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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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## 1. Introduction

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 enrollment also eclipses that of most other public or private health insurers. Consequently, the Medicare program looms large as a dominant payer in the US healthcare landscape and may influence physician treatment decisions as well as standards of care beyond its patient population and statutory bounds.

Prior research documents important 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] However, Medicare policy is broader than administrative pricing and often includes care delivery regulations. The impact of these latter policy levers—i.e., Medicare's *nonprice* regulatory decisions—on provider behavior inside and outside of the Medicare market is less well studied. To be clear, 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 necessary for formulating optimal Medicare policy and other healthcare regulation. Additionally, 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

[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).

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 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. We also show that it did not coincide with the relaxing of other Medicare treatment setting restrictions for other procedures important to the affected surgeons. Instead, the original Medicare ban existed without a clear evidence-base and did not necessarily align with care delivery parameters stipulated by other payers or similar surgical services. 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.

A key institutional feature for our outpatient surgery context is that, when permitted by the relevant payer, physicians often divide their patients receiving the same surgical service between HOPD and ASC delivery settings, rather than operate solely within one. This behavior has been of economic interest, and David and Neuman (2011) usefully refers to such physicians as "splitters" since they split their relevant case load across facility types. David and Neuman (2011) then investigates splitters' sorting of patients between treatment settings according to their patients' surgical risk profiles. Yee (2011) and Munnich and Parente (2018) extend this work to better understand what drives physician splitters to allocate the marginal patient to a particular facility type and the implications for care quality outcomes. Yet, surprisingly little economics research to date has examined the underlying determinants of a physician choosing to split a given procedure between ASC and HOPD options in the first place. The lone and recent exception that we are aware of is Munnich *et al*. (2021), which shows a sharp and substantive ASC extensive margin effect when physicians newly acquire financial stakes in one or more ASCs. In what follows, we demonstrate that Medicare regulation can have a similarly immediate impact on physicians' decisions to split outpatient surgeries for Medicare and non-Medicare cases alike.

To build on this literature, we analyze physicians' decisions within a multi-payer context to split surgeries across settings as our primary outcome of interest. As we describe in more detail

below, there are several reasons to expect that a physician's decision to begin using ASCs for some of her Medicare patients might be jointly made with her decision to begin using ASCs for some patients with other insurance coverage.[3] To help motivate this possibility, we note an empirical regularity: a physician's splitter status for her Medicare outpatient procedures is highly correlated with her splitter status for the same procedures paid for by commercial insurers in the cross section. In our data (described below) and across all unique physician-procedure combinations in 2007, we observe that conditional on a physician behaving as a splitter for a given Medicare procedure, the probability that the same physician also divides her corresponding commercial procedure volume between HOPDs and ASCs is high (88%, see Figure 1).[4] Conditional on a physician *not* splitting a given Medicare procedure between settings, the probability that she nonetheless does so for the same procedure 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.

[3] As we discuss in below, the effects we find could be consistent with several channels. 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. Alternatively, by influencing the standard of care to allow ASC use, Medicare might reduce any perceived litigation risk associated with ASC use for commercial patients. Similarly, commercial insurers might follow Medicare's lead when it comes to setting treatment restrictions for providers. The data here cannot cleanly differentiate between the channels, though we provide some discussion of the possibilities below.

[4] Authors' cross-sectional calculation from the universe of outpatient procedure records in Florida during 2007. Full data details are provided in Section 4. 34% of commercial outpatient procedures are split between both HOPD and ASC settings in the 2007 data. 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.

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 splitting FFS Medicare laparoscopic cholecystectomy surgeries once Medicare removes the ASC ban for these surgeries.[5] 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 also move roughly a quarter of their collective Medicare surgical volume for the targeted procedure into an ASC setting over the following four years.

After establishing the direct policy effect, we investigate our spillover effect of interest: physician-level splitter status for *non*-Medicare patients requiring the same surgical procedure. Again, by comparing surgeons who perform the targeted procedure to all other physicians in a difference-in-differences framework, we show a 25% increase over pre-policy levels in the probability a physician splits her *commercially insured* laparoscopic cholecystectomy surgeries during the first year of the *Medicare* rule change. The effect grows and stabilizes to a 70% increase

[5] Throughout, we use Medicare to denote fee-for-service (FFS) 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.

by the third post-policy year and thus reveals that the Medicare rule change had a substantial impact on how physicians provided care to non-Medicare patients.[6]

Thus, our main contribution is to establish, for the first time, that Medicare regulation prohibiting certain modes of service provision substantially affects physician practice patterns for non-Medicare patient populations. We are able to do so because the changing Medicare policy stance focused on laparoscopic cholecystectomy surgeries creates a quasi-experiment to exploit. However, the physician behavior changes we document have important implications beyond the narrow surgical procedure that we study. The same type of Medicare regulatory policy is in place (statically) for essentially every surgical procedure in US healthcare delivery—either prohibiting or permitting certain modes and places of care. These same rules are also an active source of contemporary debate and policy shifts.[7] In this way, our identifying variation offers a rare opportunity to understand the broader impacts of this type of Medicare administrative decision-making, which can inform ongoing deliberations on related policies tied to a wider variety of medical services.

Our findings also contribute to an active literature on the externalities from public health insurance programs for the healthcare economy. This includes work on public insurance payments influencing private insurer payments (e.g., White (2013), Clemens and Gottlieb (2017), Clemens,

[6] Within supplementary analyses described in Section 6, we also 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.

[7] Examples of industry commentaries on policy alignments and contrasts across the two recent executive branch administrations can be found here: https://www.beckersasc.com/asc-news/trump-vs-biden-who-is-better-for-ascs.html and here: https://www.ascassociation.org/asca/aboutus/latestnews/newsarchive/newsarchive2021/july2021/202107medicare2022proposedpaymentrule. The Centers for Medicare and Medicaid Services (CMS) is currently proposing to reinstate some previous prohibitions on ASC-delivered surgeries (see here https://www.cms.gov/newsroom/fact-sheets/cy-2022-medicare-hospital-outpatient-prospective-payment-system-and-ambulatory-surgical-center).

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.

## 2. Background

### *2.1 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]

Intuitively, the complexity—and hence adverse event risks—accompanying a procedure are likely to influence physicians' willingness to make use of both treatment settings. For example, splitting is likely to be rarer 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 inclined to rely on ASCs at all for certain high-complexity procedures that carry greater risks and are therefore best suited for hospital-based delivery. However, for surgeries of moderate complexity (such as laparoscopic cholecystectomies), 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 cases) a key physician decision-making margin for such procedures.

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

[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.

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 small 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*. 2021).[10] 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). Medicare loosening restrictions on laparoscopic cholecystectomies at ASCs could also cause physicians to be willing to perform commercial laparoscopic cholecystectomies at ASCs through a litigation risk channel—e.g., if Medicare's previous ban on the procedure (prior to 2008) established an implicit standard of care that could be applied to treatment decisions affecting other patients. 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

[10] Note, reimbursements for physicians (i.e., the professional component of payment) is independent of the chosen treatment setting. Thus, even physician ASC equity owners are only indirectly rewarded for choosing an ASC instead of HOPD via their partial claim on the facility payment, which is separate from the physician payment.

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 3, though our paper aims to empirically establish whether cross-payer influences exist, not to identify the particular channel—which our data are not well-suited for.

*2.2 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.[11] 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

[11] 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).

changes were published in the Federal Register the following November (2007) so that they could be implemented at the start of 2008.[12] Importantly, the pre-2008 refusal to reimburse for this specific procedure performed within an ASC is typically characterized as an administrative oversight, rather than a prudent concern for beneficiaries' safety (Meredith 2008; *OR Manager* 2007).[13] 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 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.

We also verified that the policy change we exploit was not part of a wave of new ASC permissions affecting other common procedure types that could confound our identification strategy. In particular, we examined all procedure (Current Procedure Terminology or CPT) codes belonging to our treatment group physicians (defined fully below) and their Medicare patient

[12] 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

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

population in 2007, regardless of the procedure setting. Of the roughly 600 such codes, the top 50 ranked by volume accounted for 82% of the overall Medicare outpatient procedure volume for these physicians. We manually reviewed the publicly-posted Medicare facility reimbursement policy for ASCs for each of these top-50 codes. Of these, only laparoscopic cholecystectomies were not eligible for Medicare reimbursement if performed in an ASC prior to 2008. Finally, we note that there was no contemporaneous variation in the physician reimbursement that would have made ASCs more attractive for performing laparoscopic cholecystectomies. For our laparoscopic cholecystectomy procedure of interest—and indeed, for all outpatient procedures—Medicare does not reimburse the physician differently as a function of where the surgery took place. The physician professional fee is the same in the ASC and HOPD settings.

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%.[14] We also note that while commercial insurers may adopt Medicare regulatory positions, they are not required to. In fact, we observe commercially insured laparoscopic cholecystectomy surgeries taking place within ASCs prior to 2008.[15]

[14] Authors' calculations based on the universe of ambulatory procedure data from Florida (fully described within Section 4).

[15] As described in Section 6, 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.

## 3. 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.[16]

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 '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

[16] 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).

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 (i.e., behave as a 'splitter') 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:

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

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 $v_i^j$ 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 $v_i^j$.

Because we ultimately investigate what fraction of physicians change behavior by splitting 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. Abstracting from binary nature of the ASC ban, and considering a marginal change (such as adjusting rules about what patients are permissible for ASC treatment) for illustration, 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 7.

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.

## 4. Empirical Strategy for Own and Spillover Medicare Deregulation Effects

### *4.1 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.[17]

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.[18] 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: traditional Medicare and the (non-Medicare) commercially insured.[19] Having these multiple and

[17] 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).

[18] 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.

[19] 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).

comprehensive pieces of information—which would typically be unavailable in claims data—is critical to addressing our research question.[20]

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.[21] 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.

*4.2 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 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

[20] 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.

[21] 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.

analogous approach (fully described below) 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.[22] 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. Of note, among our treatment group of LC surgeons, the share of their outpatient procedures made up of LC surgeries is typically around 10%—making it one of their more common medical services performed.[23] We also aggregate the quarterly data to the half-year level since procedures could have few or no cases for a given physician-payer combination in a given quarter. 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.[24]

[22] Recall, we are using the 'LC' abbreviation as convenient shorthand for laparoscopic cholecystectomy surgeries. We maintain this abbreviation in Sections 5 and 6 as well to clearly demarcate affected and unaffected physicians as well as targeted and untargeted outpatient procedures.

[23] The typical LC surgeon most likely trained as a "general surgeon" during the required post-medical school residency program; therefore, the surgeon will typically not exclusively perform LC surgeries. For example, among our analytic sample of Medicare LC surgeons used to produce the DD results in Section 5, they performed 618 unique outpatient procedures (defined as unique CPT codes) for Florida Medicare beneficiaries in 2007. The LC deregulation event is likely to have been salient to these physicians (given the frequency by which they perform LCs).

[24] 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, which is consistent with the David and Neuman (2011) terminology. 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.[25]

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 3 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 6. 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

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

records.[26] 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.

[26] 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 ($\theta$), which subsume the *LCSurgeon* main effect.[27] The $\delta$ 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 ($\gamma_m$) 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 ($\delta_n$) 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 5.2). The choice of clustering level is motivated over concerns about standard error under-estimation due to uneven cluster group sizes

[27] 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. The statistical significance of our findings is entirely robust to the alternative clustering. See Appendix Table A1 and Appendix Table A2.

## 5. Results for Own and Spillover Deregulation Effects

### *5.1 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 4). In column 1 of Table 2, we identify a large and highly significant 11-percentage point uptick in the likelihood of surgeons behaving as a splitter 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 $t + 1$).[28] The policy response grows throughout the post-implementation period, with the effect size nearly twice as

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

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 of LC surgeons 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 behaving as a splitter for 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 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.[29] 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.

*5.2 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

[29] This was also during the labor market nadir following the Great Recession. Across Florida and the wider US, job losses and commercial insurance losses were extensive, which likely accounts for the slight dip in the control group during 2010 and 2011 and would be a common shock to all commercially insured procedures.

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.

## 6. Secondary Spillover Effects

### *6.1 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 3 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 ($\lambda_i$) rather than procedure-physician pair fixed effects ($\theta_p$). 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.[30] This second outcome could show secondary spillover effects even if the other (i.e., splitter) outcome does not. The treatment group surgeons could alter the type of ASC that they use for non-LC procedures

[30] 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, less than 30% of Florida ASCs perform any laparoscopic surgery cases (of any type for any payer) during the 2005-2011 period.

without changing their underlying propensity to simultaneously use ASCs and HOPDs for their Medicare and commercially insured patients.

*6.2 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 split their non-LC patients' procedures 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 5, 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.

*6.3 Supplementary Descriptive Results*

Before concluding Section 6, we produce a more nuanced but necessarily descriptive set of facts for the same outcomes examined in Section 6.2. 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 before the Medicare policy change, those who began doing so only after the policy change, and those who never adopt the splitter style 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.[31] Future work (and different data) would be needed to assess these more diffuse spillovers or to analyze the detailed channels by which physicians' equilibrium behavior changed.

[31] 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.

## 7. Discussion

### *7.1 Overall ASC Volume Impact*

Our focus on the physician choice of whether to use an ASC for any patients builds on a prior literature aimed at understanding this extensive margin decision related to splitting caseloads across treatment settings (e.g., David and Neuman, 2011). A related question concerns the volume of procedures ultimately moved to ASCs following the policy change. For Medicare volume, this statistic is straightforward to calculate. Because essentially no LCs were performed at ASCs for Medicare patients prior to 2008 while the ban was in place, the fraction of Medicare LCs performed at ASCs after the ban is lifted summarizes the volume impact of removing the ban. In all, 10% of Medicare LC procedures performed by the physicians in our analytic sample take place in ASCs by the final year of our study period (2011).[32] 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.[33] An analogous calculation is not available for measuring the volume margin among commercial laparoscopic cholecystectomy cases, however. This is due to the possibility that some increases in ASC use for

[32] This calculation is based simply on observing the total number of LCs performed in ASCs as well as total LCs performed (across both settings) in 2011 by physicians belonging to the analytic samples from Table 2 and Figure 2. Of note, when restricting our attention to the physicians responding to the policy (i.e., who begin to use ASCs for some of their LC Medicare patients 2008-2011), we find that they shift around 25% of their collective Medicare LC surgical volume into an ASC during the post-period years (35% of their collective volume in 2011 alone). 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.

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

LCs for the commercially insured between the pre- and post-periods could have occurred absent the Medicare policy change.

Descriptively, we observe a commercially insured LC ASC use increase from 5.2% to 8.2% among the treatment group between the pre- and post-periods, while this summary statistic for our control group climbs from 54.3% to 59.4% (Appendix Table A3). As a point of comparison, among our Medicare market analytic sample, LC ASC use goes from effectively zero to approximately 6%, while the control group ASC use increases from 57% to 62% (Appendix Table A3). These statistics illustrate the order of magnitude difference between our LC surgeons and our control group physicians as well as the importance of absolute versus relative changes for this measure.

To further examine the intensive margin while trying to appropriately control for any underlying trends, we return to the same difference-in-differences regression from Equation (5). We replace the payer-specific splitter dependent variable in Equation (5) with the log-transformed fraction of cases of each procedure sent to ASCs. The unit of observation remains the physician × procedure × period, and the control group remains all procedures by physicians who do not perform LCs, just as in Figures 2 and 3. The log transformation is meant to better match the control and treatment group trends because the control groups (non-LC procedures) have very different underlying baseline rates of ASC use from each other and from the treatment group, as noted above.[34]

Appendix Figure A5 reports these supplementary event study results for both the direct effect on Medicare volume and the spillover effect on commercial volume. Panel (a) plots the difference-in-differences coefficients for the volume of ASC use in Medicare, showing a large

[34] We add a small constant in order to not drop the many observations from the regression for which the untransformed dependent variable is zero. Alternatively, transforming the dependent variable via inverse hyperbolic sine yields very similar results.

relative change in ASC use for LC surgeons for Medicare patients, but which is driven by a small absolute change (6%). Panel (b) plots the analogous coefficients for the commercially insured patients, which indicate that overall ASC use for LCs among commercially insured patients increases by a little over 20% on average, relative to the six months preceding the Medicare policy change and relative to the physician-procedure pairs comprising our control group. For both the Medicare and commercial regressions, the early part of our analytic window demonstrates poor alignment between the treatment and control units, driven by underlying trends in the controls.[35] Overall, these results are less precise than our main splitter (extensive margin) specification and less well-behaved, with an imperfect match between the control and treatment trends. We therefore treat these results as suggestive.

Though the magnitudes of these volume effects, as well as the magnitudes of the direct effects on physicians' decisions to split their Medicare cases, are of economic and policy interest, our key contribution is to demonstrate a Medicare regulatory externality for the commercially insured market. Such externalities also have implications beyond the narrow clinical context belonging to LCs. We return to this point in Section 8.

*7.2 Channels*

The physician behavior changes we empirically observed in Section 5 are consistent with cross-payer complementarities, as described in Section 3. However, we also acknowledge that two other plausible, and not mutually exclusive, explanations for our findings may apply. First, physicians who wished to perform commercial LCs at ASCs prior to 2008 may have perceived that the litigation risk associated with that setting choice was reduced once Medicare removed its ban and

[35] Recall, Medicare ASC use among our treatment group physicians was flat at zero in the pre-period due to the ban.

explicitly deemed ASC-delivery of the surgery to be clinically safe and appropriate for beneficiaries. If courts interpret Medicare's stance on permissible treatment approaches as an important component for defining the relevant standard of care, then performing a procedure in a manner that is prohibited by the public payer would carry greater litigation risk (should an adverse outcome occur) and thus be undesirable from the physician's perspective. Additionally, or alternatively, commercial insurers could 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 (as suggested in Section 3) 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 3), the binary decision to begin dividing a specific commercial surgery between HOPDs and ASCs for physician (*i*) could be represented as $ASC_i^j = f\left(R^j\left(R^{-j}\right), v_i^j, \left\{ASC_i^{-j}\right\}\right)$, 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 contrasts with 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 held by the insurer when steering enrollees to treatment settings forbidden by the dominant, public payer. In either circumstance, a reversal of the targeted ASC ban by Medicare in 2008 would then be the impetus 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).[36]

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.[37]

In Appendix B, we take a different approach. We leverage a supplementary claims-level database (Marketscan) of more than 640,000 LC 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 clear indication that carriers or plans newly permit ASC delivery for this specific surgery after Medicare's 2008 rule change. Thus, we fail to find clear empirical evidence supporting a rule-following interpretation, though we cannot rule it out.

[36] 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).

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

## 8. Conclusion

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 examine a related but distinct question, regarding the capability of Medicare rulemaking (in this case, a prohibition) to impact physicians' decision making and care provision 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. We additionally show that 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 behave as a splitter for their commercial patients needing the procedure shortly after the procedure-specific Medicare policy is implemented. The descriptive data in Section 6.3 further suggest that the subset of our treatment 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. 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 can affect treatment setting decisions for Medicare and non-Medicare patients alike, which may be at odds with non-Medicare patients' and payers' underlying preferences.

Our results are of interest not only as a case study of the specific regulatory change involved, but also as evidence of the likely impacts on commercial care provision of the thousands of other non-price Medicare regulations that govern how or where procedures may be performed in Medicare. Our results suggest these Medicare policies may have substantial spillover effects; however, the magnitudes of such spillovers are likely to depend on the complexity of the service being deregulated. We examined a moderate-complexity procedure, with specific capital requirements (i.e., laparoscopic surgery technology). Only a minority of existing ASCs had the requisite capital investments prior to Medicare removing its ASC ban for laparoscopic cholecystectomies and few new ASCs were created after 2008.[38] Thus, the deregulation effects on treatment setting substitution that we observed could plausibly be larger for medical services unencumbered by such frictions but also smaller for more complex procedures—with the latter being the focus of recent ASC policy activity.[39]

In sum, our findings 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 the Medicare program continues to adjust regulatory parameters tied to outpatient surgery (e.g., changes to the "inpatient only" (IPO) list and related ASC permissions) to offer more convenient and lower cost treatment options for beneficiaries.[40]

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[38] Specifically, only around 30% of Florida ASCs perform any laparoscopic surgeries (of any type) in a given year, which is a useful proxy for their equipment. The entry of new ASCs was also sharply curtailed during our study period (see Munnich and Richards 2021), which may also have limited take-up in our study period.

[39] The current Medicare policy trend is to permit more higher complexity surgeries and procedures in ASCs, as opposed to small, low-risk procedures—which are typically already permitted. For this reason, our LC-focused case study is perhaps more representative of the potential effects of these recent policy shifts for physician splitting behavior as well as the degree of case migration from HOPDs to ASC settings. See here for an example of some recent Medicare policy shifts affecting ASC treatment permissions: https://www.modernhealthcare.com/outpatient/medicare-payment-change-will-shift-lucrative-heart-procedures-out-hospital.

[40] 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

While Medicare rulemaking does not explicitly account for externalities on non-Medicare patients, our findings indicate that effects on other payer groups could be significant and influence the overall costs and benefits of such contemporary policy decisions.

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

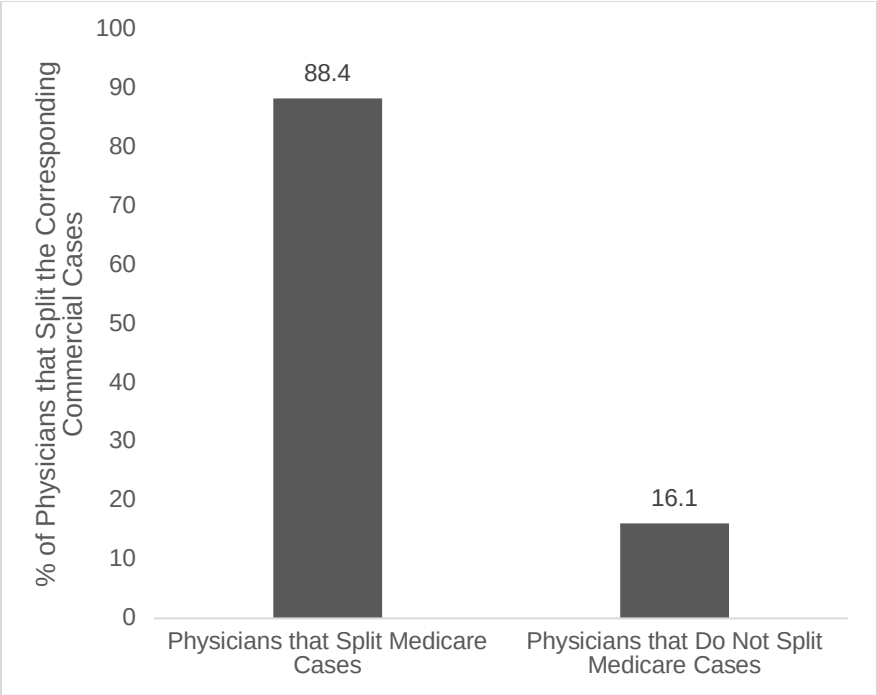



**Fig 1. Cross-Sectional Correspondence in Splitting Cases Between ASCs And HOPDs Within-Physicians, Across Their Medicare and Commercial Patients**

*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

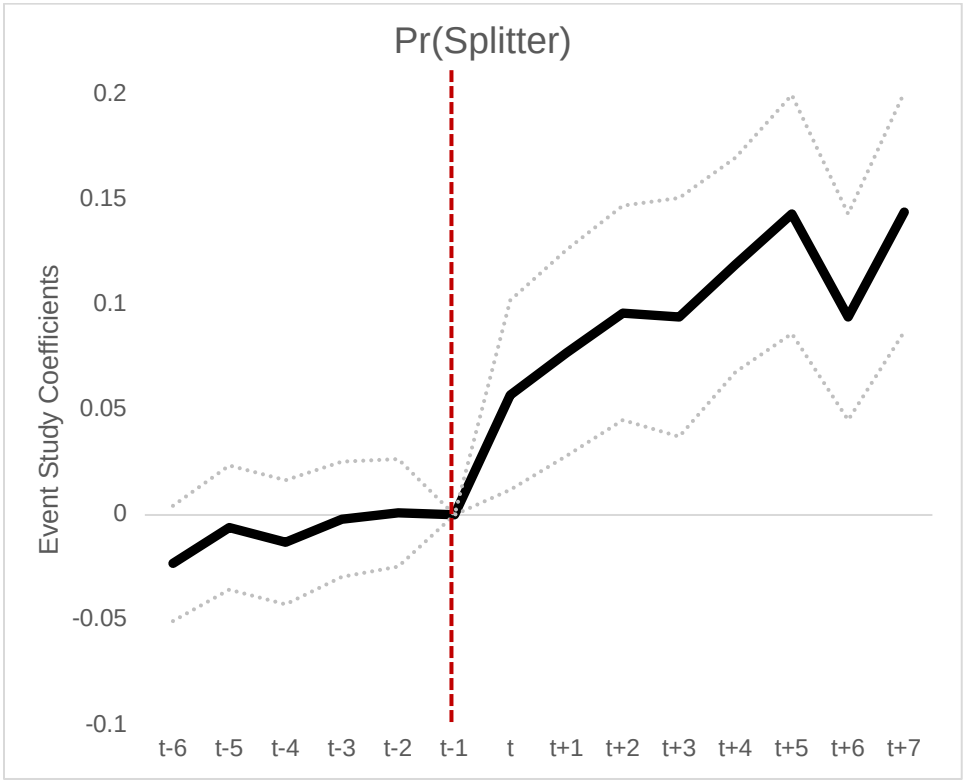



**Fig 2. Direct Effect of Medicare Policy Change That Allowed LC Surgeries in ASC Settings**

*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

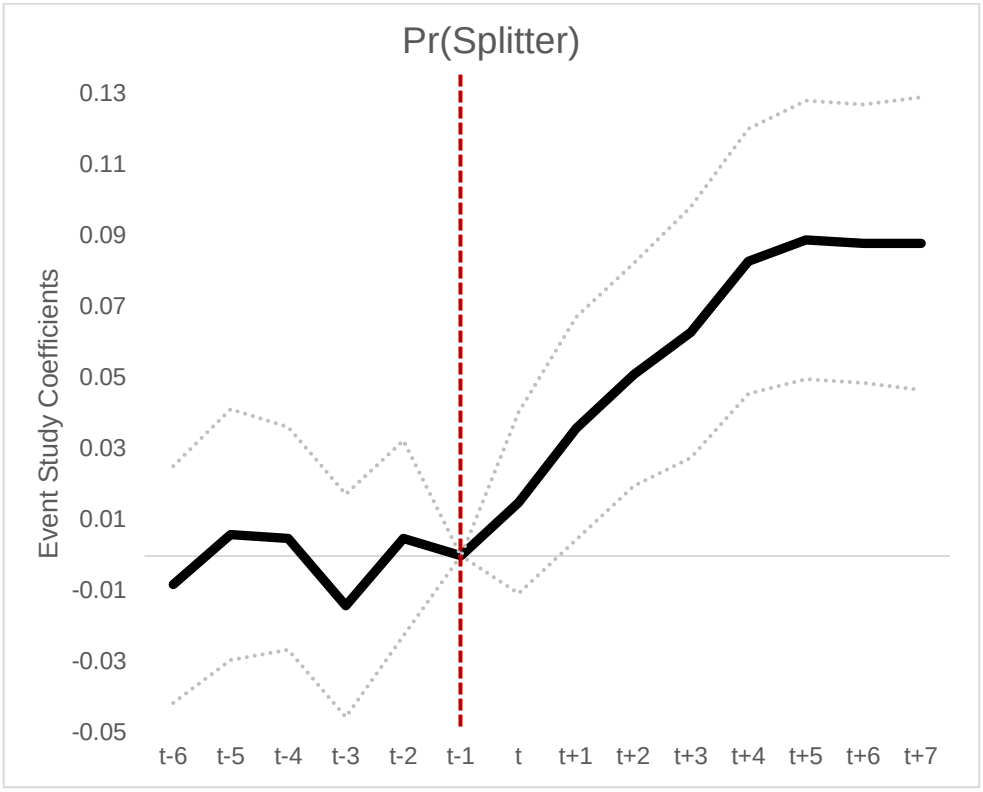
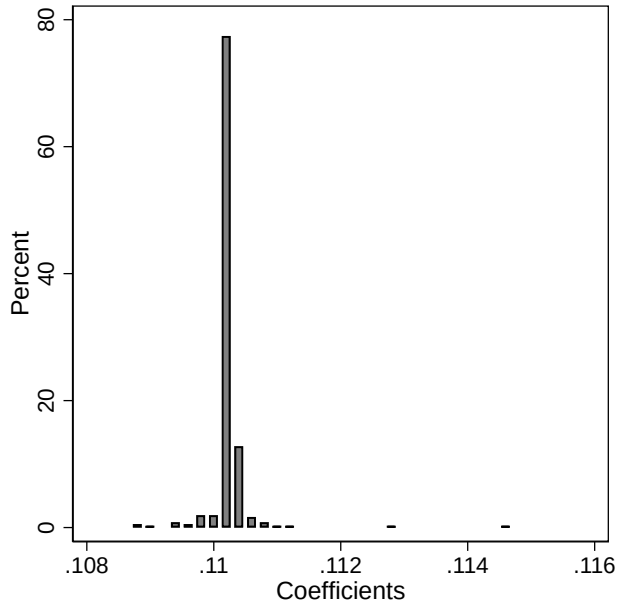
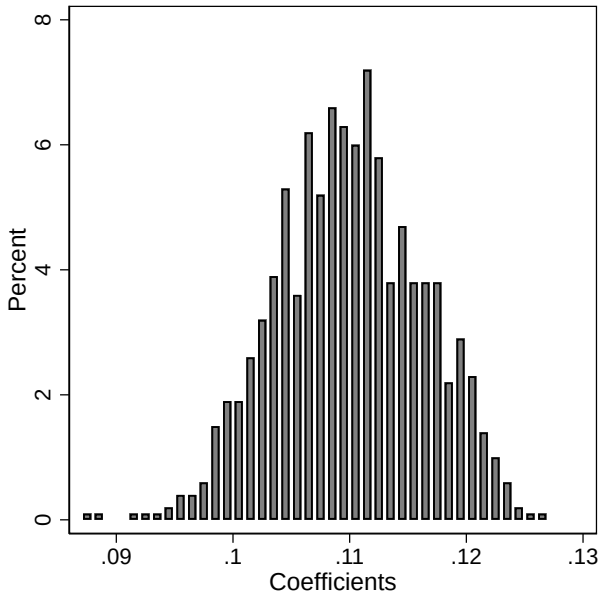



**Fig 3. Spillover Effect of Medicare Policy Change for Non-Medicare LC Patients**

*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%.



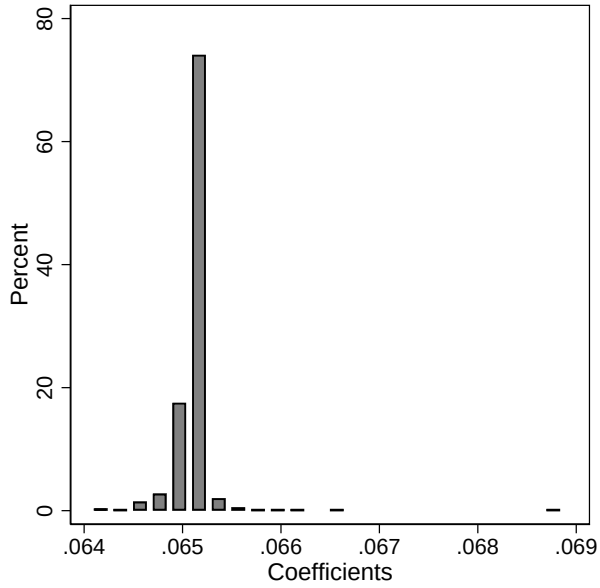

**(a) Systematically Excluding One Control Group Per Iteration**



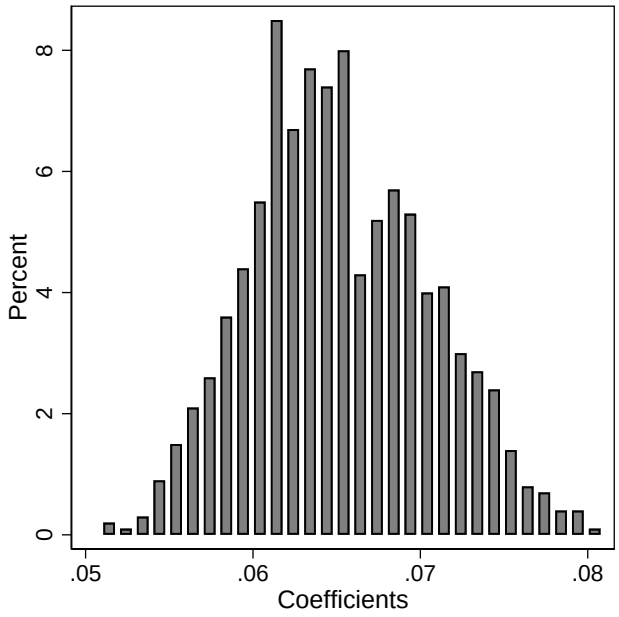

**(b) Randomly Drawn Control Groups: 1000 Iterations**

**Fig 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**

**Fig 5. Robustness Checks Against Alternative Control Groups for the Spillover (Commercial) DD Effect**

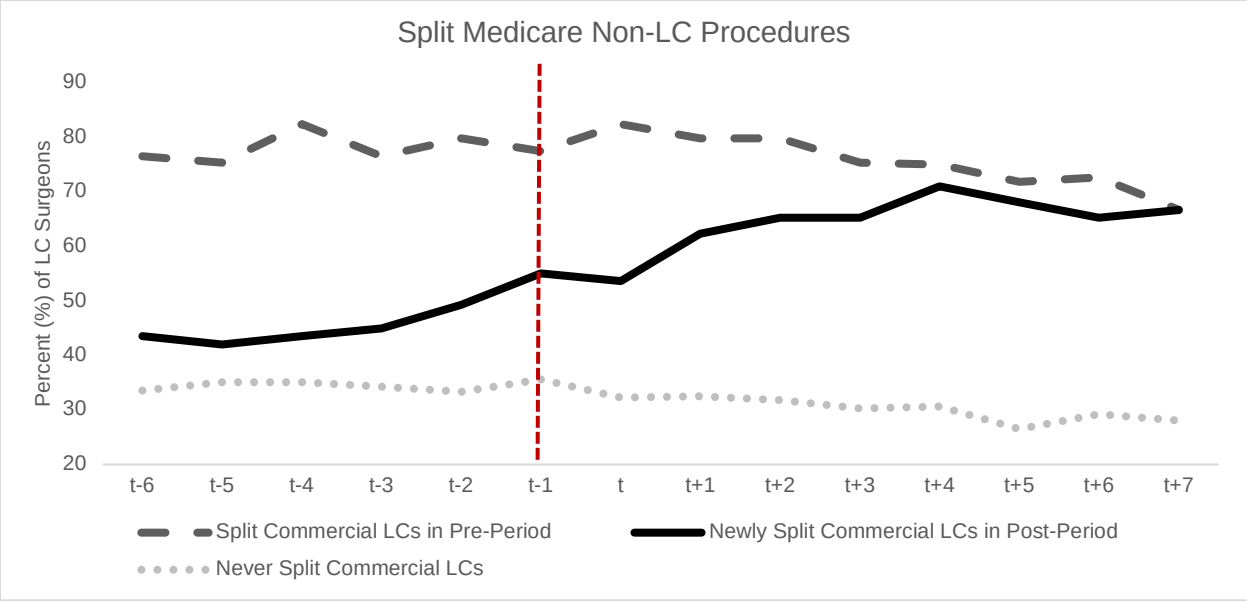
*Notes*: Panel A represent 540 re-estimations for the spillover effect on LC Surgeons' probability of splitting commercial payer LC cases between ASC and HOPD settings. Control group procedures are dropped one-by-one across the iterations. Panel B includes the DD estimates for 1,000 iterations of a randomly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

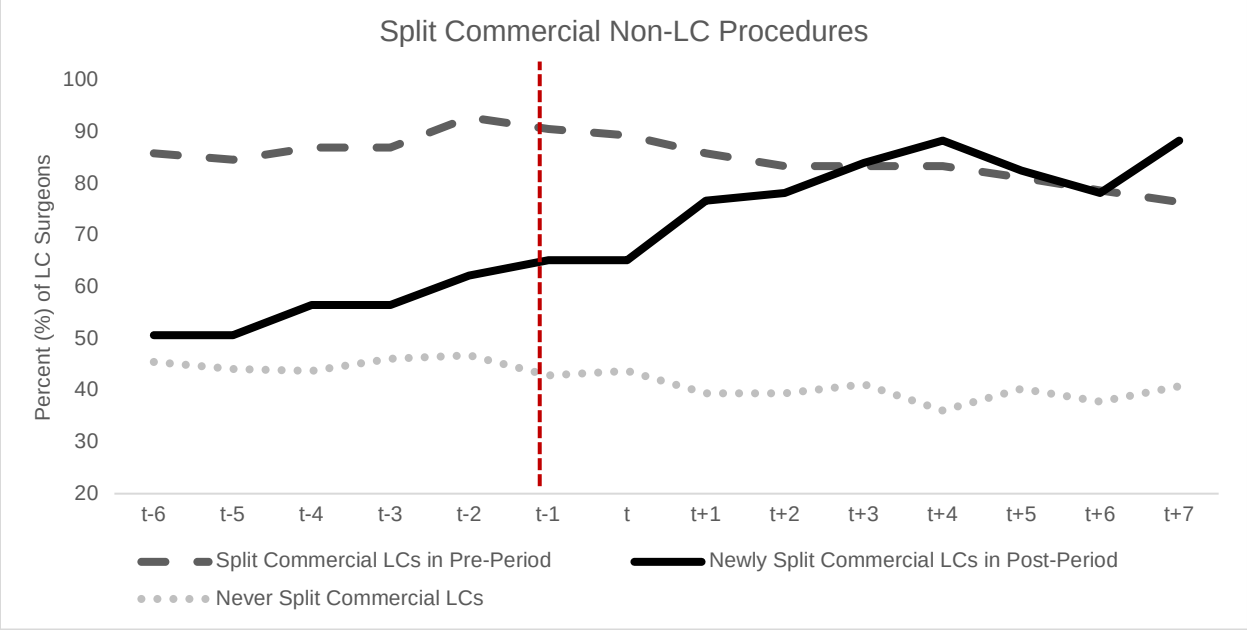
| | Pr(Splitter) | | Pr(Use ASC with Lap Technology) | |
|---|---|---|---|---|
| | Medicare | Commercial | Medicare | Commercial |
| | (1) | (2) | (3) | (4) |
| Post × LC Surgeon | –0.008 | –0.002 | –0.008 | –0.008 |
| | (0.018) | (0.018) | (0.019) | (0.019) |
| Physician FE | Yes | Yes | Yes | Yes |
| 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



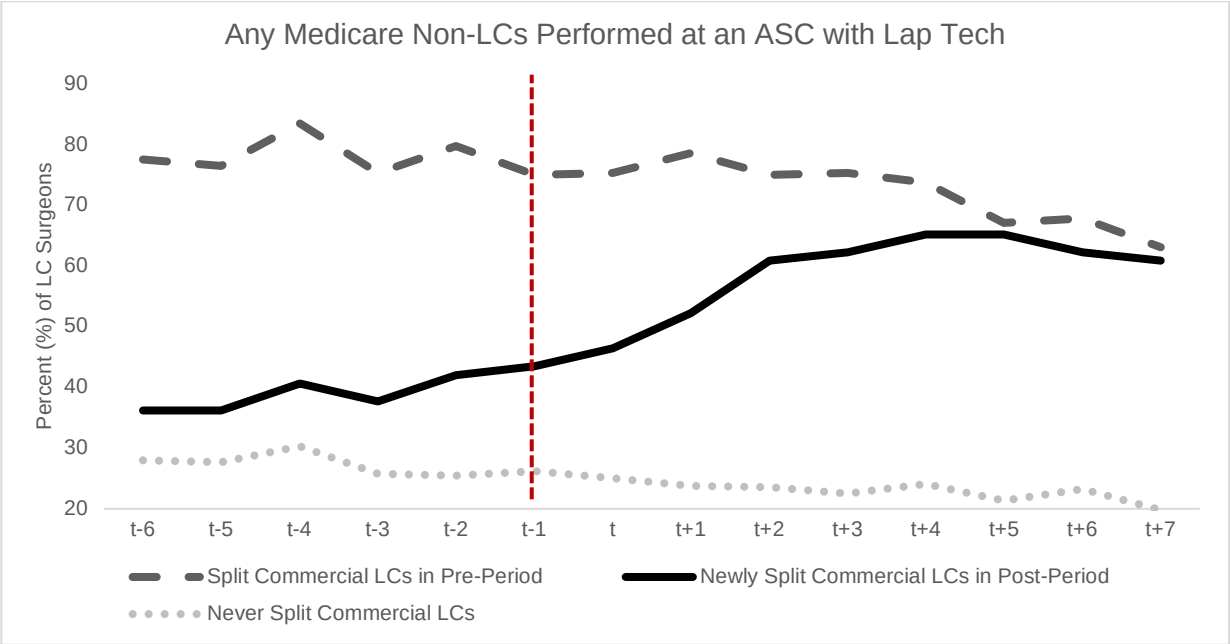

**(a) Medicare Outcomes**



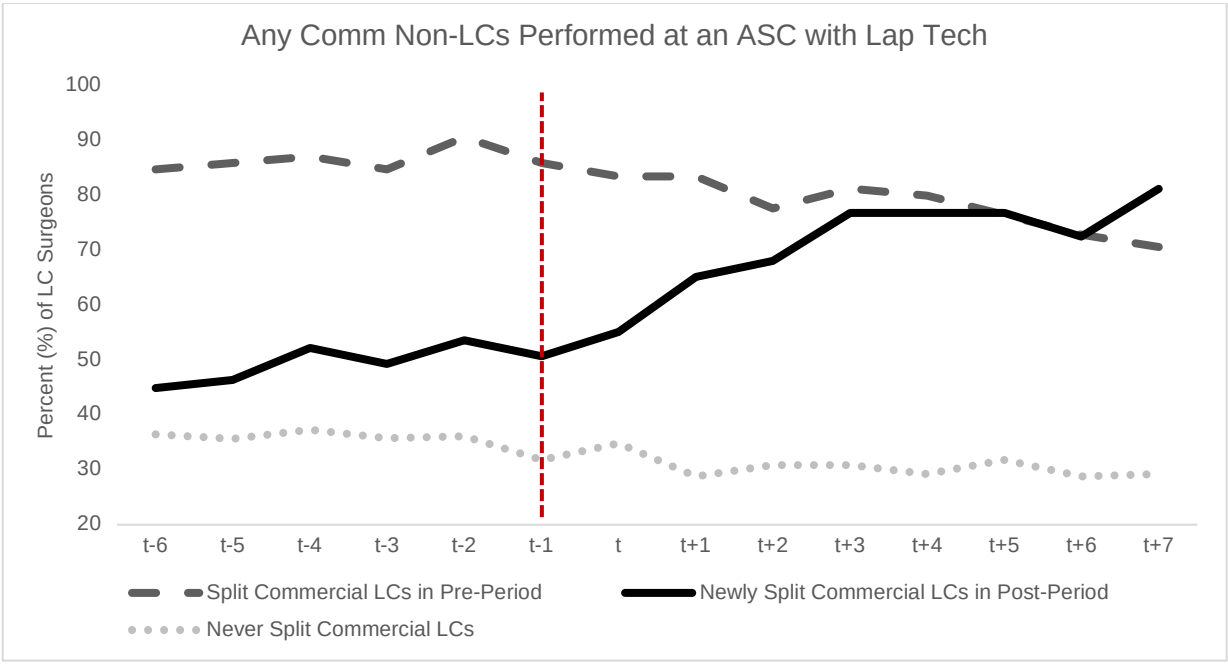

**(b) Commercially Insured Outcomes**

**Fig 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**

**Fig 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

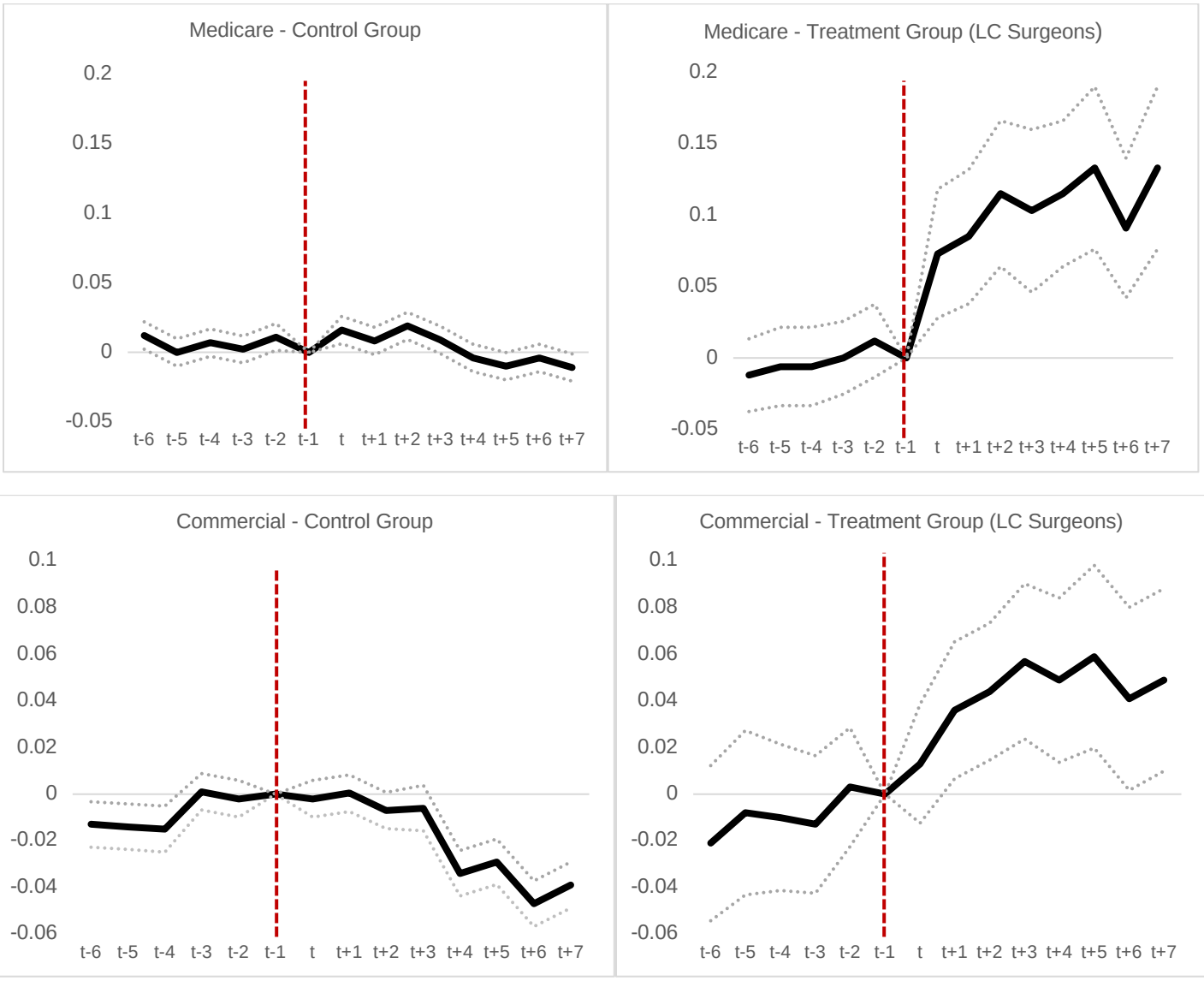
Appendix Table A2—Diff-in-Diff Estimates for the Medicare Regulation Spillover Effect on the Likelihood of Using Both ASC And HOPD Treatment Settings for Commercial Patients

| | **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

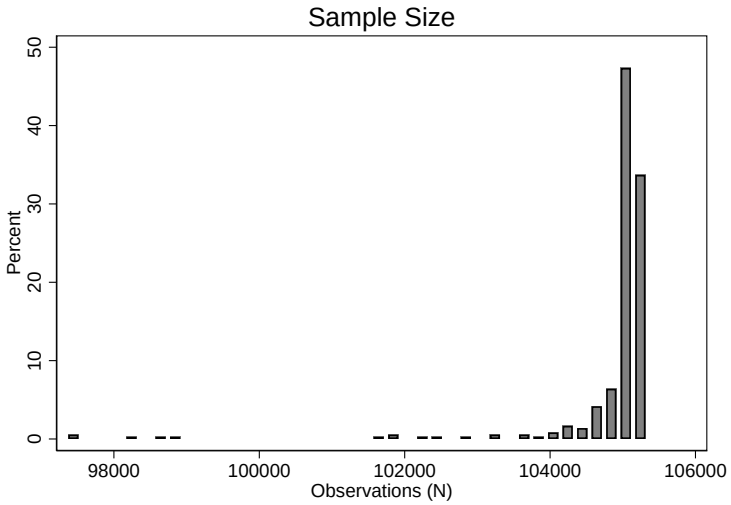
Appendix Figure A1: Separate Event Study Estimates for the Control Group and Treatment Group by Payer



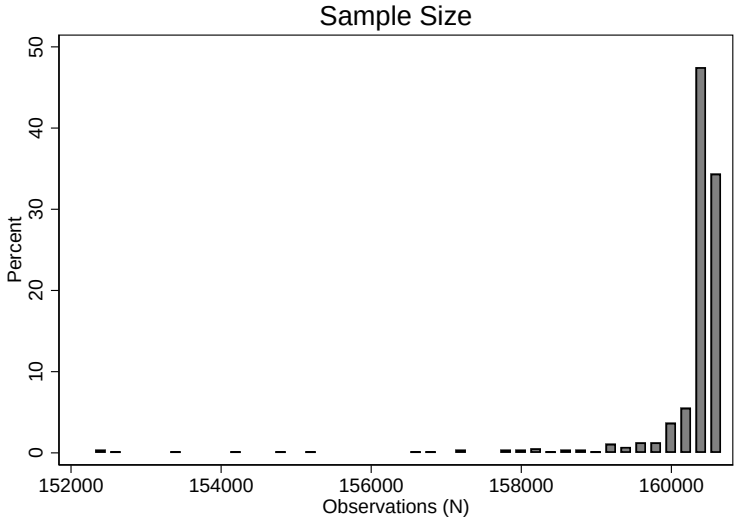

*Notes*: Control group corresponds to that used in the main event studies displayed in Figures 2 and 3. Of note, the top right panel (Medicare LC Surgeons) is not a precise zero for the pre-period coefficients due to a very small number of LC procedures reported as taking place within an ASC and for 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**

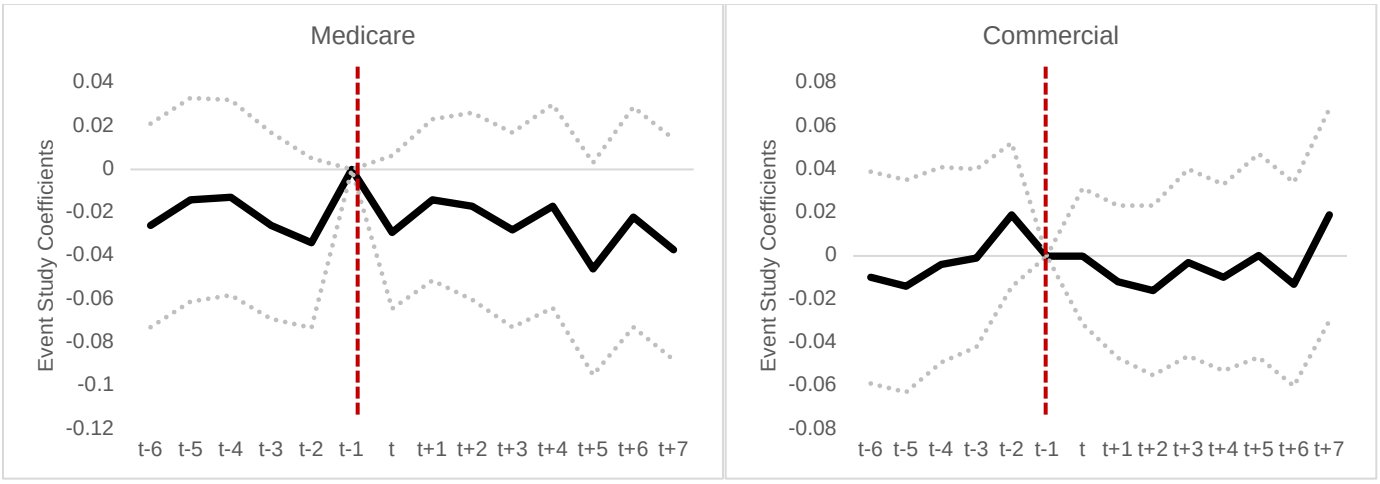



**(b) Commercial**

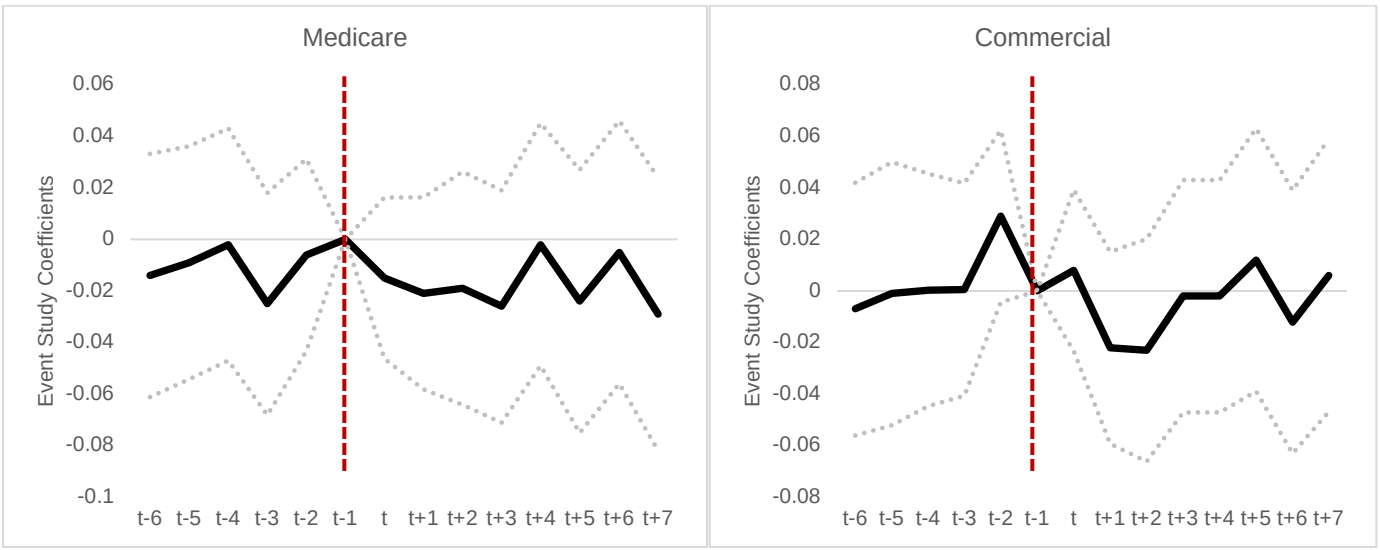


Appendix Figure A3: Event Study Results Corresponding to Table 4 in the Main Results

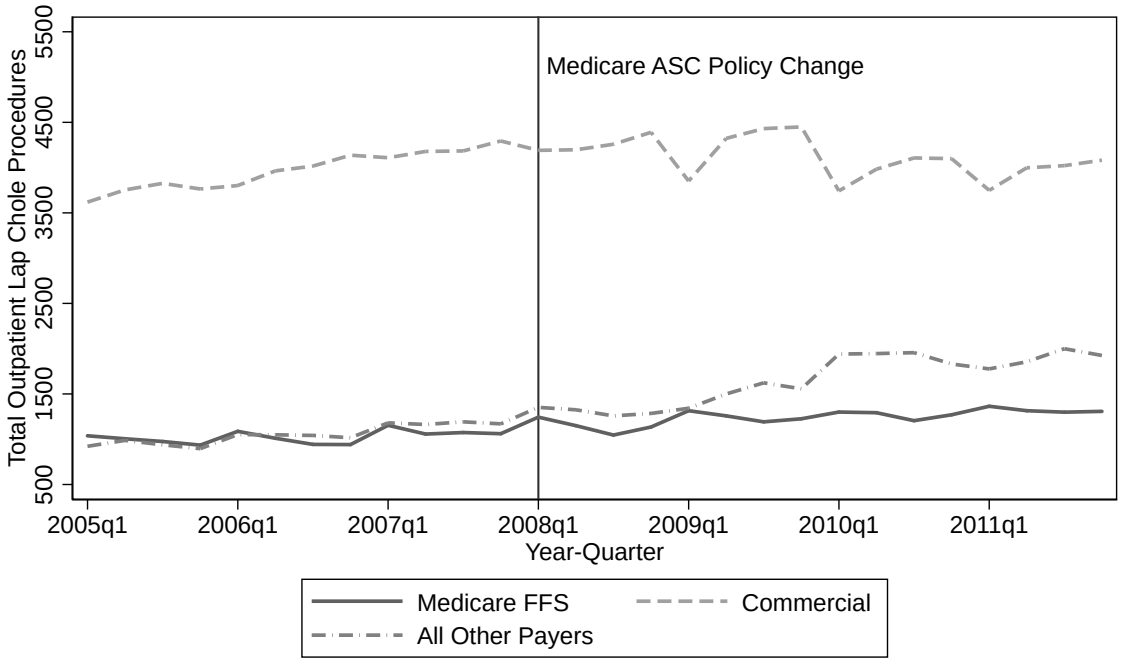
**Outcome: Pr(Splitter)**




**Outcome: Pr(Use ASC with Lap Technology)**



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

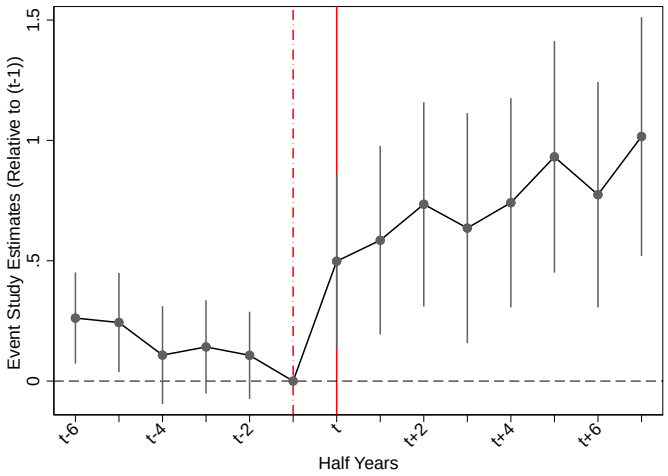



*Notes*: The data are from the universe of ambulatory procedure discharge records in Florida 2005-2011. The data are at the year-quarter level.

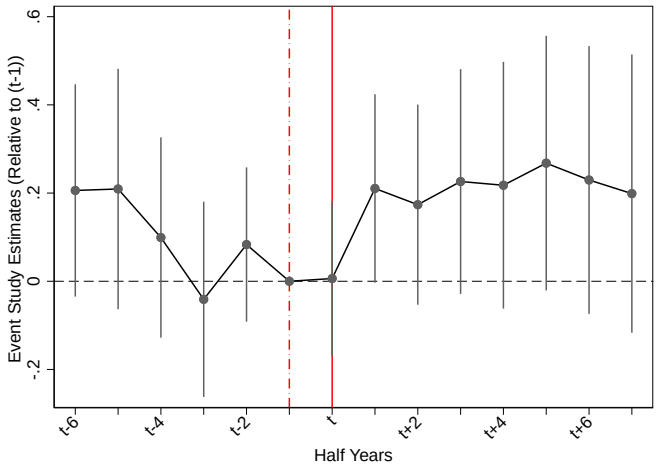
Appendix Table A3—Pre and Post Summary Measures for the Treatment and Control Groups Belonging to our DD Estimation

| | Pre-Period (2005-2007) | Post-Period (2008-2011) |
|---|---|---|
| Splitter – Medicare LC Surgeons | -- | 12.4% |
| Splitter – Medicare Control Group | 29.5% | 29.3% |
| | | |
| % in ASCs – Medicare LC Surgeons | -- | 6.3% |
| % in ASCs – Medicare Control Group | 57% | 62% |
| | | |
| Splitter – Commercial LC Surgeons | 12.3% | 17.5% |
| Splitter – Commercial Control Group | 38.4% | 37.1% |
| | | |
| % in ASCs – Commercial LC Surgeons | 5.2% | 8.2% |
| % in ASCs – Commercial Control Group | 54.3% | 59.4% |

Appendix Figure A5—Event Study Estimates for the Medicare Regulation Intensive Margin Effect: Percent of Procedures Performed in ASCs (in logs)




**(a) Medicare**




**(b) Commercial**

*Notes*: Treatment and control setup mirrors the main analyses; however, to preserve observations for the treatment group, a value of "0.01" was imputed for any treatment or control observation with 0% of procedures performed in ASCs in a given half-year so that a log value could be constructed.

# Appendix B

*Evidence on Rule Following*

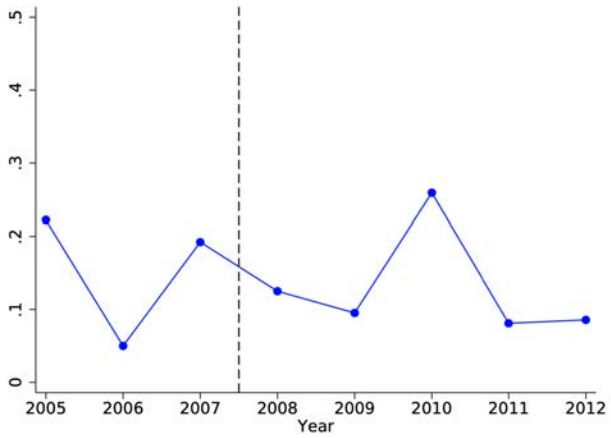
Here we investigate whether commercial insurers adopt Medicare's rules for banning (and lifting the ban) on LCs performed within ASC treatment settings. That said, we cannot observe commercial contract details with LC surgeons—and hence any direct rule following—in our discharge data belonging to our main analyses, 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.

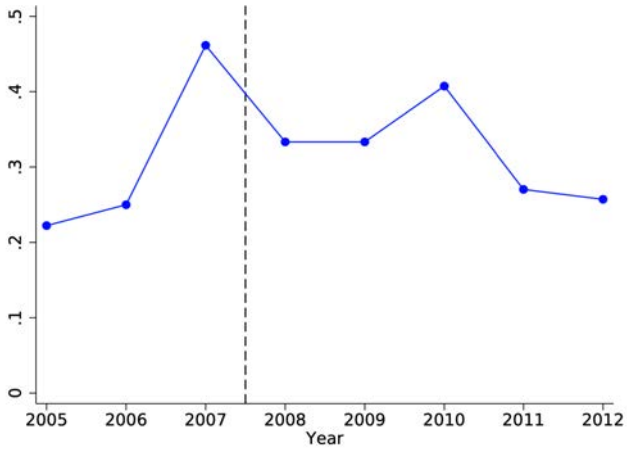
To investigate whether patterns in the Marketscan data are consistent with rule-following, we aggregate to the level of the payer. In this database this corresponds to the data contributor, and we limit to data contributors consistently present in the data over the study period. We plot the fraction 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 B1 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 B1. 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.

Appendix Figure B1: 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.