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Care Quality, Facility Investor, & Commercial Pricing Analyses Underway

Stress Testing Markets for Cardiac Care

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The diffusion of technological innovation depends on price signals and prevailing regulations. We study their intersection in cardiac procedure markets—a high-stakes medical field with regular treatment advancements. When Medicare policy newly permits non-hospitals to compete against hospitals for cardiac services, physicians exposed to new facility entry not only perform targeted Medicare services at these facilities but also untargeted procedures across payers. Beyond setting substitution, we find market expansion and higher spending overall following deregulation, with heterogeneity tied to state-level laws and hospital-physician integration. Ultimately, policy shapes healthcare market entry, which impacts the availability of treatment options and imposes externalities. (*JEL* H44, H51, H75, I11, I18)

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Technological innovation is a known source of economic progress and consumer welfare gains. However, the diffusion and ultimate impact of a given innovation will crucially depend on prevailing price signals and regulations facing private firms. Weak financial incentives and/or an unaccommodating regulatory environment can suppress, if not prevent, the spread of a technological advancement to market suppliers as well as end-consumers.

While these factors can be influential for a host of goods and services, the nearly $5 trillion healthcare sector within the US economy offers a salient example of where these forces collide. Technological advancement in medical care delivery can dramatically improve patient experiences and outcomes but also shape spending trajectories (Smith, Newhouse, and Freeland 2009; Chandra and Skinner 2012). Moreover, the mixed economy structure allows public sector pricing and policy—especially rulemaking by the large federal public insurance (i.e., Medicare) program—to strongly influence the incentives for intervention discovery as well as adopting new models of treatment delivery (e.g., see Finkelstein 2004; Acemoglu *et al*. 2006; Acemoglu and Finkelstein 2008; Blume-Kohout and Sood 2013; Budish, Roin, and Williams 2015; Freedman, Lin, and Simon 2015; Yurukoglu, Liebman, and Ridley 2017; Horn, Sacarny, and Zhou 2022). The downstream consequences of these pricing and policy decisions are also not confined to the Medicare market. The size of the program, coupled with providers' own preferences and time constraints, can cause a Medicare-specific decision to spillover onto the care delivery experience and spending for non-Medicare patients (Yip 1998; Clemens and Gottlieb 2017; Richards, Seward, and Whaley 2021; Chen *et al*. 2022; Geruso and Richards 2022; Barnett, Olenski, and Sacarny 2023).[1] Even within the Medicare program, a targeted rule can extend to untargeted procedures flowing to other Medicare beneficiaries.

The ripple effects of Medicare rulemaking are further amplified by the joint production of care delivery between provider clinicians (e.g., physicians) and provider facilities (e.g., hospitals), with separate financial incentives and separate regulations typically belonging to each production input. Policy decisions for the latter (facilities) can therefore dictate the treatment options available to the former (clinicians). The intended users of a new treatment option as well as the recipients of the treatment (i.e., patients) will have their choices expanded or constrained by the prevailing

[1] Of note, private insurers with sufficient market dominance can likewise generate externalities for the public insurance segments (e.g., see Richards and Tello-Trillo 2019).

regulatory environment facing healthcare facilities. And to further complicate matters, the rules established for these facilities can occur at both the federal and state levels, leading to policy interactions and potentially conflicts.

One medical care arena with some of the most active regulatory changes focuses on procedural and surgical care, especially when delivered in an outpatient setting. Due to new medical technologies and clinical process improvements (e.g., minimally invasive surgical techniques and in-home recovery options), a growing share of procedural care is now safely performed in non-hospital-based outpatient settings—with the freestanding ambulatory surgery center (ASC) industry being one of the most prominent examples. Importantly, these alternative (non-hospital) settings, can offer superior patient experience at lower costs—including to the Medicare public insurance program. But that does not mean that treatment setting substitution is without friction. Regulatory policy often creates a barrier to use of non-hospital options based on perceived patient safety concerns. Thus, surgeons and proceduralists may not benefit from full setting flexibility when planning treatment, at least not until a deregulation event occurs.

The national Medicare program is one of the most important sources of this type of regulatory restriction—and hence is frequently the source of decisions to eliminate such barriers for providers. We can see this concretely in the cardiac procedure space. Cardiac disease remains one of the leading causes of death in the US but over time providers have benefited from more clinical tools and clinical options at their disposal to intervene for these patients.[2] But Medicare regulatory permissions have not always kept pace with evolutions in clinical capabilities, and instead, appear with a lag. As a key example, starting in January 2019, the Centers for Medicare & Medicaid Services (CMS) expanded the list of cardiovascular procedures that can be reimbursed in ASC settings. The eleven Healthcare Common Procedure Coding System (HCPCS) codes range from 93451 to 93461 and reflect clinical variations of cardiac catheterization—a set of procedures to visualize blood flow through the heart, identify and diagnosis issues, and facilitate intervention to improve flow and cardiac function (CMS 2019). This federal policy change was of a longstanding interest to healthcare providers and the ASC industry, specifically, and represents a sizable shift in the public insurer's view of what is permissible for care delivery outside of a

[2] National mortality statistics are available from the Center for Disease Control and Prevention (CDC) and can be found here: https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm.

hospital setting. Yet, the direct and indirect market ramifications of this policy decision are currently unknown.

In this paper, we use this deregulation event from Medicare as a market entry shock to local healthcare providers' cardiac care treatment options. We comprehensively assess the policy changes impact on physicians' cardiac catheterization treatment setting choices, productivity, and Medicare spend, as well as spillover effects on other Medicare outpatient procedures and non-Medicare outpatient procedures. We do so by leveraging all-payer discharge records from the state of Florida—a state with a sizable Medicare population and relatively more aggressive ASC entry into cardiac care markets following the removal of the ASC setting barrier—as well as national Medicare claims data to capture the decomposition of physician setting substitution and payer-specific spending implications. Importantly, we also examine the role of state regulation in shaping cardiac care treatment setting by exploring heterogeneity by state-based Certificate of Need (CON) laws germane to this policy event and subsequent market competition.

We identify the effects of post-deregulation market entry using a "stacked" differences-in-differences (DD) and event study framework. Using variation in the timing and location of ASC entry as an exposure shock to physicians' treatment setting options, we then examine the volume of targeted (i.e., 2019 policy-relevant) Medicare ASC cases and the volume of untargeted Medicare ASC cases for each physician as well as their volume of these same procedures for other payers in Florida. We also apply this same DD research design to our national Medicare claims data to confirm that our Florida (all-payer) findings are likely representative of non-Florida markets and to expand the market-level effects that our results can capture.

We ultimately find that physicians exposed to ASC entry sharply increase their use of an ASC to perform the targeted procedures for Medicare beneficiaries once this option becomes available. This first-order effect makes clear that Medicare's previous regulations were binding and created a meaningful barrier to entry for the ASC industry into the cardiac catheterization procedure market. However, our all-payer data further demonstrate spillovers onto untargeted Medicare procedures performed by the same physicians as well as their non-Medicare procedure volumes (i.e., services common to the Medicare 2019 rule change as well as services outside of the 2019 rule change). We also show that the direct and indirect effects on cardiac specialists' treatment setting decisions is largely driven by an extensive margin behavior change. These

physicians are roughly 5-10 percentage-points more likely to perform any procedure for any payer in an ASC immediately after an ASC enters the cardiac care market. Heterogeneity analyses reveal that a key subset of cardiac specialists do not alter their medical decision-making: those employed by hospitals. Vertically integrated physicians do not take up the new opportunity to perform targeted or untargeted cases within the rival (ASC) industry.

When turning to our national Medicare claims data, we first explore the market-level effects of ASC entry on the total supply of the policy-targeted procedures and then detail physicians' setting substitution across three eligible sites: ASCs, HOPDs, and office-based labs (OBLs). We find that the total cardiac procedure volume increases by 10-15% following ASC entry, which is consistent with an increase in physician productivity and overall market expansion for Medicare beneficiaries. At the same time, local markets exposed to ASC entry experience declines in these cardiac procedure cases in both HOPD and OBL settings, which is indicative of setting substitution and hence business stealing by the new ASC firms. Taken together, entering ASCs compete away some cases for alternative settings but also increase the overall cardiac procedure volume in the market as well. However, these net effects on procedure activity have important financial implications for the Medicare program. Specifically, Medicare spending on the relevant procedures sharply increases and is nearly 40% above pre-ASC-entry levels in affected counties. Given that total Medicare volume for these cardiac procedures only increased by 10-15%, the disproportionately larger changes in spending suggest that savings generated by HOPD-to-ASC substitutions are offset by OBL-to-ASC substitutions, resulting in higher per-case spending for the public insurer.

We conclude our empirics by assessing the role of state-to-federal policy interaction due to states' use of "Certificate of Need" (CON) laws. Using a modified DD empirical strategy within our national Medicare claims data, we show an approximately 10% targeted cardiac procedure volume expansion in healthcare markets residing in states without restrictive regulatory environments compared to those in states that are less accommodating to ASC entry for cardiac care. The effects are also dynamic and correspond to observed ASC entry events across the country. Thus, state-level impediments to entry seem to curtail ASC industry growth for these medical services, which prevents the market expansion effects described above.

Our collection of findings makes clear that Medicare rulemaking for procedural and surgical care matters. Physicians' treatment setting choices are impacted not only for care targeted by a given Medicare policy but also for other care for Medicare patients as well as non-Medicare patients—consistent with recent research in this emerging area (Richards, Seward, and Whaley 2021; Geruso and Richards 2022). In our analytic setting, these Medicare policy externalities appear large enough to prevent the affected physicians from ever utilizing a specific, and potentially lower cost, treatment setting option for any of their patients. However, allowing greater market entry has mixed implications for the Medicare program. There is potentially desirable setting substitution (i.e., HOPD-to-ASC), which can add efficiencies for care delivery to Medicare beneficiaries. But any resulting savings appear overwhelmed by the combination of OBL-to-ASC substitutions and the overall market expansion driven by ASC entry. Higher overall Medicare spending on these cardiac care services would need to be coupled with downstream health improvements to justify higher expenditures and therefore a greater tax burden tied to the public insurer. The presence of multiple substitution margins, with opposite Medicare spending implications, also suggests roles for site-neutral reimbursements to better incentivize optimal care delivery following deregulation. And finally, the extent and speed of Medicare policy impact is mediated by state-level regulations as well as organizational dynamics within and across provider industries. Federal policymakers and public insurer administrators will need to keep this nuance in mind, as both state healthcare policy and provider ownership structures continue to evolve.

I. Outpatient Surgical Markets

A. *Industry Rivals*

More medical services are shifting outside of the inpatient setting over time, especially with respect to low-to-medium risk ("same day") procedures that do not require an overnight hospital stay (Munnich and Parente 2014; Baker, Bundorf, and Kessler 2019). This long-running trend poses a challenge for much of the "brick-and-mortar" hospital industry since inpatient delivery of care tends to generate more revenue per case, and the outpatient market landscape is becoming more crowded with competing hospital and non-hospital treatment setting options. Currently, outpatient procedural and surgical care commonly take place in one of three key facility settings: hospital outpatient departments (HOPDs), ambulatory surgery centers (ASCs), or physician office-based

labs (OBLs)—with the scope of eligible procedures narrowing when moving from HOPD to ASC to OBL settings. While joint ventures and common ownership structures can occur (e.g., see Richards and Whaley 2024), firms from each industry often compete against each other with respect to their overlapping service offerings.

ASCs main value proposition vis-à-vis HOPDs is improved consumer experience and generally less expensive care for payers and patients (Paquette *et al*. 2008; Grisel and Arjmand 2009; Munnich and Parente 2014; Weber 2014; Munnich and Parente 2018; Aouad, Brown, and Whaley 2019; Carey and Mitchell 2019; Sood and Whaley 2019; Maughan *et al*. 2025). Relative to OBLs, ASCs can often handle more complex care and utilize more advanced medical technology but may also have a higher price point for a given service common to both treatment settings. Over time, hospitals have been facing increasing competition with ASCs, specifically (e.g., see Munnich and Richards 2022), and are known to lose market share and revenue to these rival firms (Bian and Morrisey 2007; Courtemanche and Plotzke 2010; Carey, Burgess, and Young 2011; Hollenbeck *et al*. 2015). Evidence suggests that HOPDs may even be forced to lower their procedural prices in response to greater ASC competitive pressure (Carey 2017; Whaley and Brown 2018; Baker, Bundorf, and Kessler 2019).

Beyond intensifying competition over time, outpatient surgical markets are also characterized by a principal-agent relationship (e.g., see Munnich *et al*. 2025). Physicians hold considerable sway over medical treatment decisions, including treatment setting, which can have profound impacts on overall medical spend (Arrow 1963; Dranove and White 1987; McGuire 2000; Gabel *et al*. 2008; Hollingsworth *et al*. 2010; Mitchell 2010; David and Neuman 2011; Plotazke and Courtemanche 2011; Yee 2011; Howard, David, and Hockenberry 2017; Munnich *et al*. 2025). Incentive structures directly facing physicians can tilt their medical decision-making in favor of a particular outpatient facility option (e.g., Richards, Seward, and Whaley 2022; Munnich *et al*. 2025), but even in the absence of private incentives or organizational pressure, physicians' options are often constrained by payer-specific rulemaking that prohibits a particular option for certain patients. And in the presence of common treatment styles across similar patients belonging to other payers—due to physician preferences, switching costs, and/or other constraints—such payer-generated rules can spillover to other patient-payer combinations.

B. *State Regulatory Barriers*

US healthcare markets are also shaped by state-level policy choices. More specifically, "Certificate of Need" (CON) laws represent longstanding and controversial policies implemented by states that, in their most extreme form, can block entry of new healthcare businesses within the relevant healthcare industry or industries. Although Medicare approved reimbursement for cardiac catheterization services in outpatient settings in 2019, restrictions in state CON laws and state licensure laws for ASCs can still limit the provision of cardiovascular services in outpatient settings. While studies have examined CON regulations and provider supply as well as patients' use of services, these studies are rarely employing causal research designs—see Chiu (2021), Melo *et al*. (2024), and Bjoerkheim and Melad (2025) as recent attempts to move toward causal empirical approaches. CON-related studies can also be limited by imprecise legal data that only account for whether a state has any CON requirement for medical services, rather than a CON requirement specifically applying to key services subject to a policy change, such as cardiac catheterization in ASCs. We avoid these shortcomings with our supplementary empirics described in Section VI.

II. Empirical Strategy: Medicare Policy Spillovers

The first portion of our empirics documents the post-policy entry of ASCs for the relevant cardiac services within the Medicare market and then tests for spillover effects onto untargeted Medicare procedures performed by the same physicians as well as their *non-Medicare* procedure volumes (i.e., services common to the Medicare 2019 rule change as well as services outside of the 2019 rule change). Doing so reveals if Medicare rulemaking is a barrier to using alternative and potentially lower cost treatment setting options for a wider swath of care, and hence, quantifies the full extent of externalities tied to Medicare's regulatory stance toward these specialized cardiac services prior to 2019. We then follow these spillover analyses with our national Medicare data in Section IV to comprehensively assess the economic impact of Medicare's policy change on its own beneficiaries and finances.

A. *Data*

Our first source of analytic data comes from the Florida Agency for Health Care Administration (AHCA). These data provide the universe of outpatient procedural and surgical care episodes within HOPDs and ASCs from 2018Q1-2023Q4 across all payers. The latter attribute is vital to formally test for causal Medicare policy effects on other procedure and payer markets. Florida is also a populous state that is home to a large number of Medicare beneficiaries and robust healthcare industries. Each outpatient procedural discharge record (i.e., case) includes the facility type, the facility location, and the clinical provider (in this context: physician cardiac specialist) that is primarily responsible for delivering and overseeing the patient's care. We therefore know what services were provided, where, and by whom. We leverage this detailed information to construct our differences-in-differences (DD) analyses discussed in Section IIB.

Within Figure 1, we can see the timing and degree of ASC entry into the policy-relevant cardiac care markets for Medicare patients. The first such cases appear in early 2020 but do not demonstrate rapid growth until 2022—a lag relative to the policy change that could reflect the combination of building and licensing time horizons for a new facility as well as pandemic-era market uncertainty that restrained entrepreneurial activity as well as credit markets. By 2023, the ASC industry volume for these cardiac procedures plateaus at approximately 600 encounters per quarter and captures around 8% market share when compared to the total volume produced by ASC and HOPD settings in the aggregate.[3]

B. *Estimation*

We exploit the fact that while ASC entry does occur in Florida (Figure 1), it occurs unevenly throughout the state. Specifically, we observe in the data that six firms located within six unique counties are responsible for this entry behavior, especially during the 2022 ramp up in ASC market presence. We consequently treat the timing and location of ASC entry as an exposure shock to relevant physicians performing these cardiac procedures at baseline in the same counties where

[3] Of note, the Florida discharge data do not allow us to observe OBL cardiac catheterization activity. However, our national Medicare claims data (Section IV) allow us to capture procedural activity across all three settings—though just for a single payer.

entry takes place and compare their outpatient surgical care activity to similar physicians that work elsewhere around the state of Florida.[4] We also restrict our entry events of interest to those in 2022 through the start of 2023 in order to leverage the aggressive entry during that time and to avoid the peak of the COVID-19 pandemic while still preserving sufficient post-period observations.

For each physician, we calculate the volume of targeted (i.e., 2019 policy-relevant) Medicare ASC cases as well as the volume of untargeted Medicare ASC cases. We do likewise for each physician's full payer mix, including Medicare Advantage, Commercial (non-Medicare), and a composite 'All Others' subgroup. Doing so provides a full accounting of physician-level productivity for each quarter-year, with the procedures stratified along two dimensions: payer type and policy relevance. We also generate a payer-specific extensive margin outcome that captures the physician's use of an ASC at all for any patient belonging to a given payer in each quarter-year.

Given the differential timing in ASC entry exposure, even over this relatively narrow window, we operationalize our DD estimation using a 'stacked DD' strategy—akin to other recent work (e.g., see Chen *et al*. 2023; Lin *et al*. 2023; Munnich *et al*. 2025). For the treatment group physicians, we incorporate their market activity six quarters before the ASC entry exposure and the four quarters during entry exposure. Since the control group (i.e., unexposed) physicians do not possess a fixed date to establish a pre- and post-period, we randomly assign a placebo date that serves as the anchor for their panel of care delivery that they ultimately contribute to the stacked DD analytic data. The potential placebo dates are drawn from the range observed in the treatment group, and we again restrict to the six quarters prior to the randomly assigned anchor date and the following four quarters. All treatment and control group physicians provide a balanced panel of data over the 10 quarters of DD analytic data.

Our first specification is adapted to an event study framework:

$$Y_{pt} = \phi_p + \tau_t + \sum_{\substack{j=-6 \\ j\neq -4}}^{3} \delta_j \left(Treated_p \times time = j \right) + \varepsilon_{pt}$$

[4] We identify relevant physicians by using the publicly available Physician Compare data from CMS in order to restrict to physicians with cardiology, interventional cardiology, or vascular surgery as their primary specialty in order to ascertain that they are appropriately trained to perform the cardiac procedures of interest.

We also estimate a "2x2" version of DD specification that pools the post-period estimates into a singular average policy effect:

$$Y_{pt} = \phi_p + \tau_t + \delta(Treated \times Post)_{pt} + \varepsilon_{pt}$$

Common to both estimations, we have a binary treatment group variable (*Treated*) as well as physician (ϕ) and stacked quarter-time (τ) fixed effects. We also cluster the standard errors at the physician level throughout.

Given the recent wave of hospital-physician integration and known consequences for referral patterns (e.g., Richards, Seward, and Whaley 2022), we also formally test for a heterogeneous response by physicians' vertical integration (i.e., employment) status with respect to local hospitals and health systems. We do so by implementing a simple extension of Equation (2) above to estimate a triple difference-in-differences (DDD) specification that incorporates a binary indicator for vertical integration status at the physician level. We are then able to examine whether hospitals influence the treatment setting decisions by their physician employees in a manner that differentially retains their case volumes in the (higher cost) HOPD setting.

III. Results: Medicare Policy Spillovers

A. *Main Results*

Our stacked DD results begin in Figure 2 and effectively capture the "first stage" of our analyses by testing for physician-level changes in ASC procedure volumes for the 2019 Medicare policy targeted procedures. Panel A of Figure 2 confirms that physicians exposed to ASC entry are sharply increasing their use of an ASC to perform the targeted procedures for Medicare beneficiaries—approximately 1 cardiac procedure per quarter following ASC entry into the market. Importantly, the remaining panels of Figure 2 demonstrate spillover effects for these same procedures performed on patients from non-Medicare payers. Both Medicare Advantage and commercial

insurers payer groups experience roughly 0.5 of these procedures performed in an ASC once traditional Medicare removes its prohibition blocking ASC entry for these cardiac services. The 'All Other' mixed payer group shows suggestive evidence of a spillover effect as well, but it is an order of magnitude smaller when compared to the event study estimates within the other three panels of Figure 2.

Figure 3 extends our examination of spillover effects to *non-targeted* procedures for each of the four payer segments. In this way, differential ASC volume changes for any of the payer groups, including Medicare, would represent an externality from the targeted 2019 rule change. Consistent with the findings in Figure 2, we observe more procedures performed within ASC settings across entry-exposed physicians payer mix, with the exception of the much smaller 'All Other' subgroup. These physicians perform between one-half and one case per quarter for their Medicare patients and approximately one-half cases per quarter for their Medicare Advantage and commercial patient populations.

Within Table 1, we provide the "2x2" estimates for the untargeted procedure volumes in ASCs by payer type and juxtapose these findings with triple differences estimation results that formally test for a heterogeneous response by physicians vertically integrated (i.e., employed) by local hospitals and health systems. It is clear from Table 1 that the physicians working in areas experiencing ASC entry had almost no ASC case volumes prior to the arrival of new ASC treatment setting options. For their three main payer segments (columns 1, 3, and 5 in Table 1), the DD estimate translates to a 7-10 times larger ASC case load than their pre-period average. Importantly, the triple differences results reveal that there is virtually no change in ASC utilization for physicians vertically integrated with hospitals. The DDD estimates are almost perfectly offsetting when compared to the DD estimates and are also consistent with hospitals being able to exert pressure on their physician employees to retain their case volumes in the (higher cost) HOPD setting.[5]

Figure 4 offers our extensive margin results for ASC use by payer segment. The findings strongly reveal that the post-2019 entry behavior for cardiac services by the ASC industry is causing many of the relevant, local physicians to begin using ASC treatment settings for the first

[5] Related work finds foreclosure effects for ASCs following hospital and health system acquisitions of physician practices that provide procedural and surgical care (Richards, Seward, and Whaley 2022).

time. For traditional Medicare, Medicare Advantage, and commercially insured patients, these physicians are roughly 5-10 percentage-points more likely to perform any treatments in an ASC immediately after the ASC entry event. Given the low baseline ASC utilization rates (1-3%) for both the treatment and control group physicians (Table 2), the differential increases among the ASC entry-exposed cardiac specialists represents an approximately 300-500% relative increase in extensive margin ASC use.

B. *Extensions*

Before concluding our use of the Florida discharge data, we adapt our stacked DD framework to a 'market-level' analyses in order to ensure that our physician-level analyses are not generating unrepresentative inferences and to motivate our empirical work described within Sections IV and VI. The setup and empirical execution closely follow Section IIB. The main modifications are twofold: (1) construct the data at the county-by-time level and (2) transform Equation (1) into a county-level event study estimation.[6]

$$Y_{ct} = \alpha_c + \tau_t + \sum_{\substack{j=-6 \\ j\neq -4}}^{3} \delta_j \left(Treated_c \times time = j\right) + \varepsilon_{ct}$$

Following the aggregation change to the county-level, rather than physician-level, we only need to substitute county fixed effects (α) for the previous physician fixed effects (ϕ) and to cluster the standard errors at the county level as well. The remainder of Equation (3) and its interpretations are otherwise identical to Equation (1).

Figure 5 and Figure 6 present the payer-specific results from the county-level stacked DD event study estimation for targeted and non-targeted procedures, respectively. The findings align well with Figures 2 and 3 in Section IIIA. ASC entry corresponds to a sharp increase in Medicare

[6] For the "non-targeted" ASC procedures at the county level, we only count cases where the patient's principal diagnosis code falls within the ICD-10 range for circulatory medical problems.

as well as non-Medicare ASC case volumes for the cardiac procedures tied to the 2019 rule change by the Medicare program (Figure 5). The effect size is nearly 100 targeted procedures per quarter in an ASC setting for the traditional Medicare market and 30-50 of these same procedures per quarter for the Medicare Advantage and commercially insured markets. All key payer segments likewise experience a spillover effect for non-targeted ASC case volumes following the ASC entry event as well—ranging from 5 to 40 cases per quarter (Figure 6).

IV. Empirical Strategy: Productivity, Setting Substitution, and Spending

A. *Data*

Moving to our national Medicare claims data, we next explore ASC cardiac market entry effects on the total supply of these specific procedures at the local market level as well as a decomposition of the procedure volumes across the three eligible settings: ASCs, HOPDs, and OBLs. Besides offering national scope to the analyses, the Medicare claims data also allow us to capture procedural activity within OBLs—which is unobserved in the Florida discharge data (Section II-III) and other discharge database sources, as far as we are aware.

We specifically utilize a 20% traditional Medicare Part B claims data from 2017-2023 and spanning all 50 US states and Washington DC. We identify the number of relevant cardiac catheterization procedures (i.e., the eleven HCPCS of interest) in each county in each quarter year and stratified by setting (i.e., ASC, HOPD, or OBL). We consider counties with 10 or more relevant procedures performed within an ASC as experiencing ASC entry into this cardiac care market and thereby "treated" in our DD research design. The minimum threshold of 10 procedures is to minimize reporting errors in the claims data (i.e., inaccurate place-of-service coding) and consequently misclassification of treatment versus control status for a given county.

B. *Estimation*

Given the Medicare claims data and county-level aggregation, our DD estimation closely follows what was used with the state-level discharge data in Section III to test for Medicare deregulation spillover effects. We simply repurpose Equation (3) from Section IIIB but now apply it to our

analytic data that are national in scope—but limited to one payer. The event study implementation and interpretations are otherwise identical to those in Section III. Our outcomes of interest include: total cardiac catheterization procedures (irrespective of setting), procedures volumes for each specific setting, and total Medicare spending for these procedures (irrespective of setting).

V. Results: Productivity, Setting Substitution, and Spending

Figure 7 captures the stacked DD estimates for the aggregate (i.e., setting agnostic) supply of these specific cardiac procedures when comparing counties that experienced ASC market entry to those that did not. Total cardiac procedure volume in the treatment group is closely tracking the control group counties for the six quarters prior to the entry event. Immediately following entry, the volume increases by 10-15%, implying an overall market expansion effect.[7] Of note, a modest strand of economics literature finds that public insurance size and incentives can impact physician labor supply (e.g., Garthwaite 2012; Chen, Lo Sasso, and Richards 2018). The results in Figure 7 are at least consistent with the Medicare deregulation decision and subsequent facility option expansion facilitating greater output among local physicians.

Within Figure 8, we provide a complete decomposition of the relevant cardiac procedure volumes according to facility setting type. Doing so allows us to assess any underlying setting substitution as well as the source of the market expansion observed in Figure 7. Unsurprisingly, counties exposed to ASC entry newly experience approximately 20 of these cardiac procedures performed within an ASC per quarter. At the same time, procedural volumes decline within HOPD and OBL settings. One year after the entry event, local HOPDs have lost 10 cases, on average, while local OBLs have lost six cases. Taken together, ASC entry increases the local supply of these procedures overall but also steals business from the other two setting options in the market.

However, in Figure 9, we also see that Medicare spending on these outpatient cardiac catheterization procedures sharply increases and is nearly 40% above pre-ASC-entry levels in these counties. Given that total Medicare volume for these cardiac procedures only increased by

[7] Appendix Figure A1 restricts the control counties to residing in the same states (15) as the treatment counties. While the shrinking of the sample size expectedly sacrifices some precision, the event study pattern and coefficient magnitudes are qualitatively the same as Figure 7.

10-15% (Figure 7), the disproportionately larger changes in spending suggest that HOPD-to-ASC setting substitutions save money for the Medicare program, but OBL-to-ASC substitutions translate to higher per-case spending for the public insurer—which seem to overwhelm the savings from reallocating cases away from HOPDs.

VI. Empirical Strategy and Results: State-Based Regulations

A. *Data and Estimation*

The national Medicare data also facilitate an exploration of state-based Certificate of Need (CON) laws germane to this policy event and subsequent market competition. Specifically, state CON laws determine whether physicians can actually provide cardiac catheterization services in ASC settings after Medicare has made its rule change.

We compiled data on state-specific restrictions on the provision of the 11 codes of interest in ASC settings using data from the National Conference of State Legislatures. We created a binary variable equal to 1 for states *without* any CON restrictions as of 2019, and 0 otherwise.[8] We identified 28 states without any CON restrictions on the provision of cardiac catheterization services in ASCs.[9] Our DD event study setup to test for CON-driven heterogeneity is subsequently straightforward since it relies on binary CON status and a single time point for treatment (i.e., the beginning of 2019). We leverage our previously constructed county-quarter-year analytic data (see Section IV) from our full data period: 2017-2023 to implement a standard event study specification:

[8] Some states have updated their CON since 2019. For example, Pennsylvania enacted a law (SB 818) in 2022 allowing ASCs to perform cardiac catheterization procedures.

[9] States without CON restrictions for the relevant procedures include Arizona, Arkansas, California, Colorado, Florida, Idaho, Indiana, Kansas, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Mexico, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah, Wisconsin, and Wyoming.

$$Y_{ct} = \alpha_c + \gamma_t + \sum_{\substack{j=-8 \\ j \neq -4}}^{19} \delta_j \left(Treated_c \times time = j\right) + \varepsilon_{ct}$$

We retain our county fixed effects (α) just as before in Section IV but replace our stacked-time fixed effects with calendar quarter-year fixed effects (γ). The outcome of interest is the total Medicare volume of cardiac catheterizations, irrespective of treatment setting (i.e., market-level supply). The standard errors are clustered at the county level in accordance with our empirical approach in Section IV.

B. *Results*

Figure 10 displays the event study findings from our CON-focused heterogeneity analyses. CON-free and CON-restricted counties' cardiac catheterization Medicare volumes closely track each other in the lead up to 2019 and during the early period of Medicare's deregulation implementation. However, beginning in late 2020 and persisting through 2023, a divergence emerges. Specifically, counties located within states lacking CON barriers to ASC market entry for these cardiac services demonstrate approximately 10% total volume expansion on average and relative to counties residing in more restrictive state regulatory environments. In other words, state-level impediments to entry seem to curtail ASC industry growth for these medical services, which prevents the market expansion effects shown in Section V. As corroborating evidence, we also observe that each instance of ASC market entry present in our Medicare analytic data (Section IV) is confined to states *without* relevant CON restrictions when Medicare makes its 2019 rule change.

VII. Conclusion

There is longstanding economic interest in the causes and consequences of physician treatment style variation, including which facilities they choose to utilize for care and at what cost to payers and patients. Physician preferences tend to evolve alongside technological advancements and clinical innovation, but regulation can play a substantive role. Abrupt changes to rulemaking can

generate sharp shifts in their treatment approaches, and when policy decisions emanate from the large and influential Medicare program, the impact can reverberate throughout the entire market.

We show that a seemingly narrow Medicare policy change impacting 11 cardiac procedural services (all tied to cardiac catheterization care, specifically) has wide-ranging implications. The previously excluded industry (i.e., ASCs) newly enter the market, and local cardiac specialists begin using ASCs for these policy-targeted *and* non-targeted procedures for their Medicare and non-Medicare patients alike. The reach of Medicare regulations is therefore well-beyond just the Medicare program and can potentially distort clinical decision-making and care delivery for a variety of patients. That said, Medicare's deregulation event in 2019 not only invited market entry by ASC but also led to market expansion for these cardiac services—accompanied by significantly higher spending (approximately 40% above baseline) for the Medicare program. The policy impact has been mitigated by state-level laws and cross-industry provider integration, however, which further underscores the multifactorial reality when it comes to whether and to what degree new treatment options are taken up by front-line providers. In order to achieve optimal treatment setting choices, policy concordance is needed between the federal and state levels, and proper incentive structures are needed to encourage physicians to select the most efficient setting option.

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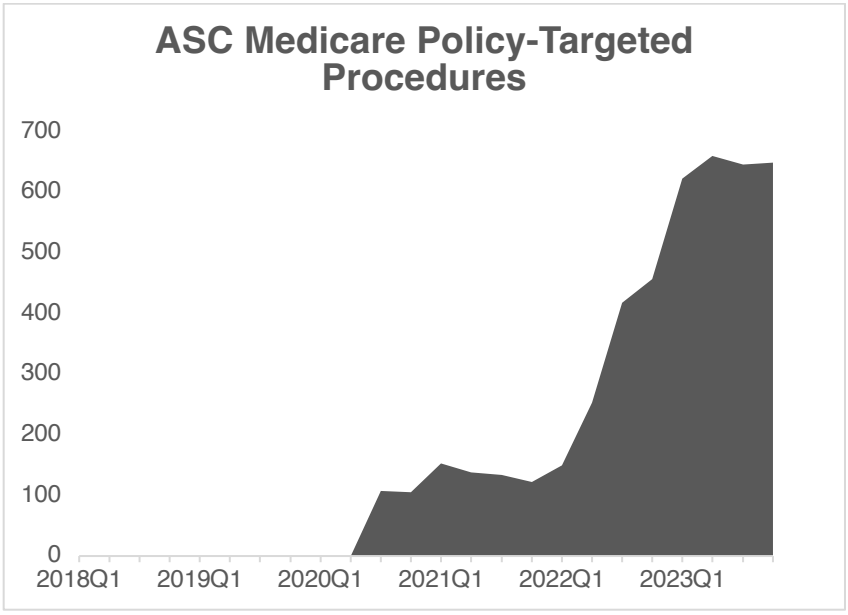
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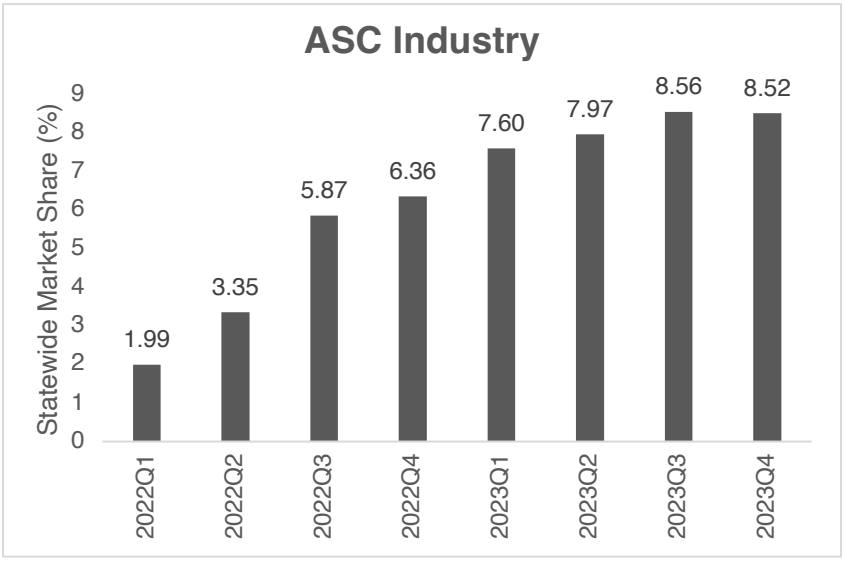
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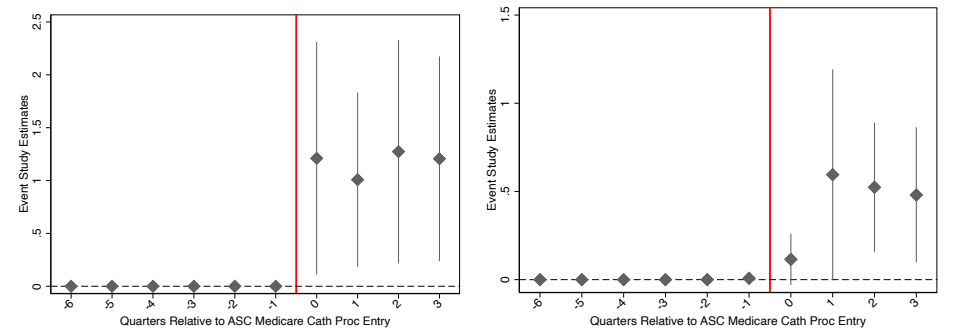
(a) Industry Volume Trend



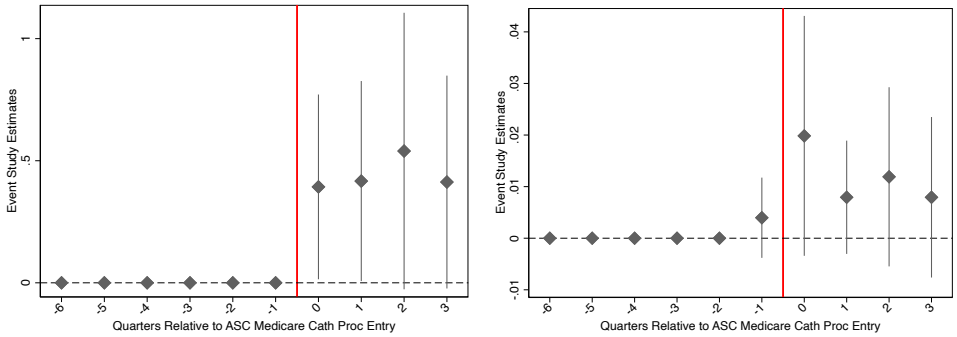
(b) Industry Market Share Trend

FIG 1. QUARTERLY PROCEDURE VOLUME AND ASC MARKET SHARE FOR POLICY AFFECTED SERVICES IN FLORIDA

Notes: Data are from Florida AHCA. "ASC" stands for ambulatory surgery center, and Medicare's related deregulation policy took effect January 2019.



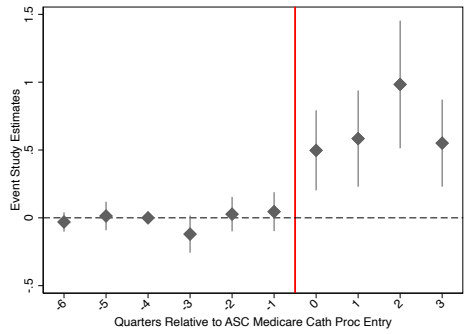
(a) Medicare Targeted Volume – ASCs **(b) Medicare Advantage Targeted Volume – ASCs**



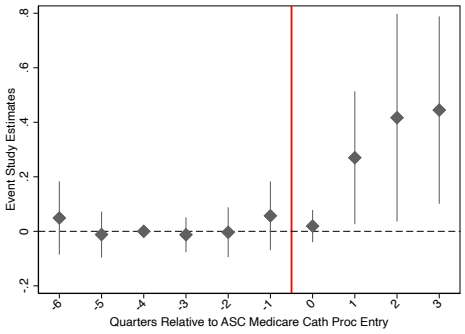
(c) Commercial Targeted Volume – ASCs **(d) All Others Targeted Volume – ASCs**

FIG 2. PHYSICIAN LEVEL EFFECTS OF ASC ENTRY ACROSS PAYERS

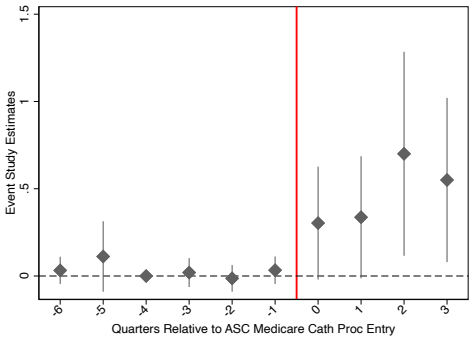
Notes: Event study estimates using stacked DD analytic sample (see Section II). Treated physicians are those who are exposed to ASC entry and who perform the relevant cardiac procedures at baseline. Control physicians are physicians who perform the relevant cardiac procedures at baseline and work elsewhere around the state of Florida. Event studies include physician and stacked quarter-time fixed effects. Standard errors are clustered at the physician level.



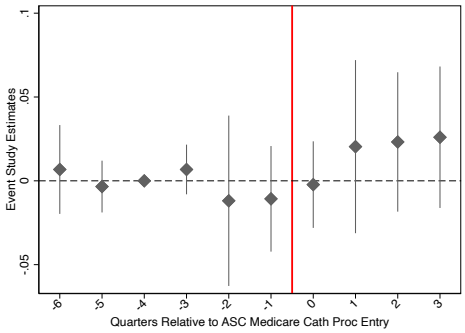
(a) Medicare Non-Targeted Volume – ASCs



(b) Medicare Advantage Non-Targeted Volume – ASCs



(c) Commercial Non-Targeted Volume – ASCs



(d) All Others Non-Targeted Volume – ASCs

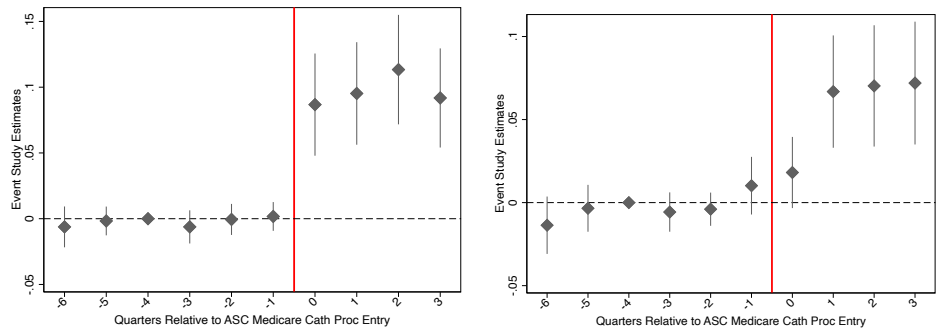
FIG 3. PHYSICIAN LEVEL EFFECTS OF ASC ENTRY ACROSS PAYERS

Notes: Event study estimates using stacked DD analytic sample (see Section II). Treated physicians are those who are exposed to ASC entry and who perform the relevant cardiac procedures at baseline. Control physicians are physicians who perform the relevant cardiac procedures at baseline and work elsewhere around the state of Florida. Event studies include physician and stacked quarter-time fixed effects. Standard errors are clustered at the physician level.

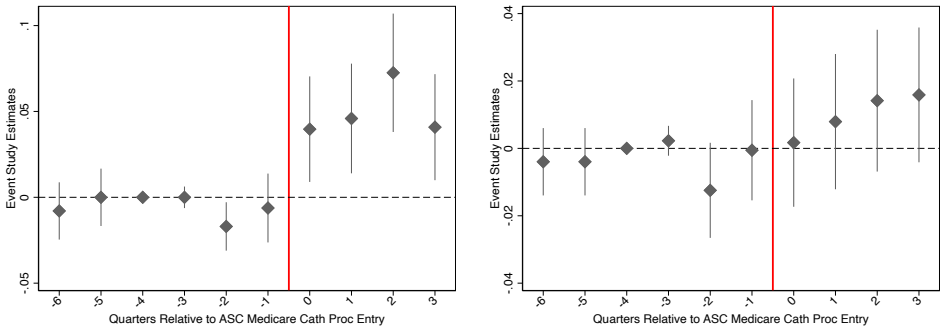
TABLE 1—2x2 STACKED DIFF-IN-DIFF AND TRIPLE DIFF ESTIMATES FOR PHYSICIAN LEVEL ASC ENTRY SPILLOVER EFFECTS ACROSS NON-TARGETED PROCEDURES ACROSS PAYERS

	Medicare Untargeted Procedure Volume in ASCs		Medicare Advantage Untargeted Procedure Volume in ASCs		Commercial Untargeted Procedure Volume in ASCs		All Others Untargeted Procedure Volume in ASCs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated x Post	0.665***	0.792***	0.275**	0.331**	0.442**	0.519**	0.019	0.023
	(0.161)	(0.193)	(0.116)	(0.139)	(0.206)	(0.245)	(0.014)	(0.016)
Treated x Post x VI		–0.754***		–0.331**		–0.481**		–0.021
		(0.197)		(0.134)		(0.248)		(0.016)
Physician Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stacked Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations (N)	6,950	6,950	6,950	6,950	6,950	6,950	6,950	6,950
Unique Physicians	695	695	695	695	695	695	695	695
Pre-Period Mean: Treated	0.08	--	0.04	--	0.04	--	0.01	--
Pre-Period Mean: Controls	0.40	--	0.26	--	0.32	--	0.02	--

Notes: “VI” is a binary indicator for physicians vertically integrated with a local hospital or health system in 2020. Standard errors clustered at the physician level. *** P value at 0.01 ** P value at 0.05. * P value at 0.10



(a) Any Medicare ASC Volume **(b) Any Medicare Advantage ASC Volume**



(c) Any Commercial ASC Volume **(d) Any All Others ASC Volume**

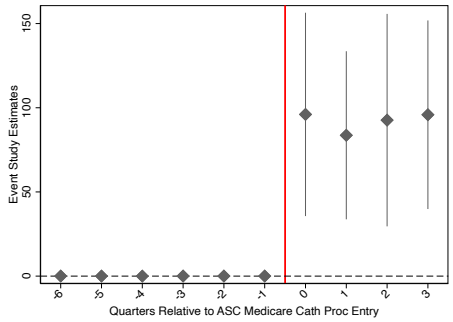
FIG 4. PHYSICIAN LEVEL EFFECTS OF ASC ENTRY ACROSS PAYERS

Notes: Event study estimates using stacked DD analytic sample (see Section II). Treated physicians are those who are exposed to ASC entry and who perform the relevant cardiac procedures at baseline. Control physicians are physicians who perform the relevant cardiac procedures at baseline and work elsewhere around the state of Florida. Event studies include physician and stacked quarter-time fixed effects. Standard errors are clustered at the physician level.

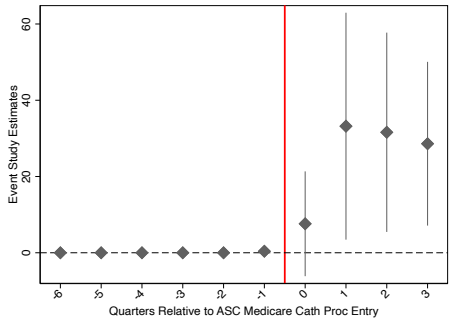
TABLE 2—2x2 STACKED DIFF-IN-DIFF ESTIMATES FOR PHYSICIAN LEVEL EXTENSIVE MARGIN EFFECTS ON ASC USE BY PAYER

	Medicare	Medicare Advantage	Commercial	All Others
	(1)	(2)	(3)	(4)
Treated x Post	0.099***	0.060***	0.055***	0.013**
	(0.018)	(0.013)	(0.014)	(0.006)
Physician Fixed Effects	Yes	Yes	Yes	Yes
Stacked Time Fixed Effects	Yes	Yes	Yes	Yes
Observations (N)	6,950	6,950	6,950	6,950
Unique Physicians	695	695	695	695
Pre-Period Mean: Treated	0.02	0.02	0.02	0.01
Pre-Period Mean: Controls	0.03	0.02	0.03	0.01

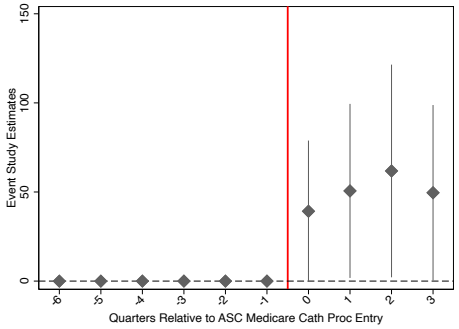
Notes: Standard errors clustered at the physician level. *** P value at 0.01 ** P value at 0.05. * P value at 0.10



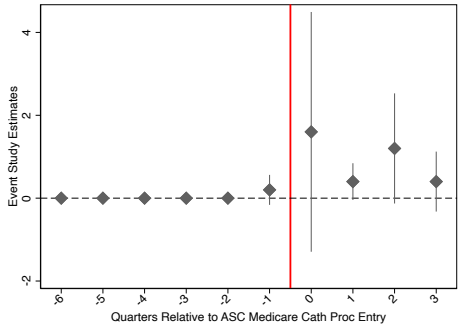
(a) Medicare Targeted Volume – ASCs



(b) Medicare Advantage Targeted Volume – ASCs



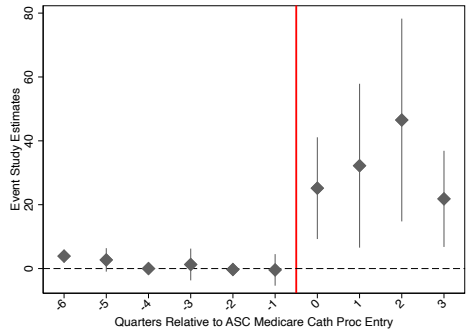
(c) Commercial Targeted Volume – ASCs



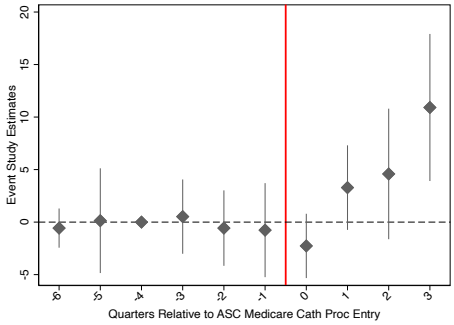
(d) All Others Targeted Volume – ASCs

FIG 5. MARKET LEVEL EFFECTS OF ASC ENTRY ACROSS PAYERS

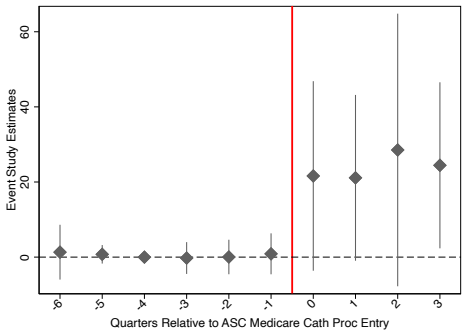
Notes: Event study estimates using stacked DD analytic sample (see Section II). Treated physicians are those who are exposed to ASC entry and who perform the relevant cardiac procedures at baseline. Control physicians are physicians who perform the relevant cardiac procedures at baseline and work elsewhere around the state of Florida. Event studies include physician and stacked quarter-time fixed effects. Standard errors are clustered at the physician level.



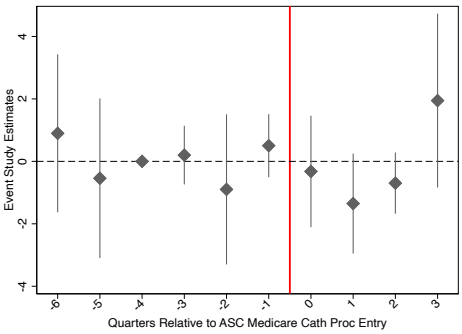
(a) Medicare Non-Targeted Volume – ASCs



(b) Medicare Advantage Non-Targeted Volume – ASCs



(c) Commercial Non-Targeted Volume – ASCs



(d) All Others Non-Targeted Volume – ASCs

FIG 6. MARKET LEVEL EFFECTS OF ASC ENTRY ACROSS PAYERS

Notes: Event study estimates using stacked DD analytic sample (see Section II). Treated physicians are those who are exposed to ASC entry and who perform the relevant cardiac procedures at baseline. Control physicians are physicians who perform the relevant cardiac procedures at baseline and work elsewhere around the state of Florida. Event studies include physician and stacked quarter-time fixed effects. Standard errors are clustered at the physician level.

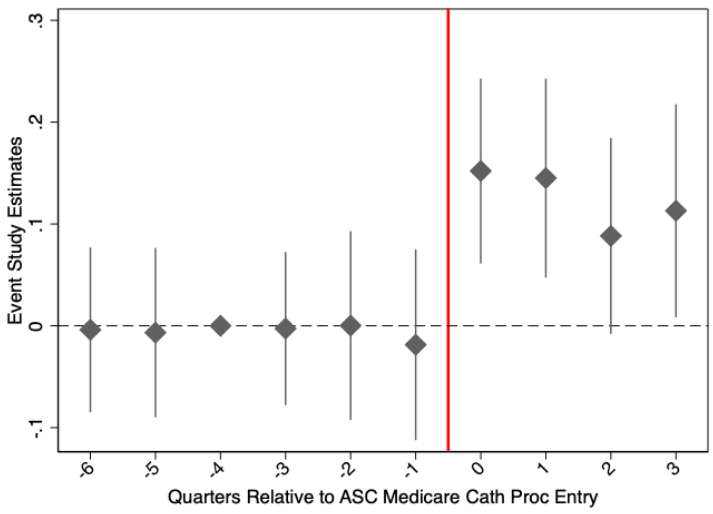
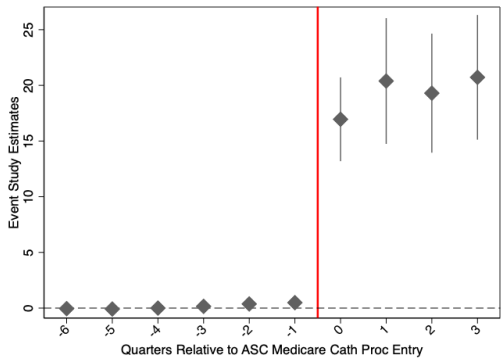
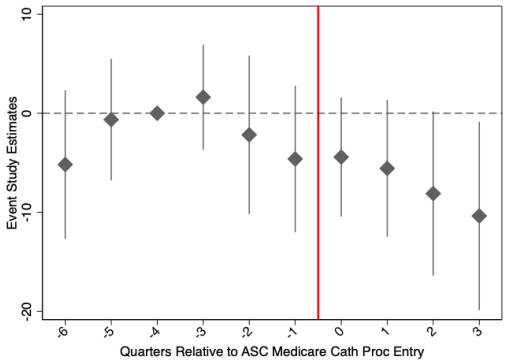


FIG 7. MARKET LEVEL EFFECTS OF ASC ENTRY ON TOTAL PROCEDURE OUTPUT IN LOGS

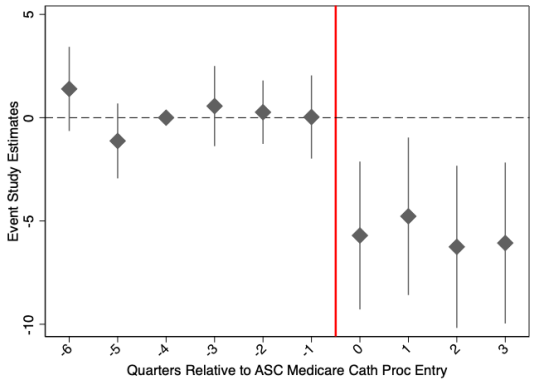
Notes: Event study estimates using national Medicare claims data and stacked DD analytic sample (see Section IV). Treated counties are those that experience ASC entry, defined as counties with 10 or more relevant procedures performed within an ASC. Procedure volume includes the 11 cardiac catheterization procedures affected by the 2019 policy change regardless of setting (i.e., ASC, HOPD, or OBL).



(a) ASC



(b) HOPD



(c) OBL

FIG 8. DECOMPOSITION OF CARDIAC PROCEDURE VOLUME BY OUTPATIENT SETTING TYPE

Notes: Event study estimates using national Medicare claims data and stacked DD analytic sample (see Section IV). Treated counties are those that experience ASC entry, defined as counties with 10 or more relevant procedures performed within an ASC. Procedure volume includes the 11 cardiac catheterization procedures affected by the 2019 policy change.

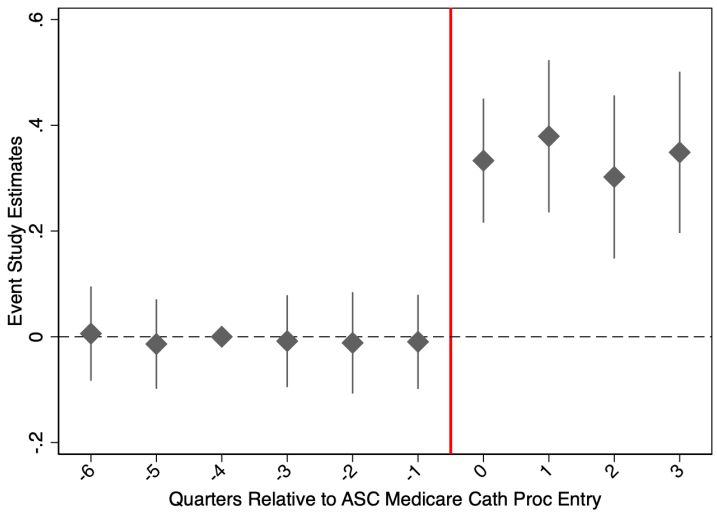


FIG 9. MARKET LEVEL EFFECTS OF ASC ENTRY ON TOTAL CARDIAC CATH PROCEDURE SPENDING IN LOGS

Notes: Event study estimates using national Medicare claims data and stacked DD analytic sample (see Section IV). Treated counties are those that experience ASC entry, defined as counties with 10 or more relevant procedures performed within an ASC. Procedure volume includes the 11 cardiac catheterization procedures affected by the 2019 policy change.

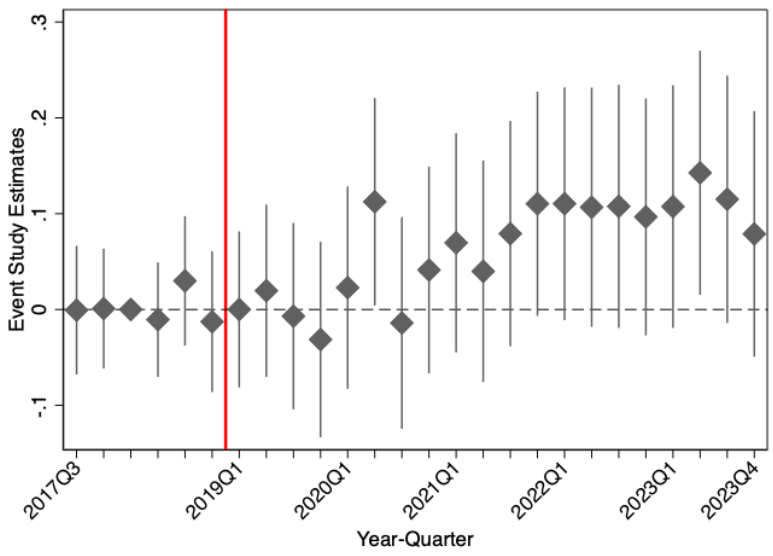


FIG 10. HETEROGENEITY IN MEDICARE DEREGULATION EFFECTS BY STATE CON STATUS

Notes: Event study estimates using national Medicare claims data. Post-period begins 2019Q1. Outcome is total cardiac catheterization outpatient procedures, irrespective of treatment setting (in logs). Treated counties are those located in states without CON ("Certificate of Need") restrictions. Control counties are those located in states with active and relevant CON restrictions in 2019.

Appendix

Appendix Figure A1: Market Level Effects of ASC Entry on Total Procedure Volume Using Medicare Claims Data and Restricting Controls to States with Treated Counties

