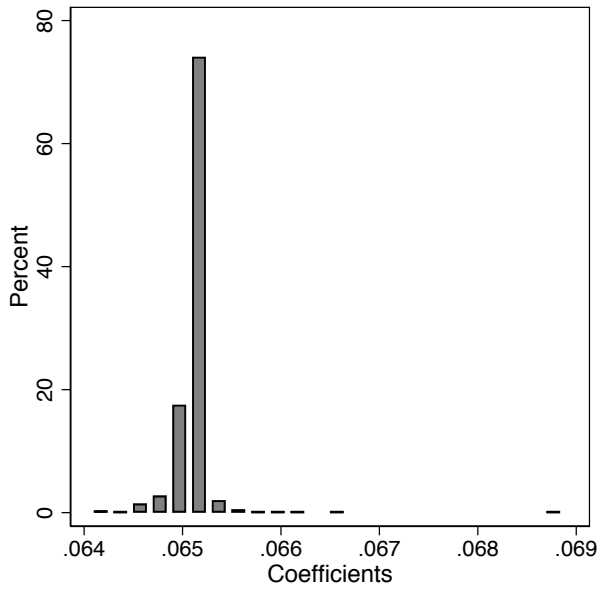
(a) Systematically Excluding One Control Group Per Iteration



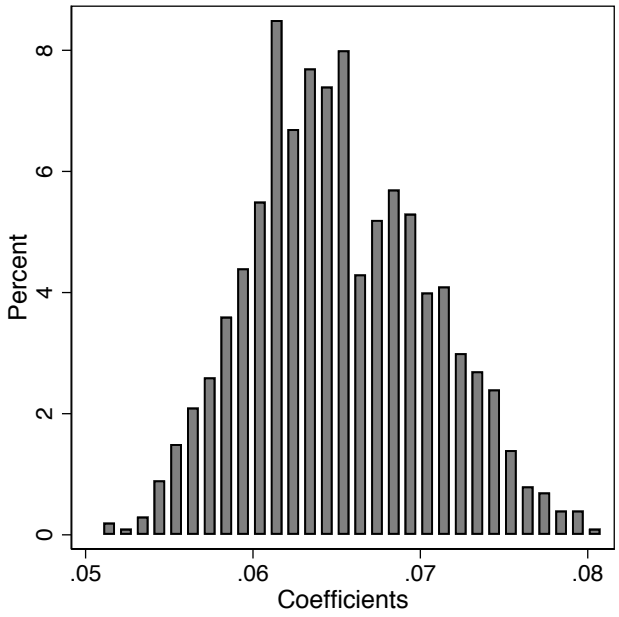
(b) Randomly Drawn Control Groups: 1000 Iterations

FIGURE 4. ROBUSTNESS CHECKS AGAINST ALTERNATIVE CONTROL GROUPS FOR THE DIRECT (MEDICARE) DD EFFECT

Notes: Panel A represents 358 re-estimations for the direct effect on LC Surgeons' probability of splitting Medicare LC cases between ASC and HOPD settings. Control group procedures are dropped one-by-one across the iterations. Panel B includes the DD estimates for 1,000 iterations of a randomly drawn 50% control group of non-LC principle procedures



(a) Systematically Excluding One Control Group Per Iteration



(b) Randomly Drawn Control Groups: 1000 Iterations

FIGURE 5. ROBUSTNESS CHECKS AGAINST ALTERNATIVE CONTROL GROUPS FOR THE SPILLOVER (COMMERCIAL) DD EFFECT

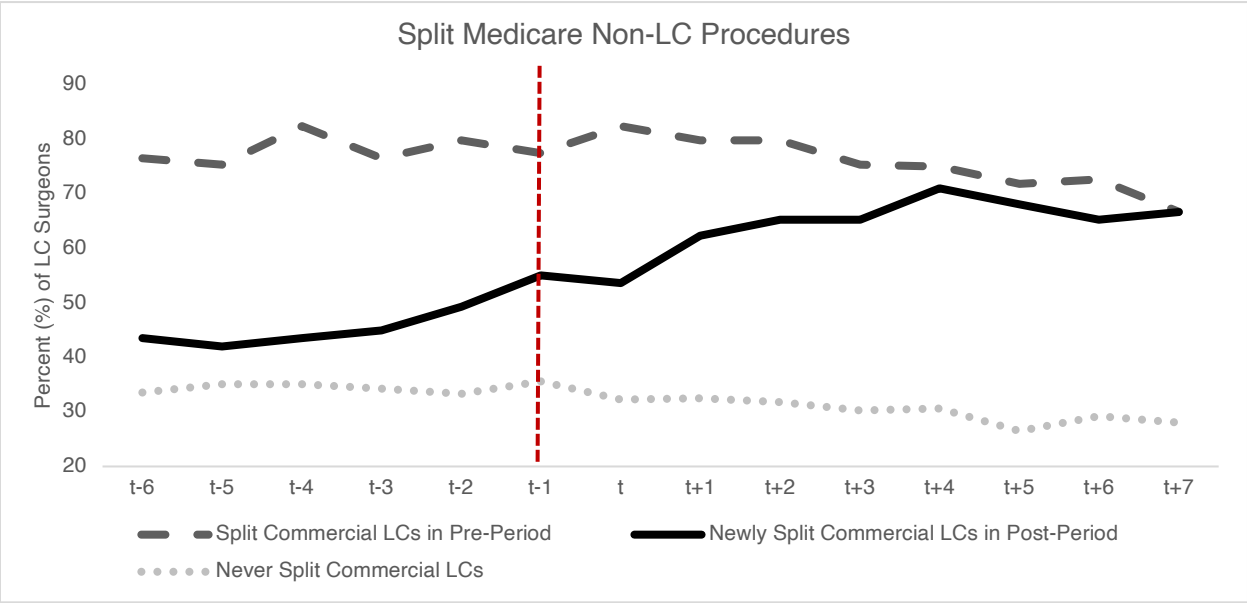
Notes: Panel A represent 540 re-estimations for the spillover effect on LC Surgeons' probability of splitting commercial payer LC cases between ASC and HOPD settings. Control group procedures are dropped one-by-one across the iterations. Panel B includes the DD estimates for 1,000 iterations of a randomly drawn 50% control group of non-LC principle procedures.

TABLE 4—DIFF-IN-DIFF ESTIMATES FOR MEDICARE REGULATION SPILLOVER EFFECTS ON UNTARGETED (NON-LC) PROCEDURES

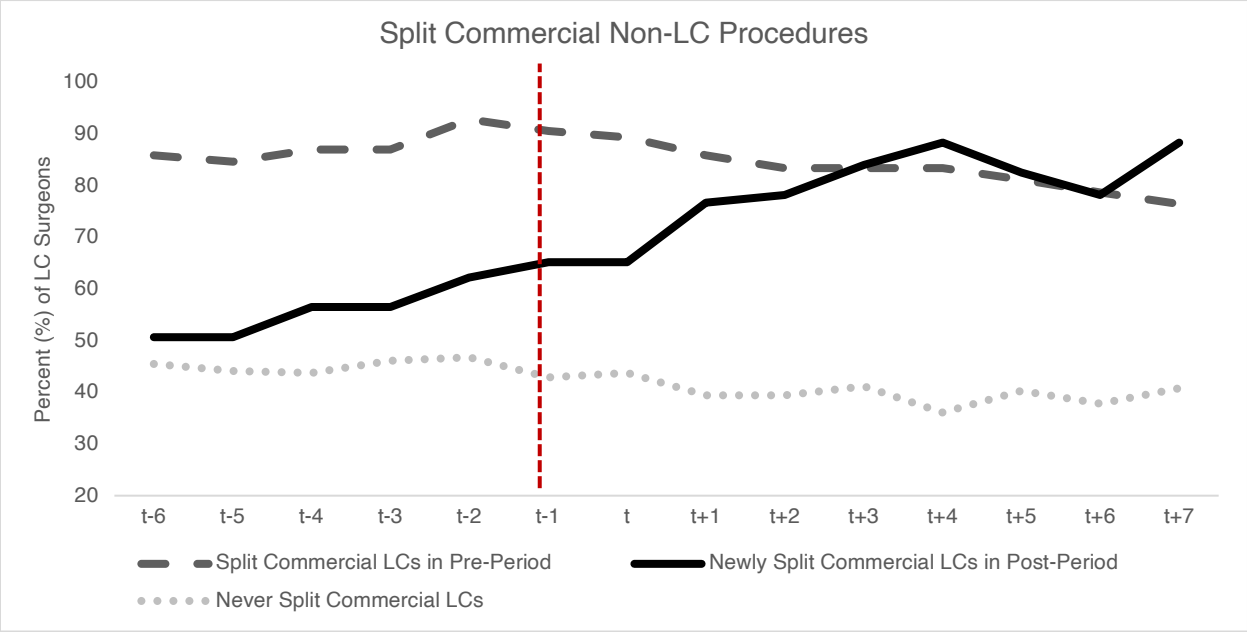
	Pr(Splitter)		**Pr(Use ASC with Lap Technology)**	
	Medicare	Commercial	Medicare	Commercial
	(1)	(2)	(3)	(4)
Post × LC Surgeon	–0.008	–0.002	–0.008	–0.008
	(0.018)	(0.018)	(0.019)	(0.019)
Physician FE	Yes	Yes	Yes	Yes
Unique Physicians	4,040	4,112	4,040	4,112
Observations (N)	52,599	57,567	52,599	57,567
LC surgeon Pre-Period Mean	0.46	0.57	0.41	0.49

Notes: Analytic sample is restricted to physicians present in the main spillover analysis (column 2 Table 2) and all non-LC procedures belonging to those physicians. "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings. "Use of ASC with Lap Technology" is equal to one for a physician-half-year when at least one non-LC procedure takes place within an ASC that currently has laparoscopic surgery technology. "LC Surgeon" is composed of our treatment group (i.e., laparoscopic cholecystectomy surgeons), just as before.

** P value at 0.05 *** P value at 0.01, standard errors clustered at the physician level



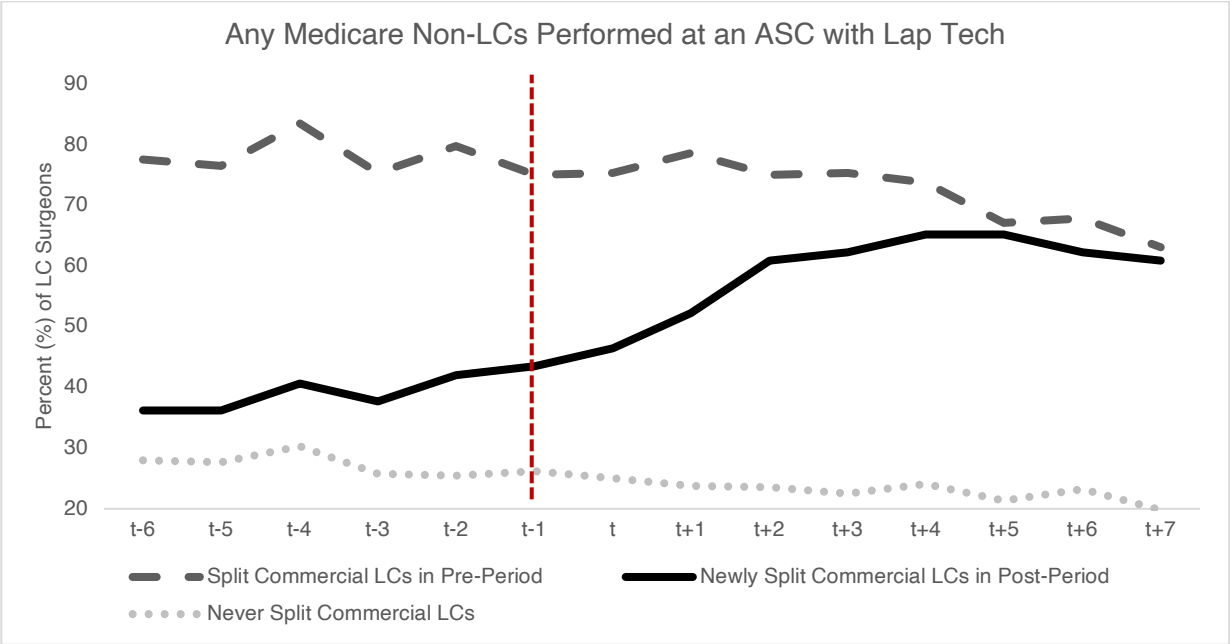
(a) Medicare Outcomes



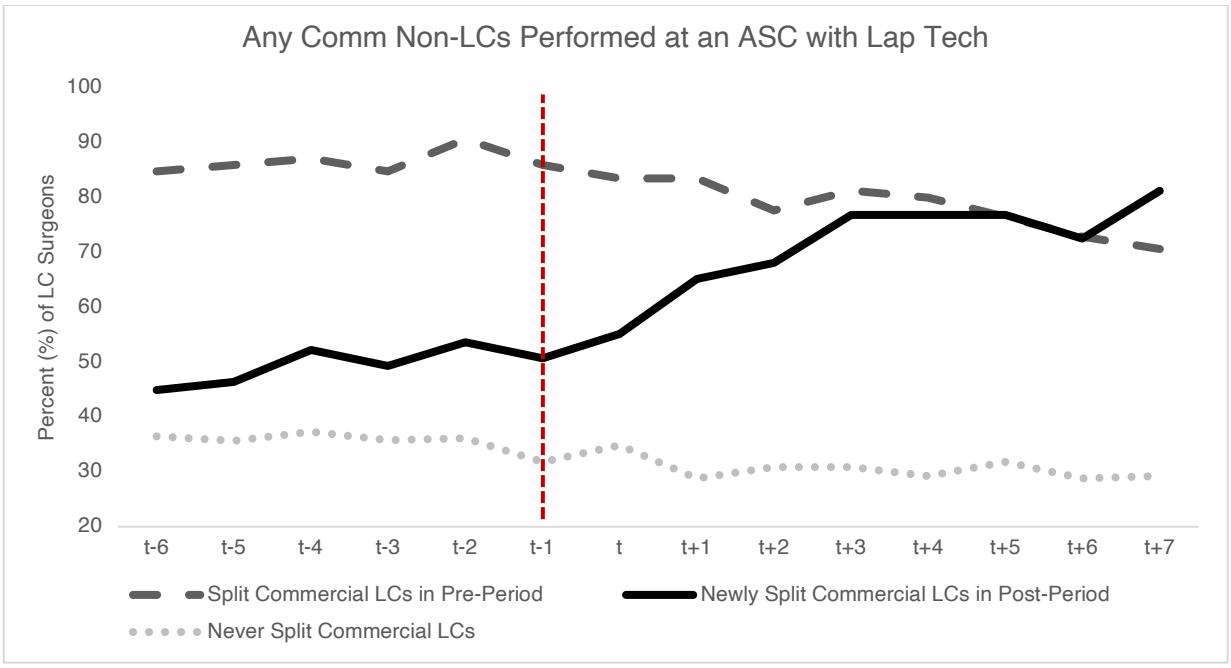
(b) Commercially Insured Outcomes

FIGURE 6. TRENDS IN SPLITTING FOR NON-LC PROCEDURES AMONG LC SURGEONS BY PAYER

Notes: Restricts to LC surgeons belonging to our main analytic sample underlying column 2 in Table 2 and their corresponding non-LC outpatient procedures (i.e., all other services these surgeons provide to the Medicare or commercial market in a given time period). LC surgeons are further stratified by their regulatory response type from the main spillover analysis (Table 2).



(a) Medicare Outcomes



(b) Commercially Insured Outcomes

FIGURE 7. TRENDS IN EXTENSIVE MARGIN USE OF ASCs WITH LAP TECHNOLOGY FOR NON-LC PROCEDURES AMONG LC SURGEONS BY PAYER

Notes: Restricts to LC surgeons belonging to our main analytic sample underlying column 2 in Table 2 and their corresponding non-LC outpatient procedures (i.e., all other services these surgeons provide to the Medicare or commercial market in a given time period). LC surgeons are further stratified by their regulatory response type from the main spillover analysis (Table 2).

APPENDIX RESULTS

Appendix A

Appendix Table A1—Diff-in-Diff Estimates for the Medicare Regulation Direct Effect on the Likelihood of Using Both ASC And HOPD Treatment Settings for Medicare Patients

	Pr(Splitter)
	(1)
Post × LC Surgeon	0.110***
	(0.0196)
Physician-Procedure FE	Yes
Unique Physician-Procedure Pairs	7,512
Observations (N)	105,168

Notes: "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings. It is effectively synonymous with the extensive margin ASC use for the LC surgeons in our context. "LC Surgeon" is composed of our treatment group (i.e., laparoscopic cholecystectomy surgeons). This differs from our main specification in that standard errors are clustered at the physician level.

** P value at 0.05 *** P value at 0.01, standard errors clustered at the physician level

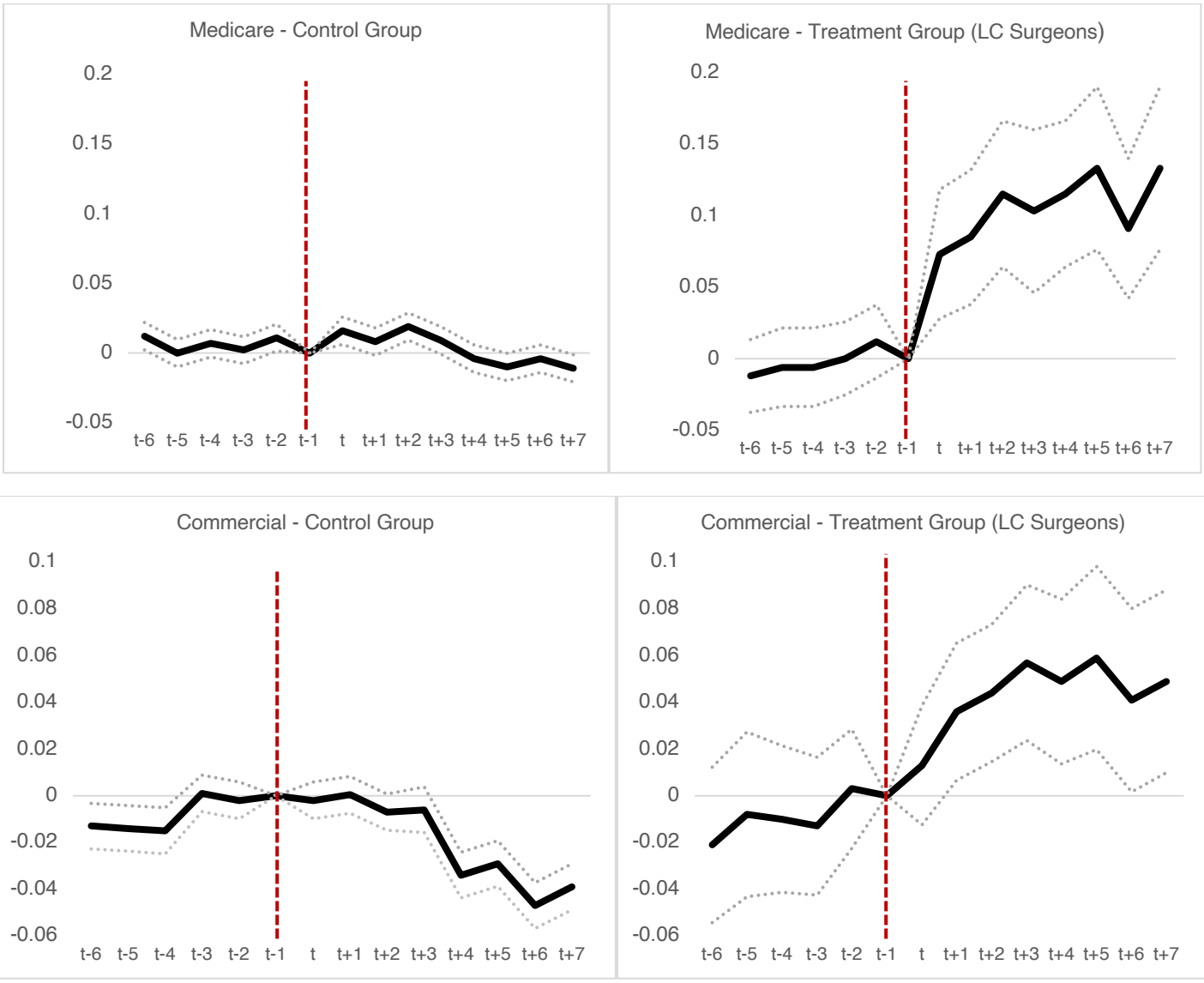
Appendix Table A2—Diff-in-Diff Estimates for the Medicare Regulation Spillover Effect on the Likelihood of Using Both ASC And HOPD Treatment Settings for Commercial Patients

	Pr(Splitter)
	(1)
Post × LC Surgeon	0.065***
	(0.0133)
Physician-Procedure FE	Yes
Unique Physician-Procedure Pairs	11,465
Observations (N)	160,510

Notes: "Splitter" indicates that the physician provides at least some of the relevant procedure cases at both ASC and HOPD settings. It is effectively synonymous with the extensive margin ASC use for the LC surgeons in our context. "LC Surgeon" is composed of our treatment group (i.e., laparoscopic cholecystectomy surgeons). This differs from our main specification in that standard errors are clustered at the physician level.

** P value at 0.05 *** P value at 0.01, standard errors clustered at the physician level

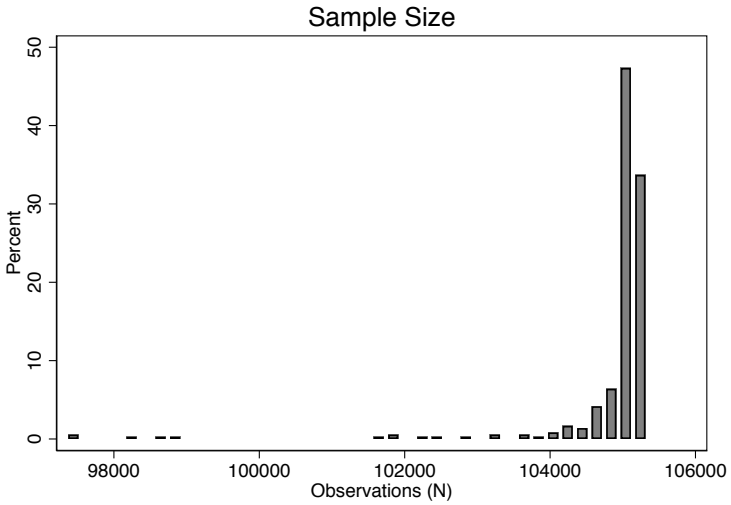
Appendix Figure A1: Separate Event Study Estimates for the Control Group and Treatment Group by Payer



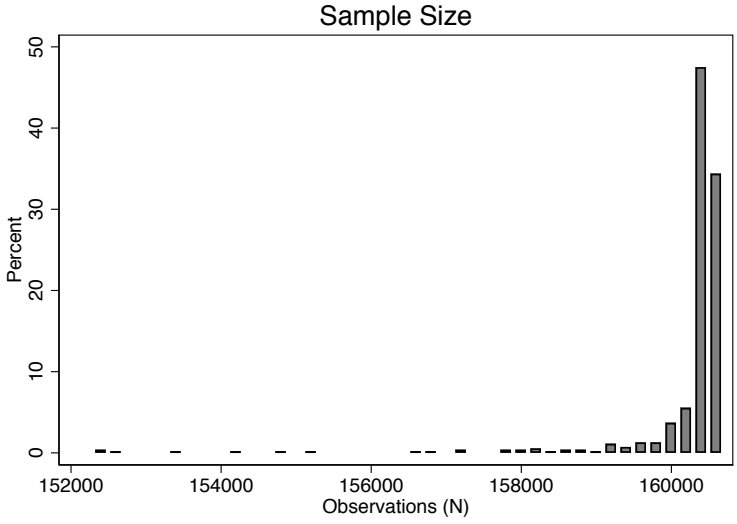
Notes: Control group corresponds to that used in the main event studies displayed in Figures 2 and 3. Of note, the top right panel (Medicare LC Surgeons) is not a precise zero for the pre-period coefficients due to a very small number of LC procedures reported as taking place within an ASC and for a Medicare patient. This may reflect misclassification of these cases or, at least in theory, could reflect a small minority of LC surgeons receiving special permission to perform select Medicare LC cases in the ASC—even though the ASC will receive no subsequent payment from Medicare. One such scenario could be an LC surgeon with a significant ownership stake in the ASC and therefore extensive discretion in such a decision. The vertical and dashed lines enclose the announcement period prior to the Medicare regulatory change.

Appendix Figure A2: Sample Size Changes When Systematically Re-Estimating the DD Model Without One Control Group Principle Procedure

(a) Medicare

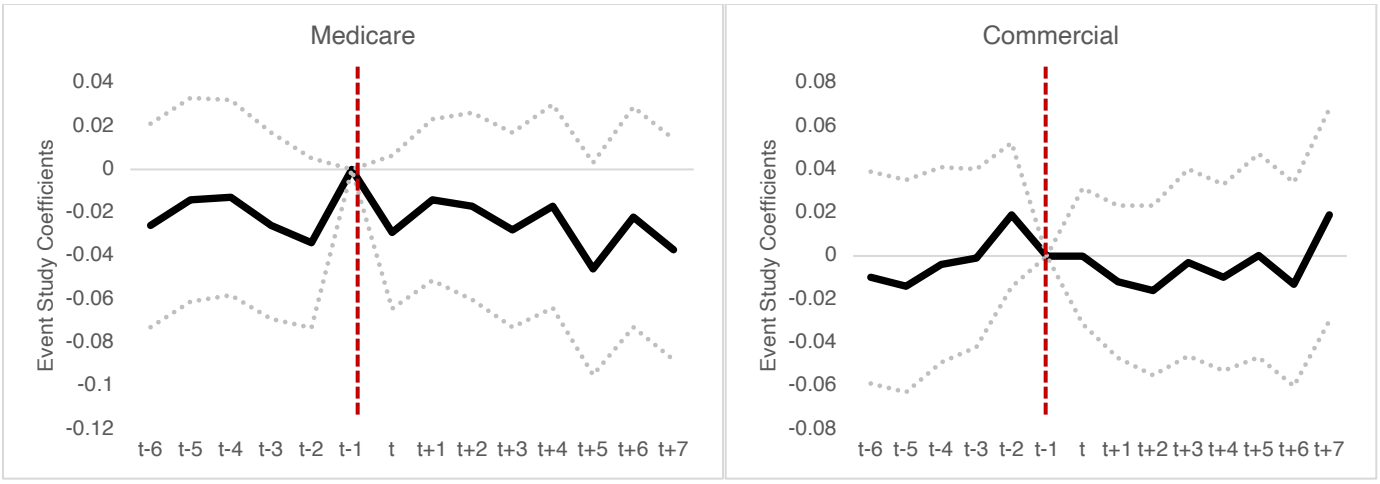


(b) Commercial

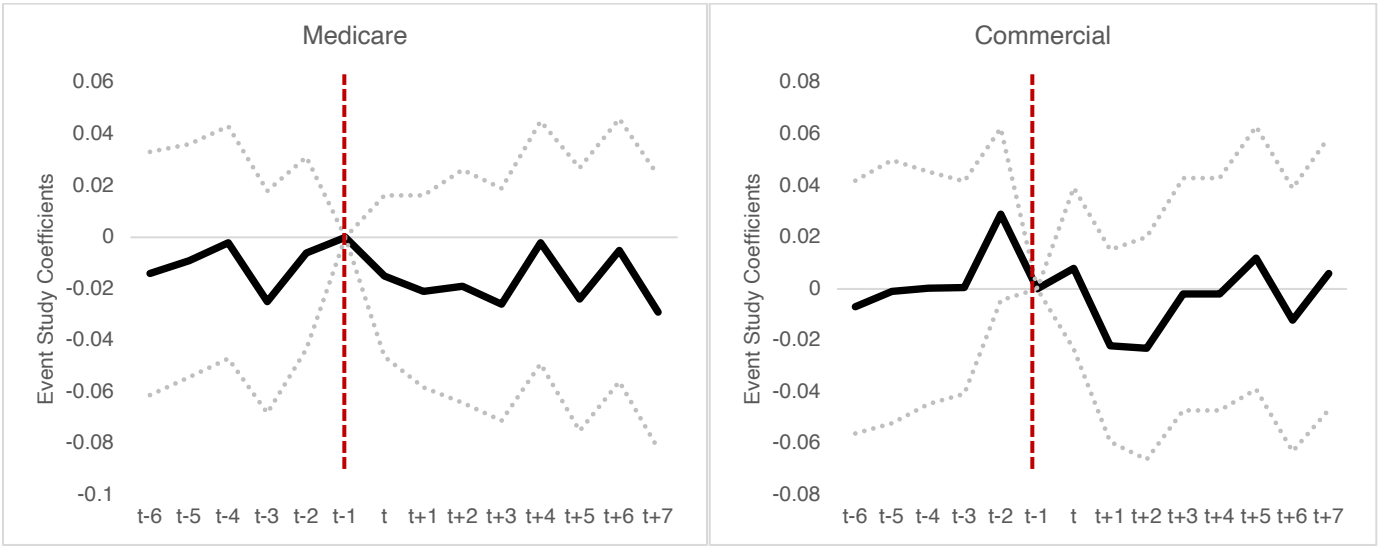


Appendix Figure A3: Event Study Results Corresponding to Table 4 in the Main Results

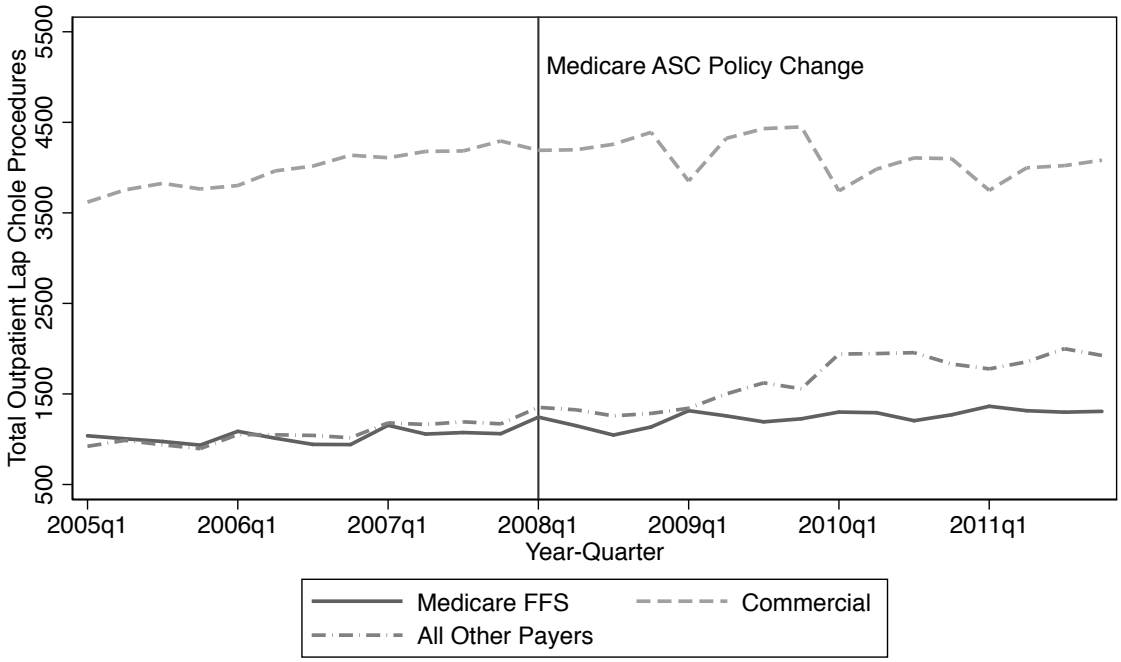
Outcome: Pr(Splitter)



Outcome: Pr(Use ASC with Lap Technology)



Appendix Figure A4: Laparoscopic Cholecystectomy Volumes in Florida 2005-2011 by Payer



Notes: The data are from the universe of ambulatory procedure discharge records in Florida 2005-2011. The data are at the year-quarter level.

Appendix B

Evidence on Rule Following

Here we investigate whether commercial insurers adopt Medicare's rules for banning (and lifting the ban) on LCs performed within ASC treatment settings. We begin by focusing on a subgroup of physicians for whom commercial insurer rule following would seem to be the primary plausible explanation for an abrupt change in treatment setting decisions: physicians that do not perform LC procedures at ASCs for their Medicare patients (and so cannot be motivated by complementarities related to treatment decisions over their Medicare LC patients).

As an empirical test for whether rule following could be partially responsible for our overall findings from Section IV, we leverage our ability to observe the same physicians' LC treatment setting decisions across the Medicare and commercially insured markets. We use this information to then determine the within-physician prevalence of concordant behavior in terms of treatment decisions for Medicare and commercially insured LC patients following the deregulation event. Newly relying on ASCs for commercial LC procedures but not for Medicare LC procedures would, at least initially, be at odds with the complementarity mechanism but could be consistent with commercial insurer rule following.

Operationally, we simply take all of the observed potential policy responders from our main (spillover) analysis (i.e., those newly splitting commercial LC procedures in the post-period) and then examine their treatment setting choices for their respective Medicare LC procedures. We then calculate the share of these (spillover) policy responders that also devote Medicare LC procedures to ASCs at some point after the Medicare rule change (i.e., from 2008 through 2011). We find that 42% of post-policy new commercial LC splitters also perform at least one Medicare LC within an ASC following the regulatory change (aligning with the complementarity mechanism interpretation). This means that 58% of these LC surgeons do not move any Medicare LCs into an ASC setting once they are allowed to do so. Given that they have non-zero Medicare LC volumes during the 2008-2011 period, this latter group seems not to be motivated by complementarities originating from the provision of Medicare and commercial LC procedures within an ASC.

Before accepting this interpretation, we compare and contrast these two types of new commercial LC splitters in the post-policy period. Within Appendix Table B1, we see that those who never allocate Medicare LCs to ASCs during 2008-2011 have much less consistent splitter

status for their commercial LCs over this same period (2008-2011). When summing their total time observed as a commercial LC splitter during the four-year post-deregulation period, the median value is one-half-year (i.e., six months in total), and the 90th percentile is 1.5 years in total. Conversely, LC surgeons that newly split commercial *and* Medicare LCs during the post-period demonstrate much more frequent and persistent commercial LC splitter status from 2008-2011—e.g., the median is 2 years and the 90th percentile is 3.5 years out of a possible 4.0 for this subgroup. Unsurprisingly, Appendix Figure B1 shows that this same subgroup drives the non-LC-procedure trend changes observed in Figure 6. Taken together, it could be argued that the 58% that never opt for ASC delivery of Medicare LCs are only weakly, if at all, responding to the Medicare policy change since their switch into splitter status is typically short-lived. Meanwhile, the treatment setting changes for the 42% that use ASCs for both commercial and Medicare LCs in the post-period as well as their non-LC procedure trend changes are consistent with the proposed complementarities mechanism.

That said, we cannot observe commercial contract details with LC surgeons—and hence any direct rule following—in our discharge data, which does not include information about reimbursement rules belonging to the various payers. We therefore supplement our existing analyses with Marketscan data from 2005-2012 in order to explore the rule-following mechanism further.

The Marketscan claims database offers the highest quality large, transaction-level, commercial insurer dataset for our time period of interest. Nonetheless, there are several limitations. First, it is impossible to link providers (such as LC surgeons) across procedures and over time in the database. Second, we are unable to track specific facilities in the database and have no geographic information on the location where a given physician service took place. Data contributors (typically large, self-insured firms) also change over time, which creates further ambiguity for the underlying providers and geographic locations represented in the database. For these reasons, the data cannot be used to replicate the same analyses from the paper, which would require a stable sample over time, as well as the ability to track physicians over time. However, these data are well-suited for tracking whether data contributors (e.g., large employers) change their use of ASCs for LC procedures, particularly along the extensive margin (i.e., the margin most consistent with a rule-following effect, should one exist). In other words, once Medicare allows LCs at ASC, do commercial insurers make the same change? We provide such statistics insofar as

they can be informative for aggregate patterns and the associated plausibility of a rule-following mechanism.

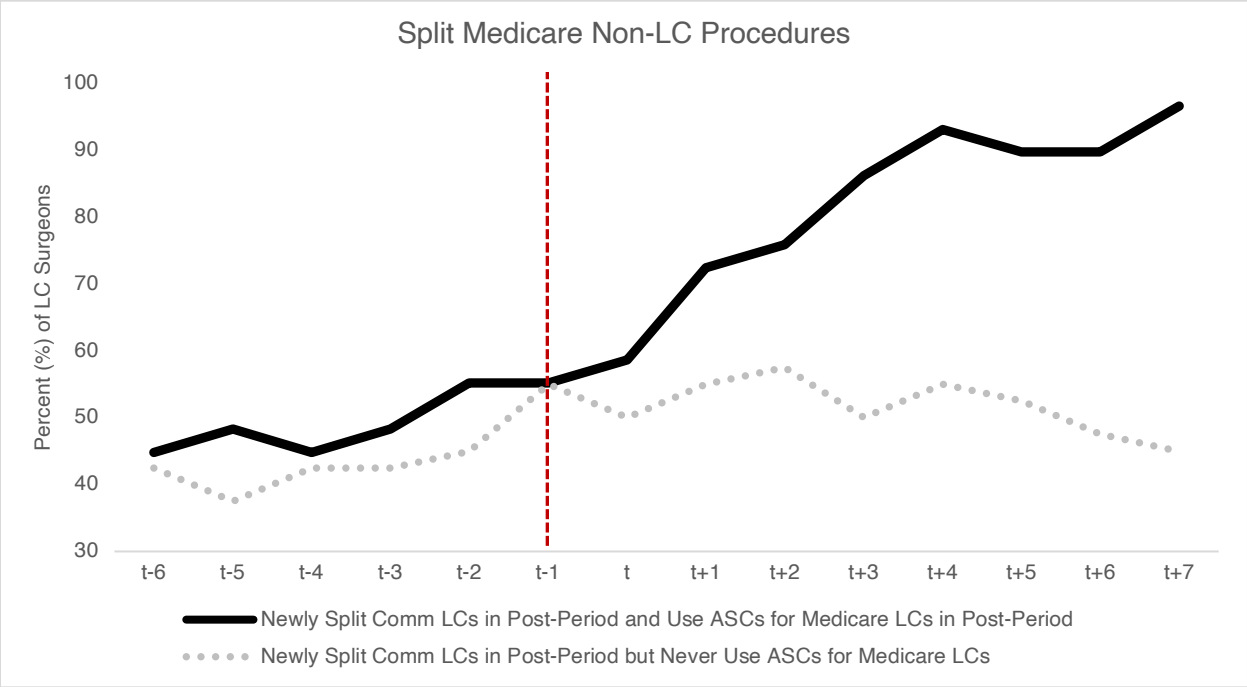
To investigate whether patterns in the Marketscan data are consistent with rule-following, we aggregate to the level of the payer. In this database this corresponds to the data contributor, and we limit to data contributors consistently present in the data over the study period. We plot the fraction of data contributors for which ASC use is precisely zero in each year. An observation is therefore a payer-year. A decrease in this statistic after 2008 (i.e., fewer commercial payers with no LCs performed within ASCs) would be consistent with payers changing their rules in the wake of the Medicare rule change targeting LCs. Panel (a) of Appendix Figure B2 shows no obvious decline following Medicare's deregulation event. Because having exactly zero ASC LC procedures in the claims records may be too stringent of a proxy disallowing ASC use, we also repeat the analysis with a threshold set at <5% ASC using in panel (b) of Appendix Figure B2. Again, there is no compelling pattern to suggest a sharp coverage policy change for these commercial payers. So, while we cannot claim conclusive evidence, the basic patterns in the Marketscan database do not add any support for a rule-following mechanism interpretation, which is also consistent with our further probing of the Florida discharge data yielded (discussed immediately above).

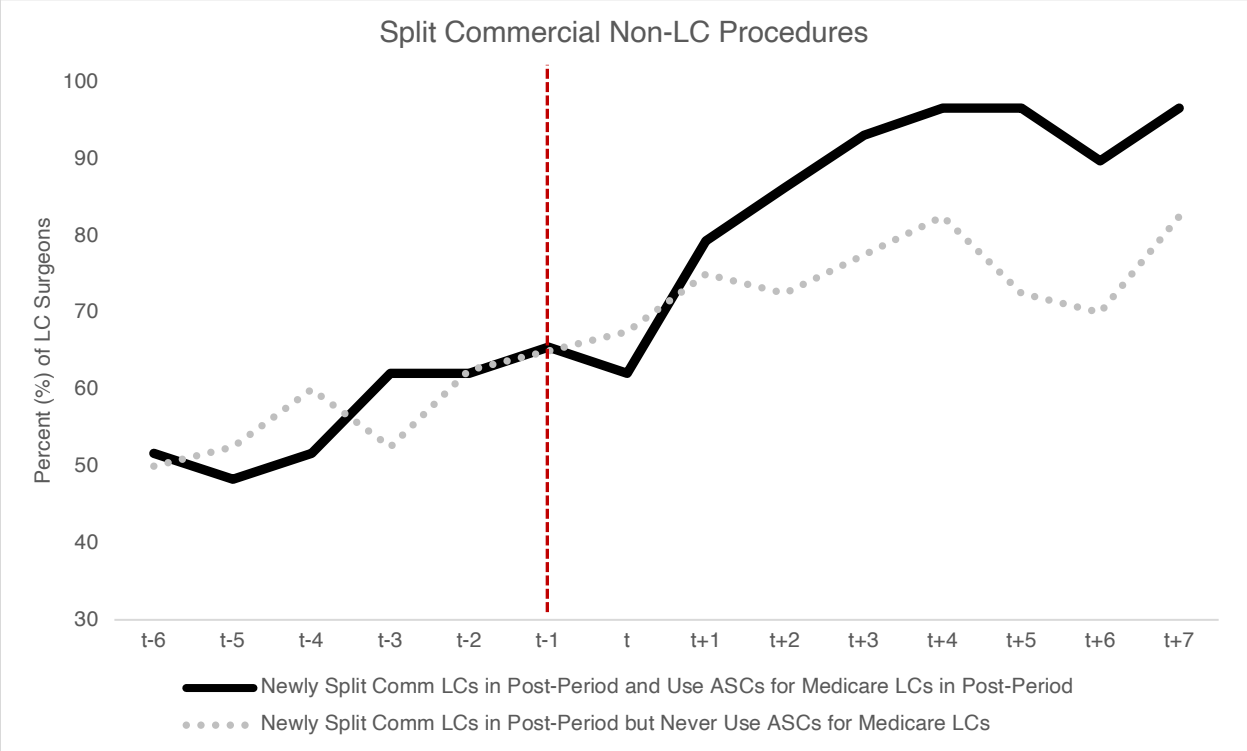
Appendix Table B1: Summary Statistics for Total Number of Post-Policy Periods Splitting Commercial LCs among Two Types of Commercial LC Post-Policy Splitters

	Newly Split Comm LCs and Use ASCs for Medicare LCs	Newly Split Comm LCs and Never Use ASCs for Medicare LCs
25th Percentile	2	1
50th Percentile	4	1
75th Percentile	5	2
90th Percentile	7	3
LC Surgeons (N)	29	40

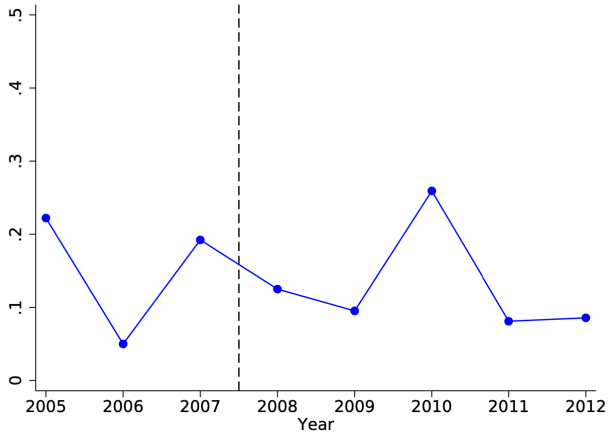
Notes: Restricts to LC surgeons newly splitting commercial LCs during the post-period (2008-2011). Maximum number of post-periods to be observed is 8 half-years over the 4-year period.

Appendix Figure B1: Splitter Status for Non-LC Procedures by Two Types of Post-Policy Commercial LC Splitters

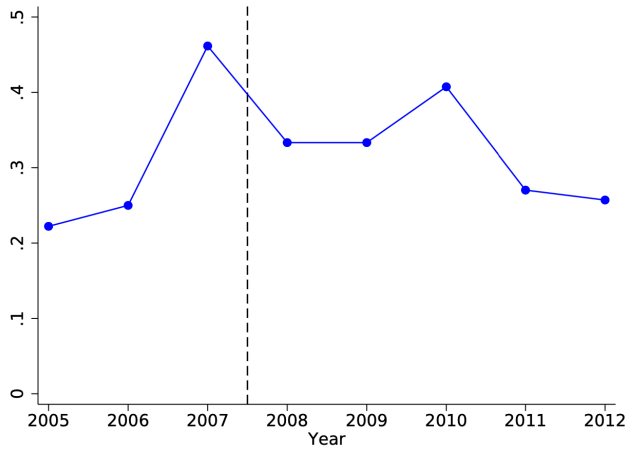




Appendix Figure B2: Trends in Extensive Margin Use for LC Procedures at the Payer Level within the Marketscan Database, 2005-2012



(a) Exactly zero ASC use



(b) <5% ASC use

Notes: Panel (a) outcome is defined as share with precisely zero ASC cases for LCs. Panel (b) relaxes the threshold to <5% ASC use for LC procedures among enrollees.