Raising the Stakes:
Physician Facility Investments and Provider Agency

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Principal-agent concerns have led to a patchwork of medical regulations, including prohibitions on certain provider financial arrangements. However, ambulatory surgery centers (ASCs), which compete with hospitals, have physician investors that are controversially shielded from such "anti-kickback" laws. It is unknown whether ASC ownership perversely affects physician behavior. We combine novel ownership data with all-payer hospital discharge data as well as a 100% sample of Medicare claims data to show that physicians strongly substitute away from hospital settings toward ASCs following their investments. We find no evidence of patient cream skimming or care quality erosion. Medicare, specifically, spends less on net. (*JEL* I11, I18, L84)

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In many markets (e.g., automobile repair, house building, legal services, tax and accounting services, etc.), consumers rely on professional assessments and recommendations from suppliers. Because consumers seek suppliers' expertise, some degree of information asymmetry is unavoidable, and the resulting information gap can lead to agency failures.[1] Mitigating the risk of consumer harm from such principal-agent issues can be accomplished through market discipline (e.g., competition and reputation effects) and/or specific regulatory interventions (Wolinsky 1993). However, the latter approach may distort supplier behavior and sacrifice efficiencies. Evidence-based policy is therefore needed to appropriately balance the tradeoffs from weaker versus stronger regulatory frameworks for a particular market.

Noteworthy examples of such principal-agent concerns can be found within medical transactions, where patients have limited information about treatment necessity and options. Physicians feature prominently in the delivery of medical care and typically act as patients' focal agents for clinical decision-making due to their extensive training and expertise and the level of trust assigned to them. These relationships do not, however, guarantee perfect agency on the part of physicians since their private interests may conflict with their patients' objectives (Arrow 1963; Dranove and White 1987; McGuire 2000). Because physician services account for approximately $700 billion in annual healthcare expenditures (20% of US healthcare spending), misaligned incentives can also be costly.[2]

The scope of potential physician-patient incentive misalignments is somewhat unique among the gamut of professional services typically sold to consumers. Physicians not only

[1] For examples across several different market transaction settings, see Chevalier and Ellison (1997), Hubbard (1998), Afendulis and Kessler (2007), Levitt and Syverson (2008), and Iizuka (2012).

[2] These and related national spending statistics are provided by the Centers for Medicare and Medicaid Services (CMS) and can be found here: https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/nationalhealthexpenddata/downloads/highlights.pdf.

recommend and deliver specific treatments, but they also decide where and how the treatments will be administered. Because US medical care is reimbursed through separate payments to different production factors (e.g., physicians, hospitals, pharmacies, etc.) and substitutable inputs are often paid different amounts,[3] these latter considerations shape the total cost of care for patients and their insurers. Importantly, physicians may not be indifferent between treatment setting options due to their perceptions of clinical appropriateness as well as their private financial interests.

A possible source of such financial influence is direct ownership of healthcare capital and companies beyond the physician's own medical practice. Holding an ownership stake entitles physicians to a share of profits from medical services that are separate from the care that they personally deliver. These broader business activities can leverage physicians' knowledge of medical care delivery and consumer preferences, as well as generate greater returns on their accumulated stock of specialized human capital. Such equity investments can even benefit consumers if they promote increased access to care, lower cost care, and/or innovative care delivery. However, ownership stakes may also distort physicians' treatment incentives, which can lead to more expensive care, excessive care, or inferior health outcomes. Patients are unlikely to be aware of underlying physician investments in complementary services, which limits the ability of market forces to mitigate perverse incentives from these opaque business arrangements. Moreover, the presence of such "side businesses" for physicians that directly impact the medical service bundle and its price does not have obvious parallels in other common principal-agent contexts (e.g., auto repair services). It also departs from other supplier-driven attempts to profitably

[3] For instance, site of care differential payments made by some payers (e.g., Medicare) lead to different facilities (e.g., a hospital versus a non-hospital facility versus a physician office) being reimbursed different amounts for providing an otherwise identical service.

influence physician behavior, such as pharmaceutical retailing (Grennan *et al*. 2018; Carey, Lieber, and Miller 2020; Li *et al*. 2020) or hospital acquisitions of physician practices (Baker, Bundorf, and Kessler 2016; Carlin, Feldman, and Dowd 2016; Koch *et al*. 2017; Richards, Seward, and Whaley 2020). Instead, physicians' engagement in medical entrepreneurship that extends beyond their direct provision of care fosters an unusual and potentially important opportunity for perverse incentives to drive market failures.

Physician entrepreneurship and agency behavior has, in turn, been of longstanding economic interest and empirical investigation.[4] A particular strand of this literature, and the focus of this paper, is the prevalence and influence of physician investments in ambulatory surgery centers (ASCs). ASCs are standalone "same day" surgical facilities that compete with hospital outpatient departments (HOPDs) for a variety of profitable services within the outpatient surgery market.[5] Controversially, ASCs tend to have at least partial, if not full, physician ownership, which allows invested physicians to receive earning streams from both their direct provision of care within the ASC as well as the ASC's overall financial performance. These equity stakes have been protected from federal regulatory interference since 1999 (described in Section IB) but plausibly introduce conflicts between physicians' financial interests and patient well-being.[6]

[4] For example, existing research finds that physician ownership of ancillary services (e.g., imaging technology, physical therapy services, and pharmacies) is linked to greater utilization and higher medical spending relative to peer providers (Mitchell and Sass 1995; Iizuka 2007, 2012; Baker 2010; Shreibati and Baker 2011; Chen, Gertler, and Yang 2016). Physician financial stakes in facilities, such as specialty hospitals, also seem to encourage strategic referrals as well as more intensive treatments for patients seen in the associated hospitals (Mitchell 2005, 2008; Barro, Huckman, and Kessler 2006).

[5] The majority of all surgical procedures occur in outpatient settings (Munnich and Parente 2018; Baker, Bundorf, and Kessler 2019). Patients receiving procedures within ASCs or HOPDs are expected to return home the same day as the procedure takes place. There are currently over 5,000 ASCs Medicare-certified across the US (MedPAC 2019).

[6] Some have even warned that ASC ownership could foster an oversupply of procedures and economically wasteful care (Casalino, Devers, and Brewster 2003; MedPAC 2019).

A modest literature to date (discussed below) lends support to the view that ASC equity stakes distort physician behavior and harm consumer welfare. Various state legislatures have even pursued their own subnational regulations to arrest further growth in physician owned ASCs and to partially undo the permissive regulatory stance taken by the federal government (e.g., see Blesch 2008).[7] Yet, we argue that the current empirical work tied to physician ASC ownership offers insufficient evidence to appropriately weigh existing and alternative approaches to oversight. We therefore aim to improve upon prior studies by leveraging precise, physician-specific ASC ownership information, including the month and year the equity investment occurs.

We obtained this information on physician ASC equity through a Freedom of Information Act (FOIA) request to the Centers for Medicare and Medicaid Services (CMS). Our FOIA data allow us to combine individual physicians' ownership stakes over time with their comprehensive clinical care delivery within the outpatient procedure market. Our primary data set benefits from eight years of complete and quarterly physician-level outpatient procedure activity across all treatment settings (i.e., ASCs and HOPDs) and payers in the state of Florida. Crucially, physicians and facilities are identifiable in both datasets, which facilitates a direct linkage between individual physician ownership status and corresponding practice patterns. Within our analytic sample, we observe more than 300 new ASC ownership formations, which we analyze using generalized differences-in-differences (DD) and event study frameworks. We then supplement our all-payer analyses from Florida with a national 100% sample of Medicare fee-for-service (FFS) claims

[7] Similarly, though targeting a different investment type (and a much smaller number of firms), Section 6001 of the Affordable Care Act (ACA) effectively prohibited future expansions of physician-owned hospitals across the US—an action championed and still supported by hospital lobby groups. Specific information from CMS on this regulatory action can be found here: https://www.cms.gov/Medicare/Fraud-and-Abuse/PhysicianSelfReferral/Physician_Owned_Hospitals. The American Hospital Association (AHA) advocacy points on the matter can be found here: https://www.aha.org/system/files/2018-03/fact-sheet-self-referral-2018.pdf. Other work has discussed similar issues related to Accountable Care Organizations and patient steering (Handel 2015; Kanter and Pauly 2019).

covering the 2013-2018 period. Doing so allows us to document the external validity of our Florida-specific findings and extend the analyses to include quality of care outcomes that are not feasible within the Florida databases.

Our estimates reveal that physicians sharply shift procedures to ASC settings following formal ownership stakes with these facilities. By the second year of ownership, affected physicians in Florida increase their share of cases performed within ASCs by approximately 18-22% across all payers. This increase is largely driven by a reallocation of procedures from HOPDs to ASCs, rather than increased procedure output for a given payer. For instance, new owners demonstrate a marked (19-23%) decline in HOPD case volumes by the second year of ownership and beyond. These patterns are largely consistent across payers, especially the two dominant payers for the ASC industry (traditional Medicare and non-Medicare commercial insurers). There is, at most, equivocal evidence that more procedures are supplied to the commercially insured market, but an increased aggregate procedure flow does not consistently materialize until more than two years after the initial ASC investment is made. Traditional Medicare volumes are unaffected throughout––which is also the market where demand inducement would typically be expected, if it exists at all. We also find no indication that Florida physicians send more of their higher risk patients to HOPDs once they have a financial interest with an ASC. We document qualitatively similar results for these margins within the national 100% Medicare claims sample, and importantly, we show that procedure complication rates and other quality benchmarks do not worsen following the ASC equity stake. These latter findings suggest no care quality erosion when relying more on ASC settings.

Overall, our findings demonstrate that ASC facility investments alter physician behavior but not necessarily in ways that negatively impact consumers or payers. Substituting ASC settings

for HOPD-delivery can be a mechanism to enhance patient convenience and substantively lower the total financial outlays for care—especially among those with Medicare public insurance coverage. Indeed, we show that total Medicare spending at the physician level (across all outpatient procedures and settings) is more than 20% lower, on average, two years after becoming an ASC owner. And in the absence of compelling evidence that holding ASC equity is leading to supplier-induced demand or strategic "cherry picking" of outpatient patients, it is far from clear that greater regulatory intervention is needed to correct an underlying market failure.

I. Background

A. *Features of the Outpatient Procedure Market*

The outpatient surgery market is effectively divided between ASCs and hospitals.[8] ASCs are overwhelmingly for-profit (94%) firms and located in urban metropolitan areas (93%). In contrast, over 70% of hospitals are not-for-profit (Lakdawalla and Philipson 2006).[9] ASCs also tend to be small, with just three operating rooms per facility, on average (MedPAC 2019). In 2017, 5,630 Medicare certified ASCs were operational across the US and accounted for 6.5 million outpatient Medicare procedures and $4.6 billion in associated payments during that year (MedPAC 2019). Across all payers, ASCs are believed to improve consumer welfare through greater convenience and lower service prices (Paquette *et al*. 2008; Grisel *et al*. 2009; Munnich and Parente 2014; Weber 2014; Munnich and Parent, 2018; Aouad, Brown, and Whaley 2019; Sood and Whaley 2019). Estimates also suggest that ASCs have lower cost structures than their rival HOPDs due to

[8] Some outpatient procedures can be performed within physician offices, but this is a small share of the market and is restricted to just a subset of procedures that are of low complexity.

[9] Related statistics on US hospital characteristics from the American Hospital Association (AHA) can be found here: https://www.aha.org/statistics/fast-facts-us-hospitals.

greater procedure specialization and economies of scale (Carey and Mitchell 2019; MedPAC 2019). Hospitals, however, argue that ASCs enjoy unfair cost advantages derived from their healthier patient mix, more restricted (i.e., profitable) service lines, and lighter regulatory burden (Casalino et al. 2003). Nevertheless, HOPDs exposed to ASC entry suffer outpatient procedure volume losses and weaker financial performance (Bian and Morrisey 2007; Courtemanche and Plotzke 2010; Carey, Burgess, and Young 2011; Koeing and Gu 2013; Hollenbeck *et al*. 2015). ASCs also appear to place downward pressure on HOPDs' service prices, which is at least consistent with consumer gains from more competition between rival suppliers (Carey 2017; Whaley and Brown 2018; Baker, Bundorf, and Kessler 2019).

B. *ASC Physician Ownership and Regulation*

Increased physician engagement in outpatient care entrepreneurship is not inherently problematic. Physicians may benefit from and contribute to the high degree of specialization belonging to ASCs, the lower organizational complexity compared to hospitals (and hence greater physician control of the firm's conduct), fewer scheduling disruptions (e.g., elective procedures being cancelled to accommodate emergent cases within hospitals), and better optimization of their procedure schedule overall.[10] Each of these features can positively impact a physician's core income stream (i.e., the reimbursements from his or her own clinical effort) and suggests much closer incentive alignment with ASCs when compared to hospitals, which are broader in clinical scope and more layered in terms of management. Consumers could likewise benefit from physicians' ASC

[10] These and other related benefits of ASC ownership for physicians are commonly asserted within the industry and trade presses. They can also be found within materials from the Ambulatory Surgery Center Association. For an example, see https://www.ascassociation.org/advancingsurgicalcare/asc/benefitsofphysicianownership.

ownership if their physicians do not subsequently change their clinical decision-making but are able to steer more procedures to more desirable and/or efficient settings.

Although Medicare has reimbursed for services performed at ASCs since 1982, the legality—and hence risks—associated with physician ASC investments have not always been clear. It was not until 1999 that physician owners received "safe harbor" protections from prevailing US regulatory statutes that otherwise could have applied to ASC financial stakes and diminished their value (Becker and Biala 2000; Dydra 2017; MedPAC 2019).[11] This federal policy decision was consequential and not without criticism since it shielded physicians from laws explicitly intended to prevent financial interests from undermining their agency functions for patients. Others (e.g., Carey and Mitchell 2019) have remarked that the favorable regulatory position adopted in 1999 likely spurred greater interest in ASC ownership among physicians.

The stylized and descriptive evidence in Figure 1 aligns with such an assertion. Among the ASC firms we observe (data fully described in Section II), the number of first-time physician ASC equity owners grows steadily between 1987 and 1998 and then rapidly accelerates in the following decade when the safe harbor rules are in place. By 2007, new ownership stakes in that year outnumber those observed in 1998 by nearly 500%. We also note that while little systematic data exist, trade press articles often quote ASC ownership share prices starting at $100,000 and climbing to over $500,000 in some circumstances. Expectedly, such outlays generally require physicians to first seek a willing lender in order to make the requisite ASC equity stake.[12]

[11] This means that federal regulations (i.e., the "Stark Laws") do not prohibit physicians from referring patients to ASCs where they have existing facility ownership investments.

[12] A recent example from the Nashville Medical News blog can be found here: https://nashvillemedicalnews.blog/2017/11/16/what-is-a-fair-price-and-value-of-an-asc-investment/.

C. *Existing Studies on ASC Ownership*

As previously noted, physician ownership is highly common among ASC firms and has attracted considerable research and policy attention. Yet, our economic understanding around whether, and to what degree, ASC investments influence individual physician behavior is limited to date. Specifically, physician-level ASC ownership has often been poorly measured or not measured at all, and *changes* in physician behavior following *changes* in ASC ownership status have typically not been captured in previous analyses. For these reasons, we contend that the existing findings may motivate closer scrutiny of physicians' ASC equity holdings, but they ultimately leave many policy relevant questions unanswered.

At this time, research demonstrates that ASC firm entry positively correlates with local outpatient procedure market expansion (Lynk and Longley 2002; Hollenbeck *et al*. 2014, 2015; Hollingsworth *et al*. 2011; Koeing and Gu 2013).[13] Studies at the physician-level reach similar conclusions when documenting positive associations between ASC ownership proxy measures and individual surgical output (e.g., Strope *et al*. 2009; Mitchell 2010; Yee 2011). Additionally, other work suggests that the availability of ASCs as well as underlying ASC ownership relationships may encourage selective (i.e., financially attractive) referrals to ASC settings and perhaps blunt physicians' incentives to adopt new evidence-based treatment protocols when doing so would be at odds with profit-maximization (Gabel *et al*. 2008; David and Neuman 2011; Plotzke and Courtemanche 2011; Howard, David, and Hockenberry 2017).

Gabel *et al*. (2008) claim to be the first study to explicitly investigate the role of ASC ownership within procedure referral patterns—namely if care is diverted to ASCs rather than

[13] Of note, Lynk and Longley (2002) offer compelling and detailed time series data, which include precise information on ownership status at the physician-level. However, the authors are restricted to two cases studies (one from Louisiana and one from South Dakota) that materialized from formal legal disputes in the late 1990s. Thus, generalizations are limited.

HOPD settings. However, the authors are restricted to two geographic markets (Pittsburgh and Philadelphia) in a single year (2003) and have to rely on an ASC referral volume threshold to serve as a proxy for actual physician ownership status. In fact, the use of arbitrary volume thresholds linked to individual physicians' ASC use has been a common limitation in the most closely related literature (e.g., see Hollingsworth *et al*. 2009, 2010; Strope *et al*. 2009). Beyond the inability to clearly classify physicians as ASC owners or nonowners, many studies have narrowly examined select physician specializations and procedures (e.g., see Hollingsworth *et al*. 2009, 2010; Strope *et al*. 2009; Mitchell 2010), which challenges the formation of generalizable inferences as well as policy recommendations. Furthermore, and as remarked above, rarely has a change in ownership status entered into the empirical analyses.

Hollingsworth *et al*. (2010) implemented a version of a DD design, though the authors were limited to data from just a three-year period, with only one year of ownership status changes and no precise information on actual ownership status at the physician level. Yee (2011) is the most similar to our study in intent and analytic setup. Yet, the author analyzes the effect of ASC board membership, rather than acquiring an ASC ownership stake. As Yee (2011) correctly points out, these two forms of financial interests are meaningfully different. Board positions tend to be of limited duration (e.g., two-year rotating assignments), and board membership status does not necessarily reflect a change in ownership status since new board members may have been previous investors in the relevant ASC. Additionally, many of the ASC's owners will not serve as board members. Yee (2011) ultimately finds greater procedure volume, a larger share of cases performed within ASCs, and selective steering of patients to ASCs once a physician becomes an ASC board member. The corresponding estimates are arguably more informative than prior research in this area since the author benefits from more detailed data and uses physician fixed effect specifications

to identify off of changes in board membership status from 1997 through 2004. That said, the empirical implementation did not demonstrate how the outcomes evolved over time, and crucially, if they were behaving similarly across treatment and comparison groups prior to the board membership events. For these reasons, we cannot be confident that the DD research design was appropriate in the author's analytic setting nor that the resulting DD coefficients are valid. Unaccounted for pre-period divergence across physician groups could lead to a biased estimate of the true board membership effect. And again, a board membership effect is not synonymous with an ASC ownership effect, with the latter being more relevant to the plurality of physician outpatient care investors and consequently of greater significance for regulatory policy.

II. Data

A. *Physician-Level Ownership Status*

One of our most important empirical contributions to the existing literature is to acquire and apply detailed ASC ownership information at the individual physician-level. As previously mentioned, these data were obtained through a FOIA request to the federal agency CMS. The original FOIA request was made in March of 2018, and the data were delivered by CMS in April 2019.

The data contain identifying information for physician owners, including their National Provider Identification (NPI) number, as well as all ownership investments they have at specific and Medicare-certified ASCs. We also observe the precise date the ownership stake is acquired and if (and when) it is ever terminated. We restrict to individual ASC investors with valid NPI information and a reported ownership stake relevant to our study. Specifically, we keep observations with the categories: "5% or more ownership interest," "partner," "sole owner," or

"sole proprietor" reported to CMS.[14] We do not observe the exact size of the physician's ownership stake, however—unless it is 100% (i.e., "sole") ownership, but this is rare in the data. The overwhelming majority of physician owners own a stake in a single ASC; however, a subset of physicians reports ownership relationships with more than one ASC. For our analytic purposes, we consider a given NPI (i.e., unique physician) to be an owner within a given point in time if that physician has an active ownership stake in at least one ASC. Accordingly, we longitudinally represent individual physician ownership as beginning when the first ASC investment is made and not concluding (for the minority that return to nonowner status at some point) until the latest observed termination date for that same physician.[15]

We do note that the FOIA data are not a complete historical record of all ASC firms ever operating or Medicare-certified in the US. Specifically, we observe firms that are in the market and certified at least by January 1, 2005 or later and consequently do not capture ASC information for those that closed prior to 2005. However, for all ASCs with an active Medicare certification by 2005 or later, we observe their complete physician ownership history, including exact start and end dates, irrespective of when the physician ownership transitions occurred. Moreover, as demonstrated in Appendix Figure A1, market exits (i.e., losses of ASC Medicare certifications) are a rare event nationally, especially when compared to the number of Medicare-certified ASCs in operation in a given year. Thus, only a small subset of historical ASC ownership events (i.e., those occurring for firms that closed prior to 2005) are not included in our data; importantly, these

[14] These are the verbatim categories captured by CMS record keeping. This excludes observations reporting administrative roles, such as "director" or "authorized representative." Note, many physicians reporting administrative roles, such as directorships, also have an additional ownership entry with the categories listed above for the same ASC facility.

[15] In this way, an ownership stake that concludes earlier than the latest termination date would be ignored since at least one other ownership stake would persist for the physician. Only a minority of ownership stakes are terminated within the database, however.

unobserved events play no role in our empirical estimations or interpretations (fully described in Sections III-VI).

B. *All-Payer Physician-Level Outpatient Procedure Activity*

Our primary encounter-level data encompass the universe of outpatient (ambulatory) procedure discharge records from the state of Florida, which we obtained from the Florida Agency for Health Care Administration (AHCA).[16] We use the administrative data over a relatively long time series and have the advantage of much more recent health care market data than what is currently found in the ASC ownership literature. Our available discharge records begin in the first quarter of 2010 and continue through the fourth quarter of 2017 for a total of eight analytic years (32 quarters). The detailed records include a rich set of variables, such as diagnosis and procedure codes, type of insurance, patient demographic information, the specific facility (e.g., ASC versus HOPD) where the procedure was performed, and the specific physician (i.e., NPI) performing the outpatient procedure.

Appendix Table A1 lists the fifteen most frequent procedures performed within Florida ASCs 2010-2017 overall and then subset to the physicians that newly become ASC owners during our study period. The resulting procedure lists illustrate the emphasis on gastroenterology, neurology/pain management, ophthalmology, and orthopedics among these specialized firms—consistent with national data on ASCs (see MedPAC 2019). The most common procedures overall and among new owners, specifically, are also nearly identical, which suggests that our observed new owner subgroup is representative of general ASC users, rather than a narrow physician

[16] The discharge data we use differs from other commonly used medical claims data (e.g., Medicare, Marketscan, or Health Care Cost Institute claims) by including all patients and procedures, rather than procedures for specific patient populations. However, unlike some medical claims data, we are unable to observe patients longitudinally.

subspecialty group. It is also clear from Appendix Table A1 that while thousands of procedures (i.e., HCPCS codes) are eligible for reimbursement within ASCs, the top fifteen procedures account for approximately two-thirds of all cases.

A unique advantage of our encounter data, distinct from many other sufficiently historical data resources, is the ability to capture all payers in Florida markets, rather than data from a select payor or subset of payors. We are thus able to examine changes in physician behavior across their entire payer mix and also stratify a physician's outpatient procedure activity by payer group—namely the commercially insured (i.e., non-Medicare, private coverage), traditional (i.e., fee-for-service) Medicare, and all other payers. Nationally, more than 80% of ambulatory surgeries are estimated to have either commercial insurance or Medicare as the main payer (Hall *et al*. 2017). Within our analytic data, 79% of cases belong to these two payer groups, with only 21% among the composite 'all other' classification. We also note that Florida has an accommodating regulatory environment toward ASCs (e.g., ASCs are not bound by any existing certificate of need laws), and in terms of ASCs per 100,000 Medicare beneficiaries, Florida falls in the middle of the national distribution (MedPAC 2019).

C. *National Medicare Claims Data*

We supplement our all-payer Florida data with a national 100% sample of FFS Medicare claims. The data span 2013-2018 and are aggregated at the physician-quarter level as well for those practicing within the 50 US states or Washington DC. We first use these data to examine outcomes that parallel the Florida data in order to assess the consistency across data sources and the generalizability of the Florida findings. Importantly, we then leverage the ability to track all care utilization at the patient level—something not possible within the Florida databases—to construct

measures of adverse events immediately following the receipt of an outpatient procedure. Our adverse event measures are consistent with related economic studies of outpatient procedure markets and provide reasonable proxies for the general quality of care belonging to a given physician in a given quarter.

III. Empirical Strategy for All-Payer Florida Data

A. *Approach*

We employ a generalized DD design with two-way fixed effects at the physician (NPI) and quarter-year levels. For our main analyses, we construct physician-payer panels for all outpatient procedure activity occurring in Florida markets. In other words, for a given physician-payer combination in a given quarter, we have an exact measure of all outpatient procedures performed (including true zeros) within ASCs, HOPDs, and overall (i.e., the summation across settings). We intentionally examine all procedures across all payers belonging to a given physician in order to have the most comprehensive and hence most policy relevant empirical view. We also restrict to physicians observed (i.e., delivering non-zero procedural output) in Florida markets in all 32 quarters from the beginning of 2010 through the end of 2017.[17]

We next merge our physician-level procedure volume panels with our ASC investor information from CMS via the NPIs common across the two databases. We use the month and year of initial (concluding) ownership to identify the exact quarter-year of the ASC ownership transition (i.e., start or finish) within a given physician's panel. We observe 355 new (first-time) ASC

[17] 36% of all Florida physicians are present in the market for the entire eight years spanning 2010-2017. Of note, not requiring a balanced panel of physicians leaves all of our core findings virtually unchanged (results available by request).

physician equity events within our analytic sample and study period.[18] These are also the physician investment actions that ultimately support our DD estimation and directly speak to the primary regulatory question of interest: do ASC ownership stakes cause perverse physician behavior?

Before diagramming our empirical approach and specification, we first characterize the three, mutually exclusive physician types comprising our analytic data. Table 1 displays these specific physician groups and summarizes their outpatient procedure output during their initial (i.e., 2010Q1) presence within the Florida discharge records. As expected, ASC owners (i.e., the 'already owners' as well as 'become owners' classifications) are the minority of physicians but are also much more productive in terms of aggregate procedure output overall and within a payer. They also rely much more heavily on ASCs at baseline, which is true within-payer as well. The third physician group, which ultimately allows us to identify ownership effects on physician behavior, aligns much closer to the physicians already invested in ASCs at baseline. This data pattern conforms with Yee (2011), which similarly shows that physicians who eventually become ASC board members are observably different at baseline than those that never hold a board position—which further cautions against drawing strong inferences from the cross-sectional empirical approaches most common in the existing ASC ownership literature. Without capturing changes in ownership status, it is difficult to disentangle differences in physician behavior due to ASC ownership effects from the myriad of other observed and unobserved physician differences across the ownership divide. Instead, careful panel estimation is required to leverage ownership transitions and to ascertain whether the key outcomes of interest are evolving similarly across these otherwise disparate physician groups prior to ASC equity investments.

[18] We also note that approximately 6-7% of all physicians in Florida hold at least one ASC investment stake in a given year (data not shown).

We begin with a simple DD specification for each analytic sample that generates a summary measure (β) for any changes in physician behavior following the ownership stake over the entire post-ownership-period. The standard two-way fixed effects specification is as follows:

$$y_{pt} = \beta\left[\mathbf{1}\left(Ownership_{pt}\right)\right] + \lambda_p + \eta_t + \varepsilon_{pt} \tag{1}$$

Our outcomes (*y*) are at the physician (*p*) and quarter-year time (*t*) levels, and we accordingly have full vectors of physician (λ) and quarter-year (η) fixed effects. The physician-specific indicator variable (*Ownership*) is equal to one when the physician has at least one active ASC investment in that quarter-year. Our overall (i.e., all-payer) and payer-specific outcomes (*y*) of interest are: percent of outpatient procedures performed in ASCs, aggregate volume of outpatient procedures performed within HOPDs, and total outpatient procedure output across all settings. Assessing changes in physicians' reliance on HOPDs, specifically, after becoming an ASC owner allows us to understand and separate reallocation effects from productivity effects in the context of increasing shares devoted to ASCs.

To more carefully model physician behavior before and after an initial ownership stake is made, we exploit our granular, physician-level data to estimate a standard event study specification:

$$y_{pt} = \sum_{\substack{j=-13^{+} \\ j\neq -4}}^{-1} \alpha_j\left[\mathbf{1}\left(t - T_p = j\right)\right] + \sum_{j=0}^{13^{+}} \delta_j\left[\mathbf{1}\left(t - T_p = j\right)\right] + \lambda_p + \eta_t + \varepsilon_{pt} \tag{2}$$

Equation (2) uses the physician-specific time point T_p, which is the year-quarter that the physician acquires an ASC equity investment for the first time. We then create a series of quarterly time indicator variables for the period leading up to the physician-specific ownership transition (at time T_p) and the period following the transition. The omitted reference point is one year prior to the ownership transition (i.e., when $t - T_p = -4$), and the α coefficients allow us to assess the plausibility of the parallel trends assumption belonging to the DD research design. For example, if these physicians adjust their behavior prior to making a formal investment and/or ASC firms intentionally target ownership offers to particular and unrepresentative physicians, this will be detected by the pre-transition estimates. To support the parallel trends assumption and the validity of the DD estimate from Equation (1), the resulting α estimates from Equation (2) should not be statistically different from zero. The series of δ coefficients reveal the time path for any change in physician behavior (relative to one year prior the equity stake) once they become an ASC owner—namely any short- versus long-run effects. Also, the physician's quarterly time series relevant to the ownership transition are bracketed by time dummies equal to one for *more than three years* (i.e., 12 quarters) before (after) the initial ASC equity stake. We also cluster our standard errors at the physician level throughout.

B. *Robustness*

Given that we are relying on healthcare market events that occur with different timing—similar to other recent economics studies (Eliason *et al*. 2019; Prager and Schmitt 2021)—we have to take additional care when drawing inferences from the resulting estimates (Goodman-Bacon 2018). We do so through a series of robustness exercises.

First, we re-estimate Equation (1) eight separate times where we leave out a single cohort of new owners in a given estimation. We define a cohort as all physicians making their equity stake in a particular year over our analytic time period (2010-2017), which creates eight cohorts of new owners in total (one for each year). Second, we re-estimate Equation (2) with altered analytic samples in order to assess the sensitivity of our results and inferences to different control groups as well as to placing further restrictions on the treatment group. Specifically, we begin by excluding 'already owners' that became ASC owners within two years of the start of our analytic period and by excluding new owners that acquire their ownership stakes within the first two years of our analytic window. The former action prevents 'already owners' from contributing to any of the first two years of post-period event-time estimates, and the latter change ensures that all of our treated physicians provide at least two years of pre-period data and shrinks the time range for new ownership events that we are identifying off of. Our next re-estimation of Equation (2) excludes 'already owners' completely—meaning that the analytic sample reduces to just the treatment group (i.e., new owners during 2010-2017) and 'never owners.' We also note that our analytic context benefits from a high prevalence of never treated (i.e., 'never owners') units—80% of the observed physicians—which helps to mitigate potential bias in the generalized DD setup.[19] The final re-estimation of Equation (2) takes one further step and refines the treated physicians to those providing at least two years of pre-period data and then compares those physicians to the 'never owners' over time. After concluding the set of re-estimations, we can then examine the collection of DD and event study results against our main analyses' findings and thereby ensure that our inferences are robust to these alternative estimation approaches.

[19] For example, the risk of bias is likely to be greater when "always treated" units represent a large share of the composite control group.

IV. Results for All-Payer Florida Data

A. *Main Results*

Table 2 presents our initial DD estimates for our three outcomes of interest at the physician level and across all payers. Column 1 shows a precisely estimated 5-percentage point increase in the share of outpatient procedures performed within ASCs, on average, which is a 9% relative increase from their baseline rate (Table 1). Physicians are simultaneously reducing their procedure volumes within HOPDs by approximately six procedures per quarter following an initial ASC equity stake. This translates to a roughly 11% relative decline when compared to their HOPD care volume at baseline (Table 1).[20] The final column in Table 2 reveals a statistically significant increase in total outpatient procedure volume by four procedures per quarter, on average; however, the coefficient is not as tightly estimated as the previous outcomes and represents a relative change of just under 4% over the baseline level (Table 1). Appendix Table A2 presents the results from our leave-one-out exercise described in Section IIIB. The exclusion of any particular cohort of new owners does not substantively change the pattern of results for the share of procedures allocated to ASCs or the total volume of procedures performed within HOPDs. The estimates are less consistent for total procedure volume, which is also the weaker finding from the main analyses in Table 2.

Within Figure 2, we can examine the event study results that correspond to the analytic sample and outcomes captured in Table 2. The pre-ownership coefficients demonstrate no obvious changes for physicians that would eventually become ASC investors. Across all three panels in Figure 2, the estimates for the quarters leading up to the ownership transition are never statistically different from zero and are typically close to zero in magnitude. In other words, these estimates imply that physicians becoming ASC investors are not differentially trending away from the

[20] Note, the baseline HOPD volume is calculated by multiplying the total procedure volume by one minus the share of cases performed in ASCs, as reported in Table 1.

control group physicians, even though their baseline levels of ASC do differ, on average (Table 1). The pattern is markedly different, however, once these physicians financially invest in an ASC. Specifically, there is a sharp and persistent increase in the share of cases allocated to ASCs during the first year the physician holds an ASC equity stake (top panel of Figure 2). The elevated ASC shares present after the first year of ownership correspond to an approximately 12-percentage point increase, or 22% relative change over their baseline rate in Table 1. The middle panel of Figure 2 displays a similar dynamic effect for HOPD volume, which demonstrates the underlying change in physician behavior that drives the shift in cases performed in ASCs. Physicians demonstrate stable HOPD volumes during the pre-ownership years but then quickly scale back their HOPD procedure activity over the initial 1-to-1.5 years of ASC investment—at which point their HOPD volumes remain 10-12 procedures (19-23%) per quarter below their pre-ASC-ownership activity. The final panel of Figure 2 offers suggestive evidence of increased overall procedure output; though, the estimates are not consistently elevated and statistically different from zero until a full two years after the ASC equity investment. Appendix Figures A2-A4 also demonstrate that the event study results are insensitive to the analytic sample modifications described in Section IIIB.

Table 3 reports the results for these three outcomes stratified by payer group. The qualitative patterns and inferences from the payer-specific DD estimates closely align with the overall results displayed in Table 2; though, the increase in total outpatient procedure volume appears largely driven by the commercial payer market. Appendix Figures A5-A7 display our event study estimates from Equation (2) for each of the outcomes captured in Table 3. Across the three payer groups, the event study estimates indicate no compelling change in treatment patterns in the three years leading up to a new ownership stake, which again supports the appropriateness of the DD research design within our analytic context. Of note, any ownership effect on total

procedure output within the commercial market does not materialize until at least two years following the initial equity stake, and even then, the estimates tend to lack sufficient precision (Appendix Figure A7). Moreover, there is no evidence of a change in procedure flows to the Medicare market in Appendix Figure A7. The coefficients oscillate around zero and fail to reach statistical significance for the full six years before and after the new ownership event. One might expect any demand-inducement (should it exist) to be most pronounced among the traditional Medicare population, given its prominent payer status and lack of managed care functions. Yet, we do not observe any such indications of perverse physician behavior within the fee-for-service Medicare market.

B. *Strategic Risk Selection*

The findings in Section IVA indicate that physicians are much more likely to shift the marginal outpatient procedure case to an ASC setting once they hold an equity stake with one or more ASCs. At the same time, we observe little to no evidence of increased procedure flows, especially within the first two years following the new ownership stake. Regulators may still worry, however, about strategic and advantageous patient risk selection (i.e., "cherry picking" cases) for ASC delivery following an ownership investment, which could generate negative externalities for competing hospitals. Relatedly, consumer welfare could be harmed if having an ASC financial interest causes physicians to adjust their sorting decisions in terms of facility appropriateness (i.e., ASC versus HOPD) for the marginal patient. Suboptimal matches between a patient's medical risk type and the facility's capabilities (e.g., sending less healthy and riskier patients to an ASC after making an ASC investment) could generate higher rates of adverse events for affected patients.[21] In this

[21] Nationally, less healthy patients tend to be less likely to receive care at ASCs, and minority groups (e.g., African Americans) are also less likely to be treated within an ASC (MedPAC 2019).

subsection, we examine each of these strategic possibilities as much as the discharge data allow and then extend as well as enhance the analyses in Section V by relying on the Medicare claims data.

We apply the same DD empirical strategy and Equation (1) to estimate post-ownership changes in the average patient profile for a given physician's HOPD cases in a given quarter-year. Making this analytic restriction allows us to test if becoming an owner affects the average patient composition (i.e., riskiness) of cases allocated to HOPDs within-physician and over time. Our corresponding outcomes of interest are patient demographics (age, sex, and race) as well as the total number of listed comorbid conditions (i.e., number of diagnosis codes in addition to the medical problem necessitating the procedure).[22]

The DD results among HOPD cases overall and stratified by payer group are presented in Table 4. Across all four panels (A-D) in Table 4, there is no clear evidence of physicians strategically consigning higher risk patients to HOPD settings after they become an ASC investor. Only two of the sixteen coefficients are statistically significant at conventional levels, but their respective magnitudes are comparatively small and lack a consistent pattern across patient populations. Taken together, these results suggest that the average patient treated within a HOPD is observably similar in terms of common risk characteristics (overall and irrespective of payer group) after the relevant physician holds equity in an ASC. Thus, a conservative interpretation of Table 4 is that new ASC physician owners do not alter their matching functions for patient-facility appropriateness when determining where to refer the marginal outpatient procedure. This is also

[22] We note that we do not find any ownership effects on patient discharge disposition—namely, being sent home with no further care needs, as opposed to being transferred to another facility and providers (results available by request) or mortality. However, both of these outcomes are extremely rare in the discharge data, which is partly why pursue alternative quality measures in Section V.

suggestive of an overall improvement in consumer welfare insofar as the reallocated patients experience greater convenience and/or lower costs from receiving care within an ASC rather than a HOPD.

V. Empirical Strategy for Care Quality in the Medicare Market

The estimates in Section IV provide evidence that physicians sharply reallocate their outpatient procedure cases after becoming an ASC investor and that this behavior change is found across payer markets. We also did not detect substantive changes in total procedure volume or the risk profile of their patients still receiving care within HOPD settings following the ASC ownership event. However, deleterious consequences remain a possibility if the ASC equity stake (and subsequent case reallocations) lead to a lower quality of care delivered to patients. As previously noted, a drawback from the all-payer Florida discharge data is the inability to track patients' utilization and health outcomes beyond the receipt of the focal outpatient procedure. Thus, to overcome this limitation, we leverage national 100% Medicare claims data to examine health outcomes following a given outpatient procedure delivered to Medicare beneficiaries.[23]

We construct and implement two separate approaches for capturing care quality changes after a physician becomes an ASC owner. The first approach follows Munnich and Parente (2018) and examines Medicare beneficiaries' use of emergency department care within the one-month period following receipt of an outpatient procedure. Specifically, we create separate physician-quarter-year measures for the rate of emergency room (ER) utilization among treated Medicare

[23] Of note, Appendix Table B1 and Appendix Figure B1 reproduce Florida-specific summary statistics and event study results when relying on the Medicare claims data to compare with the findings from the Florida discharge data. Despite the differences in analytic time periods (i.e., 2013-2018, rather than 2010-2017), the qualitative patterns align quite well across the two different data sources, which is reassuring. Also, Appendix Figure B2 demonstrates that there is no evidence of greater rates of emergency care use following ASC ownership transitions among these same Florida physicians.

patients during the same day as the outpatient procedure, 1-7 days after the procedure, and 8-30 days after the procedure. Each of these rates reflects post-procedure emergency care utilization for all outpatient procedures a given physician delivers to the Medicare market in a given quarter.

For our second approach, we follow Whaley and Brown (2018) and restrict to three specific and highly common outpatient procedures (joint arthroscopies, cataract surgeries, and colonoscopies) and then measure the quality of care using an indicator for procedural complications within a defined period after the surgery. We are intentionally trading off scope (i.e., breadth of procedures included) in order to benefit from a more granular quality benchmark that we can track over time within a given physician.

Complications are identified using the Health Care Common Procedure Coding System (HCPCS) and the International Classification of Diseases (ICD) codes (version 9 for 2013 and 2014, version 10 for the other years). For joint arthroscopy, patients are considered as having complications if they experience bleeding, postoperative deep vein thrombosis, or pulmonary embolism within 30 days after the procedure, or alternatively, if they experience mechanical failure or postoperative nerve injury within 90 days after the procedure. For cataract surgery, all complications are measured within 90 days after the index surgery. Subsequent procedures that are indicative of an adverse event tied to the index surgery are: repositioning of Intraocular Lens (IOL), removal of IOL, exchange of IOL, repair of wound or iris, therapeutic paracentesis of anterior chamber, removal of anterior chamber blood or clot, re-inflation of anterior chamber, repair of retinal detachment, vitrectomy and related procedures, removal of IOL posterior segment, intravitreal injection, drainage of choroid, anterior orbitotomy, removal of eye, evisceration, or enucleation. Finally, for colonoscopies, claims-derived markers of complications include cardiovascular, serious gastrointestinal, and/or non-serious gastrointestinal diagnoses occurring

within 30 days after the focal colonoscopy procedure. More specifically, cardiac complications include arrhythmia, congestive heart failure, cardiac or respiratory arrest, syncope, hypotension, and shock. Serious gastrointestinal complications include perforation, lower gastrointestinal bleeding, and infection. Non-serious gastrointestinal complications include paralytic ileus, nausea, vomiting, dehydration, abdominal pain, diverticulitis, and enterocolitis. The lists of corresponding codes and conditions for each the three broad outpatient procedure groups are fully detailed in Appendix Table B2.

After constructing these quality of care benchmarks for each relevant outpatient case, we calculate a within-procedure group and physician-specific complication rate per quarter that is then transformed into a standardized z-score. We apply our same DD design and estimating equations from Section III to the national Medicare claims data, with one departure: we adjust the event study to reflect 9 or more quarters before (after) the ownership transition event.

$$y_{pt} = \sum_{\substack{j=-9^{+} \\ j\neq -4}}^{-1} \alpha_j \left[\mathbf{1}\left(t - T_p = j\right) \right] + \sum_{j=0}^{9^{+}} \delta_j \left[\mathbf{1}\left(t - T_p = j\right) \right] + \lambda_p + \eta_t + \varepsilon_{pt} \quad (3)$$

All other features of Equation (2) are included in Equation (3) above, and we cluster the standard errors at the physician level, just as before. We also implement the relevant robustness checks laid out in Section IIIB.

VI. Results for Care Quality in the Medicare Market

Table 5 offers baseline summary statistics for the Medicare claims data. The top panel includes all outpatient procedures delivered to the Medicare market during the first quarter of 2013 and the

three mutually exclusive groups of physicians according to ASC ownership status. 'Never Owners' are the most common physician type within the national Medicare data, which conforms with the Florida discharge data as well (Table 1). Those that eventually become ASC owners over the 2013-2018 period have total procedure volumes closer to 'Never Owners', on average, but ASC utilization closer to the 'Always Owners' subgroup. Across all three physician subgroups, about 10% of their Medicare patients will visit an emergency department during the same day as receiving an outpatient procedure. Emergency care utilization is rare for these patients over the subsequent 30-day window. The three panels of Table 5 are specific to the relevant outpatient procedure type. Differences in procedure volumes as well as ASC reliance at baseline across the three groups are, again, not surprising, and on average, the complication rates are close to the mean (i.e., the z-scores are near zero) across all three physician subgroups and types of outpatient procedures in Table 5.[24]

The findings for emergency care utilization immediately following the receipt of an outpatient procedure are displayed in Table 6 and Figure 3. For all three outcomes in Table 6, the DD estimates are small in magnitude and not statistically different from zero. The event study results in Figure 3 likewise do not show any compelling increase in Medicare patients seeking emergency services after a physician transitions to being an ASC owner. The rates appear steady both before and after the equity stake is made. Appendix Figures B4-B6 offer a consistent pattern in the event study findings when using alternative analytic samples.

[24] Appendix B (specifically Appendix Figure B3) examines and discusses the procedure allocation and productivity outcomes from Section IV when using the Medicare claims data. Consistent with the Florida-specific results, newly becoming an ASC owner leads to a substitution of procedures away from HOPDs and toward ASCs.

Table 7 goes further and provides the DD estimates for within-physician changes in complication rates for each of the three specific procedure groups.[25] These complication rates are arguably better proxies for quality of care since they are directly connected to the specific outpatient procedure performed for a given Medicare beneficiary. Similar to Table 6, the DD coefficients are uniformly small (i.e., 1-2 hundredths of a standard deviation) and negatively signed. For colonoscopy procedures, specifically (Panel C), the negative DD estimate is statistically significant, which implies a small improvement in physicians' complication rates, on average, following a formal equity stake in one or more ASCs. The corresponding event study results are displayed in Figure 4. Consistent with Table 7, the estimates suggest that physicians' complication rates are either unchanged or slightly improved after becoming an ASC investor. Appendix Figures B8-B10 show virtually identical event study results as those found in Figure 4 when using alternative analytic samples.

VII. Physician Level Medicare Spending for Outpatient Procedures

We conclude our empirics by applying the model from Equation (3) to physician-level measures of aggregate Medicare spending tied to outpatient procedures. Recall, by statute, Medicare caps the ASC facility fee component to be no more than 59% of the corresponding HOPD facility fee for the same service.

Our first outcome is the average total Medicare allowed amount (i.e., physician and facility fees combined) per procedure for a given physician in a given quarter-year. Our second outcome is the summation of all Medicare payments (i.e., physician and facility fees) for all outpatient procedures performed by a given physician in a given quarter-year. Importantly, neither outcome

[25] Appendix Figure B7 also shows the increase in ASC reliance following a new ownership stake for each of these three select procedure groups within the Medicare claims data.

places any restrictions on the outpatient setting or type of procedure performed, so the latter measure, in particular, captures any net payment (and hence spending) changes for the Medicare program when physicians become new owners.

The corresponding event study results are in Figure 5. The average total Medicare spend (or full price) for an outpatient surgical encounter begins to fall in the months leading up to a new ownership event and continues on a steady decline. Two years after a physician becomes an ASC owner, his/her average Medicare case is generating about 20% less in Medicare payments. Similarly, the summation of all Medicare payments for a given physician in a given quarter-year is fairly stable prior to the equity investment being made but then exhibits a marked decrease after the ownership stake is taken. Once a physician has been an ASC owner for two years or more, Medicare is making 20-25% less payments for all outpatient procedures performed by the physician across all settings. These findings are also robust to alternative analytic sample constructions (Appendix Figures B11-B12).

VIII. Discussion and Conclusions

Physicians have long operated as entrepreneurs within the US healthcare system, primarily as small business owners—though this is changing with recent trends in merger and acquisition (M&A) activity within and across healthcare industries. Since the 1990s, what has attracted greater scrutiny and suspicion has been physicians' business ventures that fall outside of their personal practice of medicine. Specifically, various researchers, policymakers, and market participants have raised concerns that physicians' equity stakes in complementary services (e.g., imaging) or firms (e.g., specialty hospitals or ASCs) will inevitably distort their behavior away from patients' best interests toward their own financial interests. As we noted in Section IC, several existing studies

seem to support such a view; however, the quality of evidence specific to ASC investments is lacking. We therefore leveraged better and more comprehensive data on physicians' actual equity stakes in ASCs and improved empirical approaches to determine if ASC ownership undermines physician agency.

In contradiction with the most closely related literature, we do not observe unequivocal evidence of demand inducement by new ASC owners. Aggregate Medicare procedure volumes in Florida are very stable before and after an ownership event (Appendix Figure A7), for example. Given the importance of Medicare within the ASC payer mix and the absence of managed care levers to restrain utilization, this is arguably the market where demand inducement should be most readily apparent, if physicians respond to ASC ownership in this way.[26] Moreover, the substantive lag in the increase in commercial procedure volume following an ASC investment in Florida markets (Appendix Figure A7) does not seem strongly consistent with demand-inducement. Presumably, physicians would seek to increase volume and revenue in tandem with their equity investment, rather than wait several years out. A downstream increase in total procedure flow appears more in-line with gradual productivity improvements stemming from greater ASC use over time. Commercial payers could also punish physicians that deviate from the optimal procedure quantity for their enrollees through network exclusion or other financial penalties. We likewise do not find the average HOPD patient to be observably riskier (i.e., less healthy) following the ownership event nor do we find that patient-facility matching is appreciably changed. And our supplementary analyses using the national and 100% Medicare claims data offer no indication that physicians' quality of care is reduced once they become ASC investors. Recent and

[26] We do note in Appendix B that there appear to be increases in overall Medicare outpatient procedure volumes when using the national data, so it remains a possibility that the Florida findings do not generalize to other states. Additionally, for either data source, it is difficult to disentangle demand inducement motivations from broader productivity improvements following an ASC ownership stake.

complementary research also does not show worse health outcomes from ASC-delivered care; instead, patients appear to fare as well or better when substituting an ASC setting for the HOPD alternative (Munnich and Parente 2018; Aouad *et al*. 2019).

We do, however, observe sharp and large (e.g., roughly 20%) increases in the share of cases devoted to ASC delivery across all payers, with a reallocation effect (from HOPDs to ASCs) accounting for virtually all of the change among the two most prominent payer groups: commercially insured and traditional Medicare patients. This behavior change can also benefit both physicians and patients following the shift in care setting. Physicians may experience treatment setting complementarities across payers as well as across procedures when performing more services within ASCs (e.g., see Geruso and Richards 2020). ASCs may also reward physicians' investments through preferential case scheduling, which can help them be more productive overall. Consumers may likewise benefit from greater convenience and lower costs when they receive care in an ASC. Private insurance prices negotiated with ASCs are considerably lower than prices negotiated with HOPDs (Baker, Bundorf, and Kessler 2019), and Medicare caps ASC facility payments at 59% or below of the corresponding HOPD payment. These market features suggest both patients and purchasers can financially benefit from shifting patient demand to ASCs.[27]

Yet, hospitals are not passively absorbing the financial impacts of greater ASC competition or greater physician ASC ownership. While targeted regulatory interventions are sometimes pursued (Hollenbeck *et al*. 2014; Whaley 2018), outright purchases of the common upstream

[27] Additionally, ASCs are overwhelmingly for-profit firms and consequently bear state and federal tax liabilities on their respective earnings. Conversely, not-for-profit hospitals, which dominate the industry, receive billions of dollars in tax exemptions per year (Rosenbaum *et al*. 2015). On the other hand, reallocating high-margin procedures from hospitals to ASCs is also likely to weaken hospitals' earnings, which could negatively influence hospital investments in technology or quality (Garthwaite, Ody, and Starc 2020).

supplier (i.e., physicians) offer an alternative strategic response that can redirect referrals back to hospital-based settings (Richards, Seward, and Whaley 2020). Another increasingly common strategy by hospitals is to have joint- or complete ownership of ASCs.[28] It is far from obvious that hospital-physician integration or hospital expansion into the ASC industry carries fewer anticompetitive and perverse incentive risks than physician ASC equity investments.

At this time, federal policy is accommodating toward physicians pursuing diverse investments and income streams tied to various facets of the healthcare system. Since the 1999 granting of safe harbor status for physicians' ASC ownership stakes, specifically, the number of novel physician investors seems to have multiplied several times and many argue that a corresponding market failure requires regulatory intervention. Our empirical findings are at odds with this perception. Our results also improve upon previous studies due to our more detailed data and estimation approach. Consequently, our findings better speak to policymakers' concerns over physician agency issues tied to these direct care providers engaging in broader but intertwined business activities. Within this specific clinical context, physician entrepreneurship is not clearly in conflict with patients', payers', or policymakers' desires for more consumer-centric and efficient healthcare delivery.[29]

Other evidence suggests that professional norms, which are prevalent in medicine, affect physician behavior by driving them to place more weight on patients' preferences at the expense of their economic interests (Kesternich, Schumacher, and Winter 2015). Additionally, existing

[28] For example, the two largest for-profit hospital chains, Tenet and HCA, currently own more than 300 and 120 ASCs, respectively (MedPAC 2019), with the former hospital chain preparing to spend $1 billion for as many as 45 more (Castellucci 2020).

[29] It is still possible that certain physician specialties or certain procedures would reveal suboptimal physician agency following an ASC investment, but even so, this would be an argument for stronger managed care involvement for procedures sensitive to the incentive change, rather than a wide-reaching regulatory response (i.e., blunt policy instrument).

laws and threats of sanction tied to medical malpractice or defrauding public payers are active and still apply to these physician owners. ASCs are also predominantly located in dense, urban areas, which likely corresponds to heightened competition for highly "shoppable" services (i.e., elective care) and can amplify the importance of reputation effects among local patients and insurers. Our results cannot speak to all potential physician business activities and potential conflicts of interests, but at least in the context of physician equity holdings in ASCs, professional norms, market discipline, and/or other rationales for seeking such an investment appear to keep an appropriate balance between physician and patient objectives. A tighter approach to or reversal of previous federal policy could risk regulatory interference without a sufficient evidence base.

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MAIN RESULTS

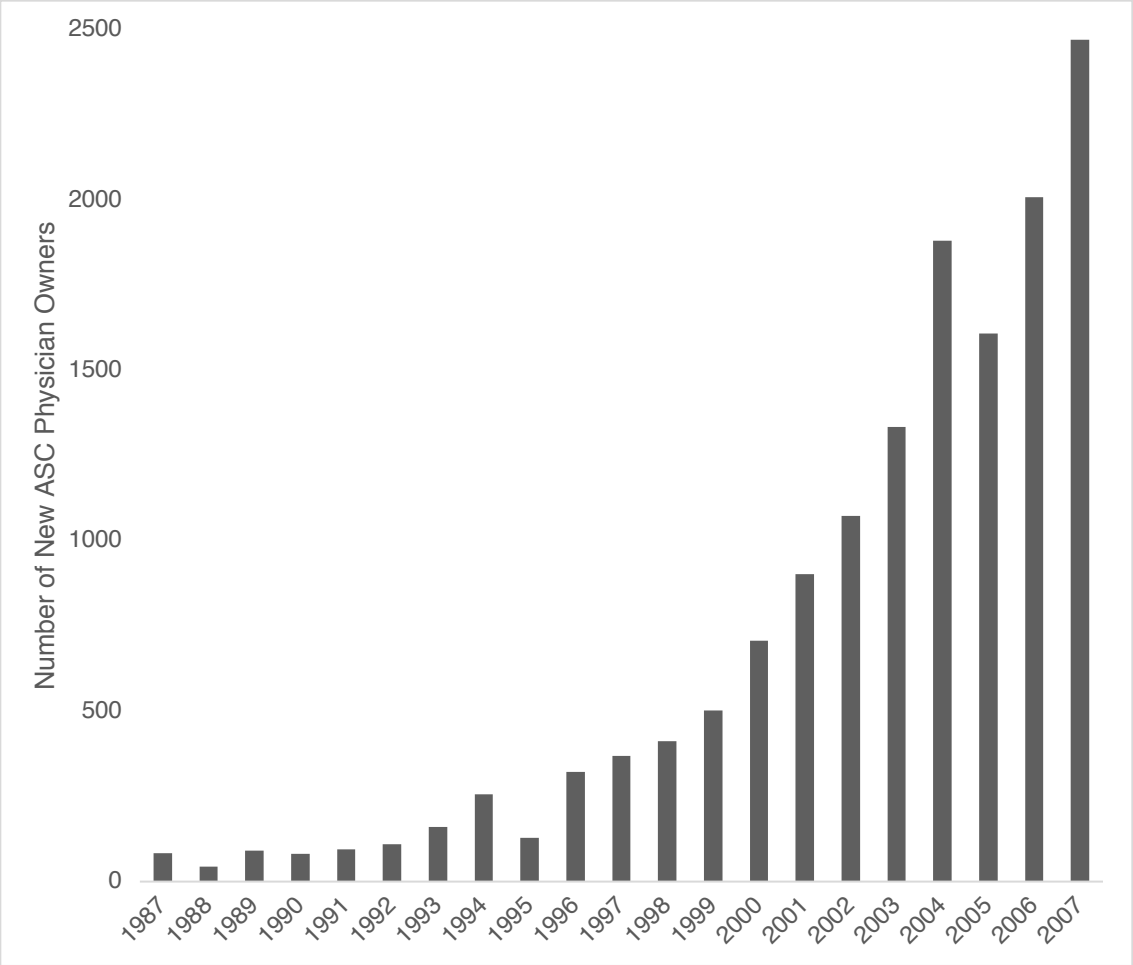


FIGURE 1. NATIONAL TREND IN PHYSICIAN-LEVEL FIRST-TIME ASC OWNERSHIP STAKES, 1987-2007

Notes: Data are from a CMS FOIA request and are described in Section II. The count captures the total number of first-time (i.e., novel) physician ASC owners in a given year; therefore, the counts are cross-sectional, rather than cumulative. We are only able to observe ASC firms that Medicare certified at least by January 1, 2005 or later. Those losing their certification prior to 2005 are not observed. Of note, in 1999, physician ASC owners were granted safe harbor status with respect to federal anti-kickback statutes.

TABLE 1—BASELINE PHYSICIAN-LEVEL SUMMARY STATISTICS BY ASC OWNERSHIP STATUS AND PAYER

	Already Owners	**Never Owners**	**Become Owners**
	Mean (SD)	Mean (SD)	Mean (SD)
Overall Proc. Volume	144.4 (145.0)	58.8 (86.2)	114.0 (117.6)
Share in ASCs	69.2 (33.8)	23.4 (35.9)	54.4 (37.8)
Physicians (N)	981	5,798	355
Comm. Proc. Volume	59.0 (63.3)	24.7 (41.8)	48.3 (54.5)
Share of Comm. in ASCs	70.3 (33.8)	25.3 (37.5)	56.2 (38.3)
Physicians (N)	976	5,529	351
Medicare Proc. Volume	62.8 (85.4)	23.7 (40.6)	47.1 (68.1)
Share of Medicare in ASCs	68.8 (36.4)	23.5 (37.6)	52.9 (40.1)
Physicians (N)	923	4,924	337
All Other Proc. Volume	28.1 (42.4)	16.8 (28.0)	22.3 (28.9)
Share of All Others in ASCs	60.8 (38.0)	21.8 (36.0)	49.2 (39.3)
Physicians (N)	930	5,205	342

Notes: Analytic data are from the Florida AHCA ambulatory discharge database 2010-2017. Analytic sample is restricted to physicians observed in all 32 quarter-years and their initial quarter-year observation. For specific payer groups, the data are further restricted to when the physician has non-zero outpatient procedures for the relevant payer in the quarter-year. This latter condition is reason for slight fluctuations in the number of unique physicians (i.e., observations) for a given ownership group across the different payer groups. "Already Owners" have ASC ownership stakes prior to 2010. "Become Owners" are those physicians that newly become owners during our study period (2010-2017). "Commercial" (Comm.) includes all privately insured individuals that are not part of the Medicare program (i.e., on Medicare Advantage plans). "Medicare" refers to the traditional (i.e., fee-for-service) public insurance program. The "All Others" category is comprised of all other potential payers. The analytic data have been collapsed to the physician-payer-quarter-year level.

TABLE 2—DIFFERENCES-IN-DIFFERENCES ESTIMATES FOR ASC OWNERSHIP EFFECTS ACROSS ALL PAYERS

	Share (PPT) of Procedures in ASCs	HOPD Procedure Volume	Total Procedure Volume
	(1)	(2)	(3)
1[Ownership]	4.955***	–5.809***	4.392**
	(0.808)	(1.359)	(2.066)
Physician Fixed Effects	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes
Unique Physicians	7,134	7,134	7,134
Observations (N)	228,288	228,288	228,288

Notes: Analytic data are from the Florida AHCA ambulatory discharge database 2010-2017. Analytic sample is restricted to physicians observed in the data in all quarters from 2010 through 2017. Standard errors clustered at the physician level, *** P value at 0.01 ** P value at 0.05

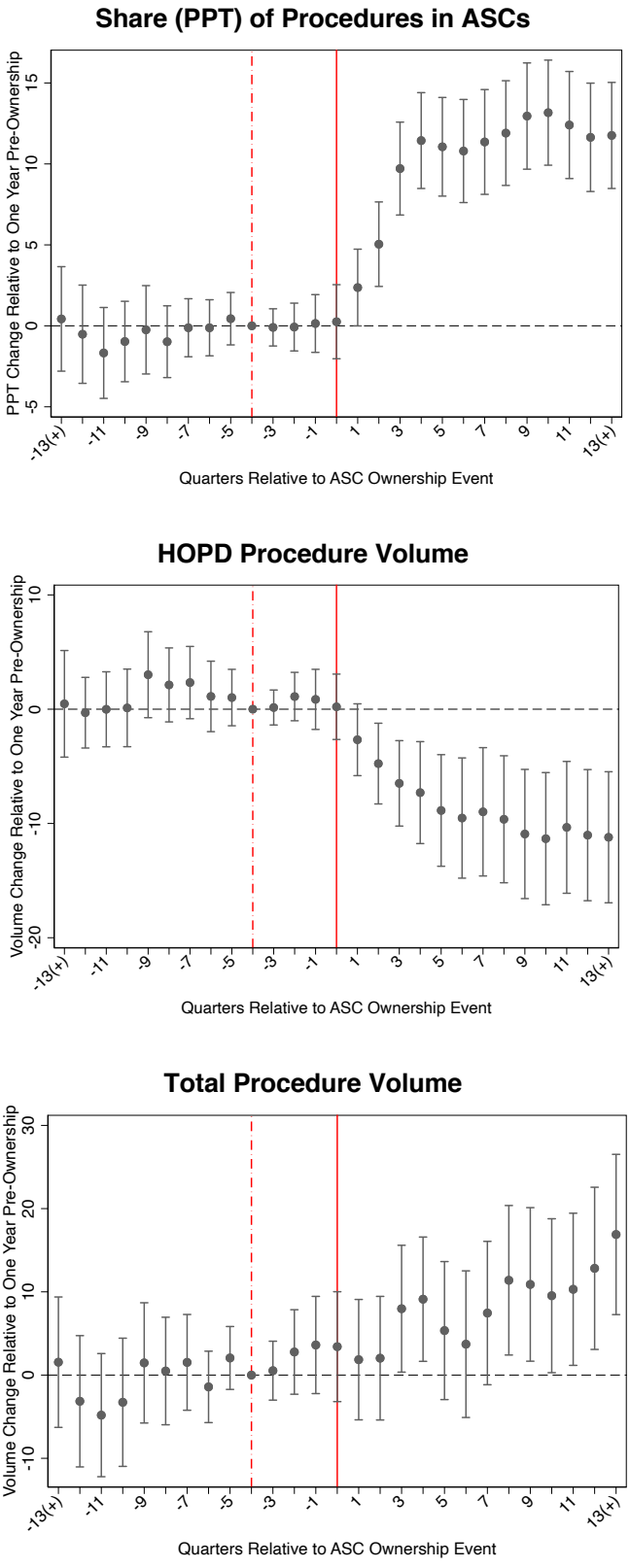


FIGURE 2. EVENT STUDY RESULTS FOR NEW ASC OWNERSHIP EFFECTS ACROSS ALL PAYERS

Notes: Outcomes and analytic samples align with Table 2. Regression is at the physician level, and the specification is from Equation 2.

TABLE 3—DIFFERENCES-IN-DIFFERENCES ESTIMATES FOR ASC OWNERSHIP EFFECTS BY PAYER

PANEL A: Commercial	Share (PPT) of Procedures in ASCs	HOPD Procedure Volume	Total Procedure Volume
	(1)	(2)	(3)
1[Ownership]	4.802***	–2.541***	2.542**
	(0.842)	(0.721)	(1.214)
Physician Fixed Effects	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes
Unique Physicians	7,134	7,134	7,134
Observations (N)	217,688	217,688	217,688
PANEL B: Medicare	Share (PPT) of Procedures in ASCs	HOPD Procedure Volume	Total Procedure Volume
	(1)	(2)	(3)
1[Ownership]	6.121***	–2.258***	1.248
	(0.910)	(0.570)	(0.870)
Physician Fixed Effects	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes
Unique Physicians	6,992	6,992	6,992
Observations (N)	196,796	196,796	196,796
PANEL C: All Others	Share (PPT) of Procedures in ASCs	HOPD Procedure Volume	Total Procedure Volume
	(1)	(2)	(3)
1[Ownership]	3.214***	–1.200***	0.776
	(0.835)	(0.393)	(1.150)
Physician Fixed Effects	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes
Unique Physicians	7,134	7,134	7,134
Observations (N)	208,725	208,725	208,725

Notes: Analytic data are from the Florida AHCA ambulatory discharge database 2010-2017. Analytic sample is restricted to physicians present in all quarters from 2010 through 2017. Standard errors clustered at the physician level, *** P value at 0.01 ** P value at 0.05

TABLE 4—ASC OWNERSHIP EFFECTS ON PATIENT RISK SELECTION FOR PROCEDURES REMAINING IN HOPD SETTINGS

Panel A: Overall	Age	Male	White	Comorbidities
	(1)	(2)	(3)	(4)
1[Ownership]	–0.193	0.005	–0.008**	–0.077
	(0.197)	(0.004)	(0.004)	(0.053)
Physician Fixed Effects	Yes	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes	Yes
Unique Physicians	6,877	6,877	6,877	6,877
Observations (N)	205,983	205,983	205,983	205,983
Sample Mean	55.9	0.41	0.80	3.45
Panel B: Commercial	Age	Male	White	Comorbidities
	(1)	(2)	(3)	(4)
1[Ownership]	0.047	0.010**	–0.003	–0.051
	(0.186)	(0.005)	(0.005)	(0.052)
Physician Fixed Effects	Yes	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes	Yes
Unique Physicians	6,820	6,820	6,820	6,820
Observations (N)	190,089	190,089	190,089	190,089
Sample Mean	48.0	0.41	0.80	3.00
Panel C: Medicare	Age	Male	White	Comorbidities
	(1)	(2)	(3)	(4)
1[Ownership]	–0.040	–0.001	–0.004	–0.053
	(0.146)	(0.006)	(0.004)	(0.070)
Physician Fixed Effects	Yes	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes	Yes
Unique Physicians	6,592	6,592	6,592	6,592
Observations (N)	165,805	165,805	165,805	165,805
Sample Mean	70.9	0.45	0.86	4.34
Panel D: All Others	Age	Male	White	Comorbidities
	(1)	(2)	(3)	(4)
1[Ownership]	0.206	–0.008	–0.006	–0.040
	(0.300)	(0.006)	(0.006)	(0.061)
Physician Fixed Effects	Yes	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes	Yes
Unique Physicians	6,792	6,792	6,792	6,792
Observations (N)	178,679	178,679	178,679	178,679
Sample Mean	55.7	0.43	0.77	3.52

Notes: Analytic data are restricted to outpatient procedures performed within a HOPD setting among physicians included in DD estimations for Table 2 and Table 3. The comorbidities outcome is the sum of all listed other diagnoses (i.e., those not tied to the reason for receiving the medical procedure) on the discharge record. Standard errors clustered at the physician level, *** P value at 0.01 ** P value at 0.05.

TABLE 5—SUMMARY STATISTICS FOR ALL AND KEY OUTPATIENT PROCEDURES IN 100% MEDICARE CLAIMS DATA

	Already Owners Mean (SD)	**Never Owners** Mean (SD)	**Become Owners** Mean (SD)
All Procedures			
Volume	49.3 (54.8)	39.9 (69.2)	37.4 (43.5)
Share of cases in ASCs	46.1 (39.0)	5.59 (20.8)	31.36 (38.0)
ER Visit Same Day	0.098 (0.1)	0.108 (0.1)	0.105 (0.1)
ER Visit 1-7 Days	0.004 (0.02)	0.005 (0.03)	0.004 (0.02)
ER Visit 8-30 Days	0.005 (0.02)	0.008 (0.03)	0.005 (0.02)
Total Medicare Spending for All Outpatient Procedures Performed ('000)	$79.1 (129.1)	$109.0 (267.8)	$95.2 (210.5)
Physicians (N)	15,286	192,372	2,869
Arthroscopy			
Volume	17.3 (18.4)	19.8 (18.9)	17.3 (17.4)
Share of cases in ASCs	50.4 (40.8)	47.1 (45.6)	38.7 (39.7)
Complications (z-score)	0.02 (0.52)	0.02 (0.52)	0.01 (0.44)
Physicians (N)	1,023	2,879	162
Cataract			
Volume	69.3 (68.7)	56.7 (87.2)	56.5 (60.2)
Share of cases in ASCs	77.4 (35.9)	39.8 (46.3)	64.0 (42.5)
Complications (z-score)	0.02 (0.35)	0.0002 (0.39)	0.07 (0.47)
Physicians (N)	2,407	8,345	405
Colonoscopy			
Volume	21.7 (16.4)	15.3 (14.5)	16.8 (13.1)
Share of cases in ASCs	73.0 (33.8)	30.1 (41.3)	60.5 (39.5)
Complications (z-score)	0.26 (0.45)	0.28 (0.55)	0.27 (0.5)
Physicians (N)	2,995	5,617	387

Notes: Analytic data are from the 100% Medicare claims data 2013–2018 and restricted to a balanced panel of physicians practicing within the 50 US states or Washington DC and their first observed quarter. "ER" stands for emergency room.

TABLE 6—ASC OWNERSHIP EFFECTS ON PROBABILITY OF EMERGENCY ROOM VISIT POST-PROCEDURE FOR ALL OUTPATIENT PROCEDURES FOR MEDICARE BENEFICIARIES

	Same Day	1-7 Days	8-30 Days
	(1)	(2)	(3)
1[Ownership]	–0.0001	–0.0002*	–7.64e–5
	(0.0007)	(0.0001)	(0.0001)
Physician Fixed Effects	Yes	Yes	Yes
Qtr-Year Fixed Effects	Yes	Yes	Yes
Unique Physicians	210,527	210,527	210,527
Observations (N)	5,052,648	5,052,648	5,052,648
Sample Mean	0.121	0.005	0.007

Notes: Analytic data are from the 100% Medicare claims data 2013–2018 and restricted to a balanced panel of physicians practicing within the 50 US states or Washington DC. Standard errors clustered at the physician level, *** P value at 0.01 ** P value at 0.05.

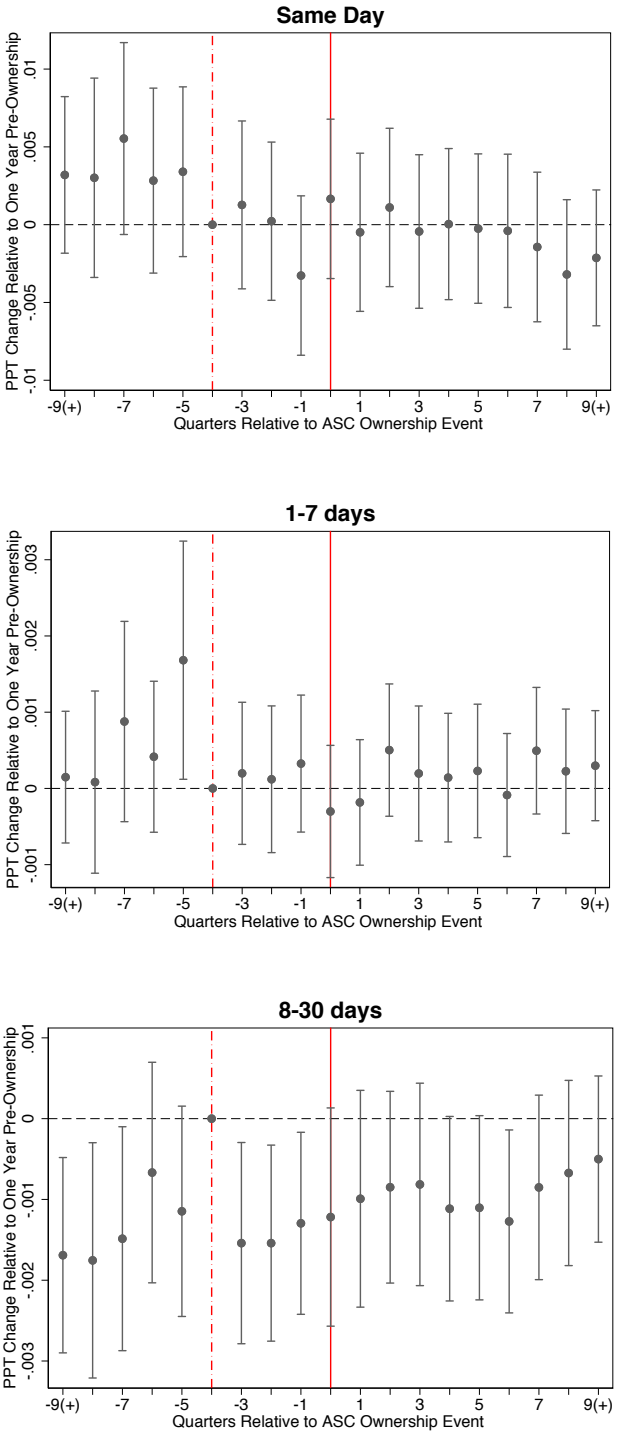


FIGURE 3. EVENT STUDY RESULTS FOR NEW ASC OWNERSHIP EFFECTS ON THE LIKELIHOOD OF AN EMERGENCY ROOM VISIT POST-PROCEDURE FOR MEDICARE BENEFICIARIES

Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3.

TABLE 7—ASC OWNERSHIP EFFECTS ON COMPLICATION RATES FOR KEY OUTPATIENT PROCEDURE TYPES

Panel A: Arthroscopy Procedures	
1[Ownership]	–0.011
	(0.015)
Physician Fixed Effects	Yes
Qtr-Year Fixed Effects	Yes
Unique Physicians	4,064
Observations (N)	97,536
Sample Mean	0.040
Panel B: Cataract Procedures	
1[Ownership]	–0.010
	(0.008)
Physician Fixed Effects	Yes
Qtr-Year Fixed Effects	Yes
Unique Physicians	11,157
Observations (N)	267,768
Sample Mean	–0.012
Panel C: Colonoscopy Procedures	
1[Ownership]	–0.023***
	(0.008)
Physician Fixed Effects	Yes
Qtr-Year Fixed Effects	Yes
Unique Physicians	8,999
Observations (N)	215,976
Sample Mean	0.274

Notes: Analytic data are from the 100% Medicare claims, 2013–2018. Analytic sample is restricted to physicians present in all quarters over this time period. Standard errors clustered at the physician level, *** P value at 0.01 ** P value at 0.05

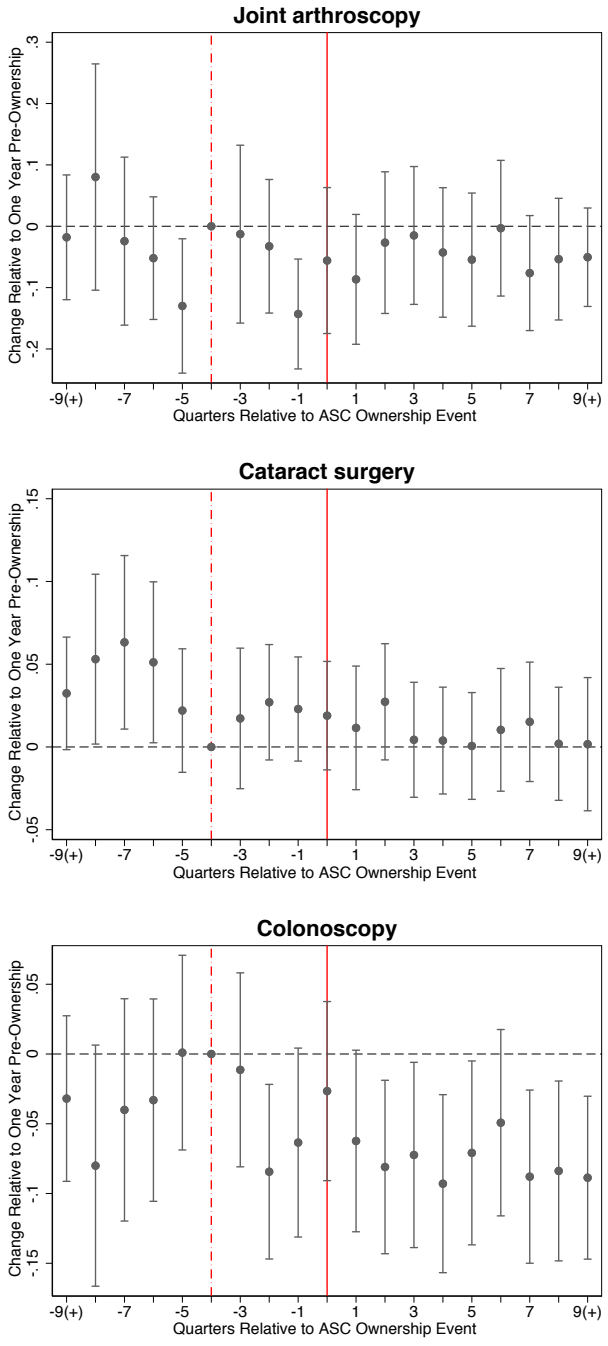
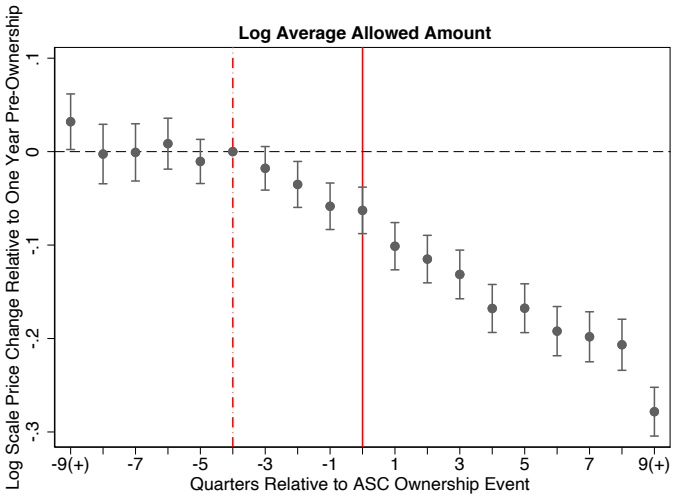


FIGURE 4. EVENT STUDY RESULTS FOR NEW ASC OWNERSHIP EFFECTS ON PROCEDURE COMPLICATION RATES

Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3.

Average Medicare Spending Per Procedure (in logs)



Total Medicare Spending Across All Outpatient Procedures (in logs)

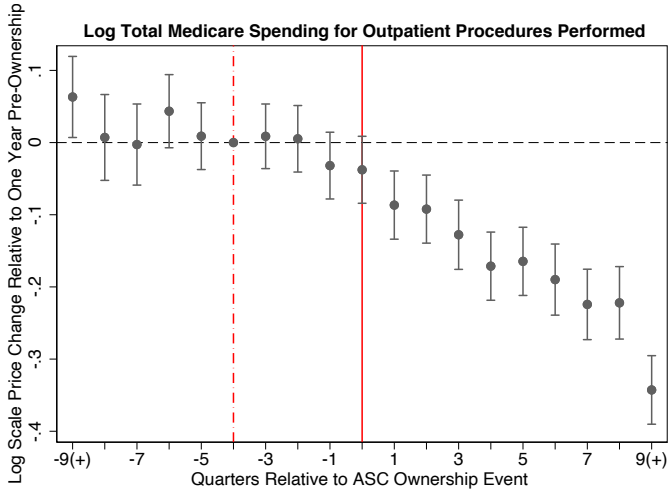


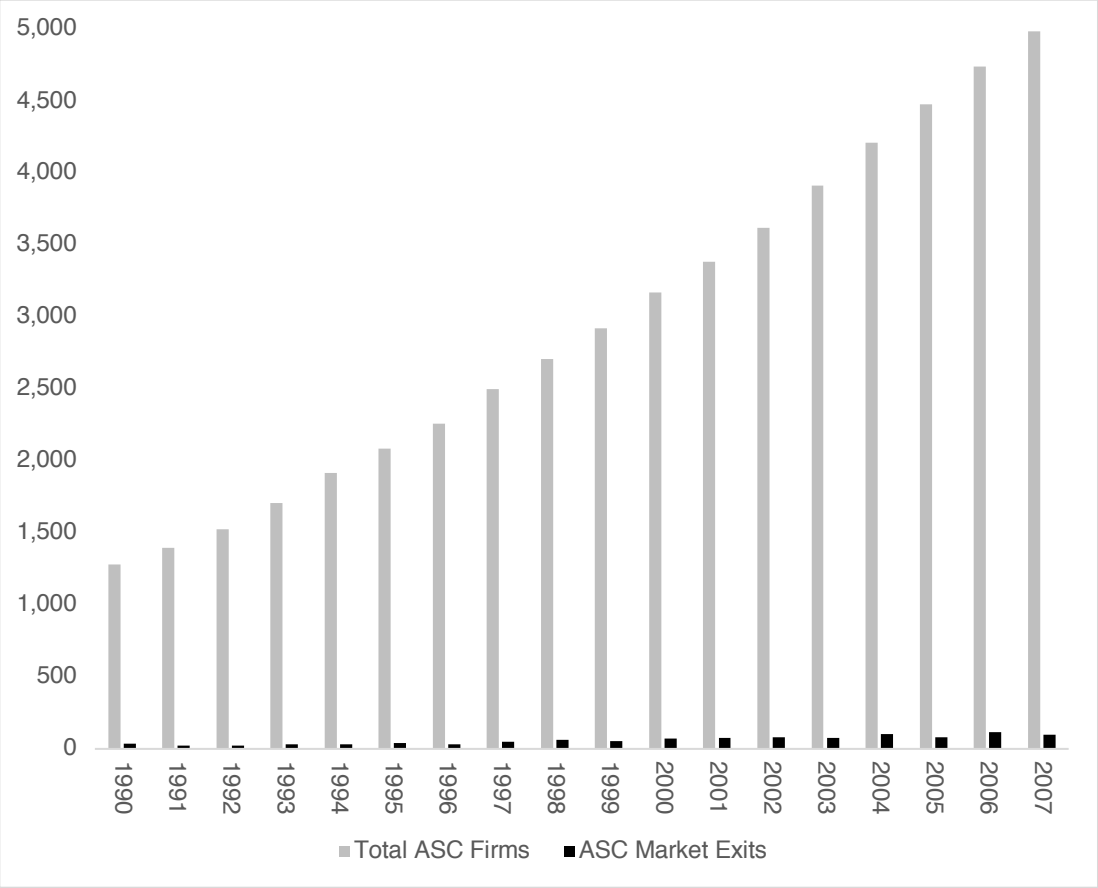
FIGURE 5. EVENT STUDY RESULTS FOR NEW ASC OWNERSHIP EFFECTS ON AVERAGE MEDICARE SPENDING PER PROCEDURE AND TOTAL MEDICARE SPENDING FOR ALL OUTPATIENT PROCEDURES

Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3.

APPENDIX RESULTS

Appendix A

Appendix Figure A1: National Trends in Total Medicare-Certified ASCs and Number of Market Exits by Year, 1990-2007



Notes: Data are from the Medicare Provider of Service Files

Appendix Table A1: Top 15 Procedure (HCPCS) Codes for ASC Cases 2010-2017

All ASC Cases 2010-2017				ASC Cases Among New Owners 2010-2017			
HCPCS Code	Rank	Short Description	Share (%) of All Cases	HCPCS Code	Rank	Short Description	Share (%) of All Cases
66984	1	Cataract surgery	13.2	66984	1	Cataract surgery	18.3
45378	2	Colonoscopy	10.8	45378	2	Colonoscopy	8.9
43239	3	Upper Endoscopy	10.1	43239	3	Upper Endoscopy	8.4
45380	4	Colonoscopy	8.0	45380	4	Colonoscopy	8.1
45385	5	Colonoscopy	7.2	45385	5	Colonoscopy	7.0
66821	6	Post-cataract laser surgery	3.8	66821	6	Post-cataract laser surgery	4.6
62311	7	Spinal injection	2.5	62311	7	Spinal injection	2.3
64483	8	Spinal injection	2.5	64483	8	Spinal injection	2.1
45384	9	Colonoscopy	2.2	52000	9	Cystoscopy	1.4
64493	10	Spinal injection	1.5	45384	10	Colonoscopy	1.4
66982	11	Cataract surgery	1.2	66982	11	Cataract surgery	1.3
29881	12	Knee arthroscopy	1.1	64721	12	Carpal tunnel surgery	1.0
62310	13	Spinal injection	1.0	29881	13	Knee arthroscopy	1.0
52000	14	Cystoscopy	1.0	64493	14	Spinal injection	1.0
64635	15	Spinal injection	0.8	65855	15	Laser eye surgery	0.9
Cumulative Share of All Cases			66.8	*Cumulative Share of All Cases*			67.7

Notes: Florida AHCA ambulatory surgery discharge database 2010-2017. Examining the first procedure code listed for all cases performed within ASCs over the eight-year study period.

Appendix Table A2: DD Estimate Sensitivity to the Exclusion of New ASC Ownership Stakes Occurring in a Particular Year During Our Analytic Window

Outcome: Share (PPT) of Procedures in ASCs

	Main Result	Exclude 2010	Exclude 2011	Exclude 2012	Exclude 2013	Exclude 2014	Exclude 2015	Exclude 2016	Exclude 2017
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1[Ownership]	4.955***	4.811***	4.520***	4.863***	3.985***	4.922***	4.376***	4.803***	4.971***
	(0.808)	(0.825)	(0.835)	(0.843)	(0.837)	(0.816)	(0.806)	(0.847)	(0.816)
Observations (N)	228,288	225,984	226,752	226,912	226,176	226,496	227,520	226,432	227,808

Outcome: HOPD Procedure Volume

	Main Result	Exclude 2010	Exclude 2011	Exclude 2012	Exclude 2013	Exclude 2014	Exclude 2015	Exclude 2016	Exclude 2017
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1[Ownership]	–5.809***	–5.658***	–5.339***	–5.550***	–4.601***	–5.936***	–5.795***	–5.958***	–5.840***
	(1.359)	(1.393)	(1.409)	(1.381)	(1.218)	(1.441)	(1.416)	(1.426)	(1.371)
Observations (N)	228,288	225,984	226,752	226,912	226,176	226,496	227,520	226,432	227,808

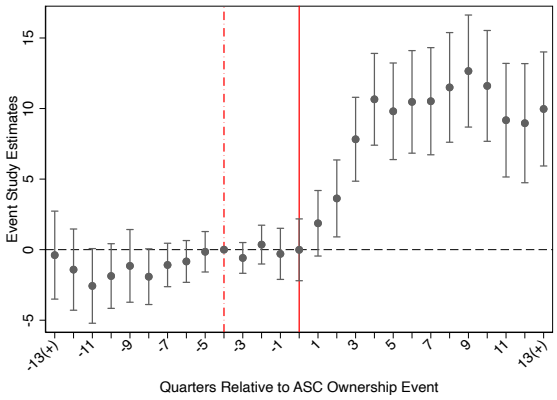
Outcome: Total Procedure Volume

	Main Result	Exclude 2010	Exclude 2011	Exclude 2012	Exclude 2013	Exclude 2014	Exclude 2015	Exclude 2016	Exclude 2017
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1[Ownership]	4.392**	4.482**	3.760	4.693**	3.286	4.529**	4.379**	4.169	4.535**
	(2.066)	(2.118)	(2.108)	(2.165)	(1.806)	(2.166)	(2.152)	(2.237)	(2.084)
Observations (N)	228,288	225,984	226,752	226,912	226,176	226,496	227,520	226,432	227,808

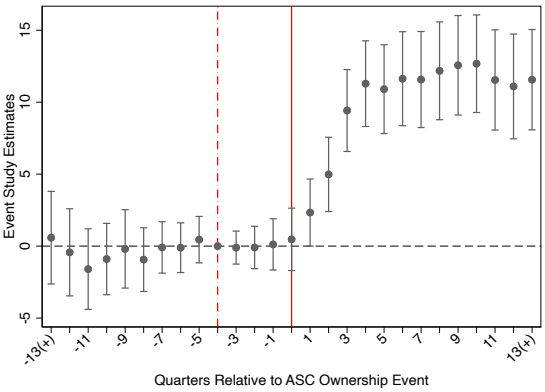
Notes: Analytic data are from the Florida AHCA ambulatory discharge database 2010-2017. Analytic sample is restricted to physicians observed in the data in all quarters from 2010 through 2017. Each model includes physician and quarter-year fixed effects. Standard errors clustered at the physician level, *** P value at 0.01 ** P value at 0.05

Appendix Figure A2: Robustness of Event Study Results for Effects of New Ownership on Procedure Allocations to ASCs When Using Alternative Control Groups and Analytic Samples

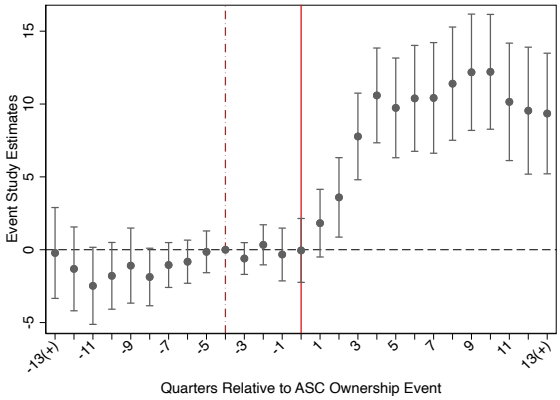
Alternative Analytic Sample 1



Alternative Analytic Sample 2



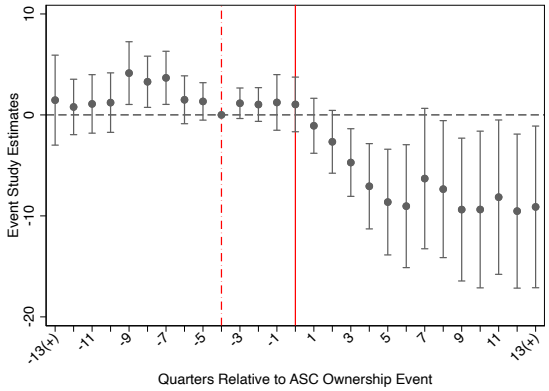
Alternative Analytic Sample 3



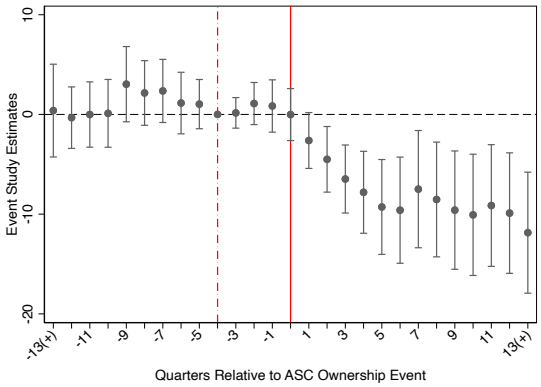
Notes: Outcome is in percentage-point (ppt) terms. Regression is at the physician level, and the specification is from Equation 2. Restricts to physicians observed in all 32 quarters of data spanning 2010-2017. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure A3: Robustness of Event Study Results for Effects of New Ownership on HOPD Procedure Volumes When Using Alternative Control Groups and Analytic Samples

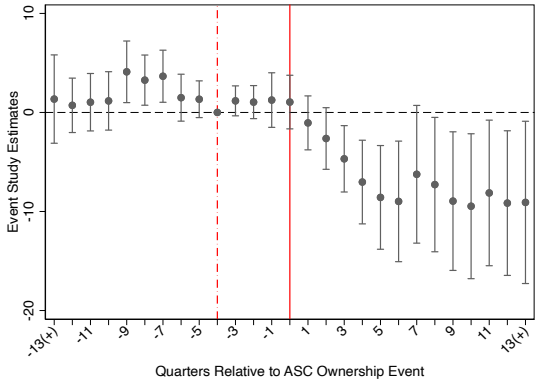
Alternative Analytic Sample 1



Alternative Analytic Sample 2



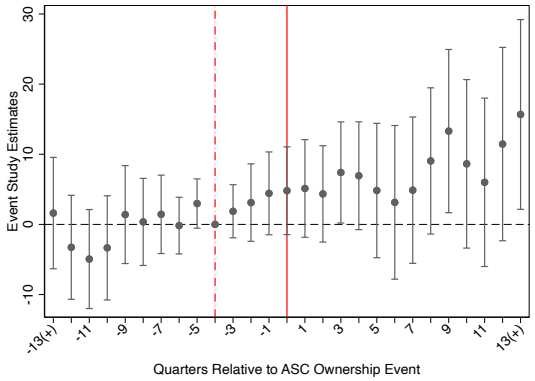
Alternative Analytic Sample 3



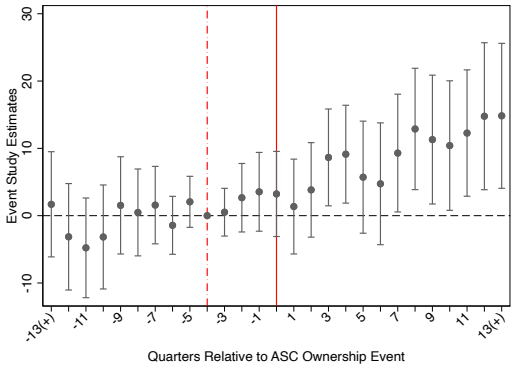
Notes: Regression is at the physician level, and the specification is from Equation 2. Restricts to physicians observed in all 32 quarters of data spanning 2010-2017. Alternative analytic sample 1 removes “already” owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses “never” owners as the control group. Alternative analytic sample 3 only uses “never” owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure A4: Robustness of Event Study Results for Effects of New Ownership on Total Procedure Volume When Using Alternative Control Groups and Analytic Samples

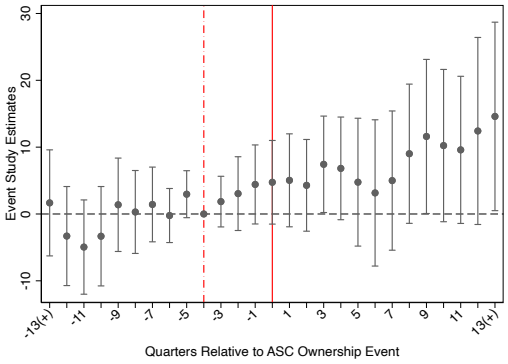
Alternative Analytic Sample 1



Alternative Analytic Sample 2

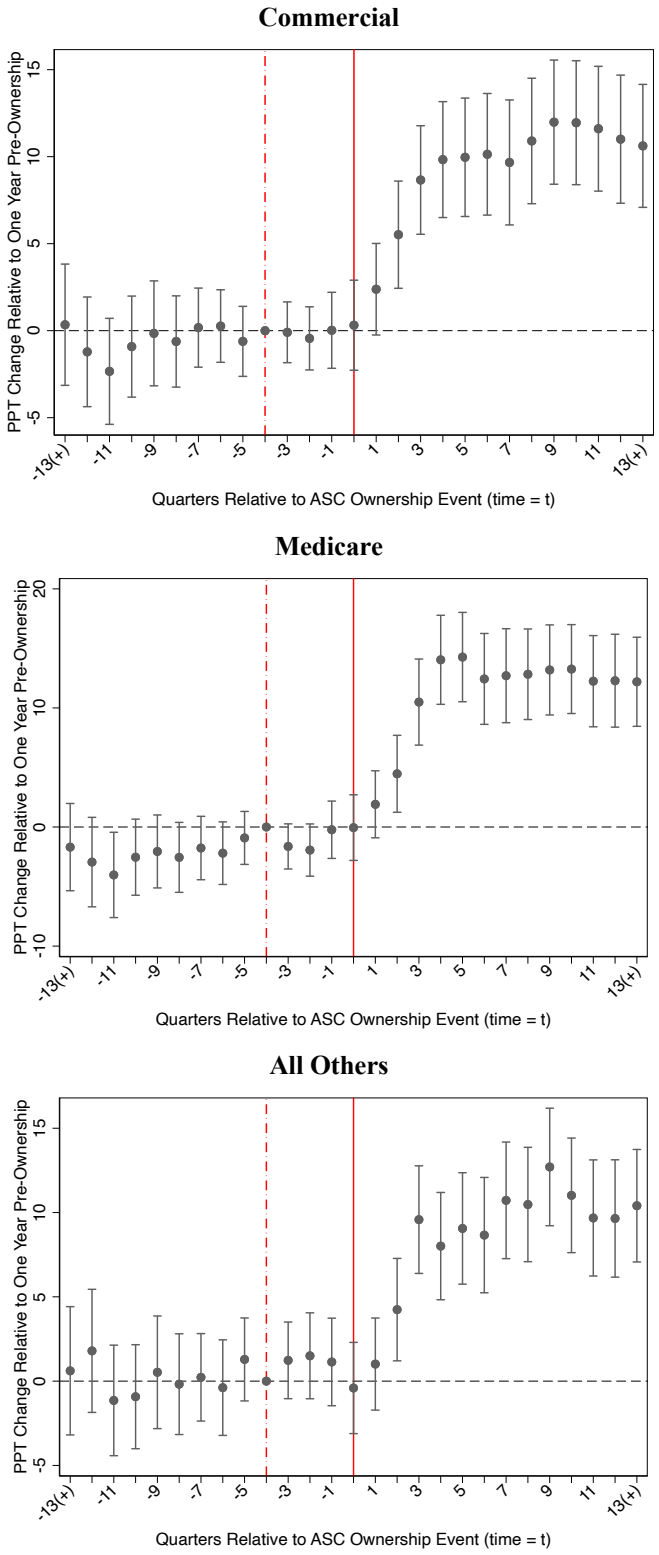


Alternative Analytic Sample 3



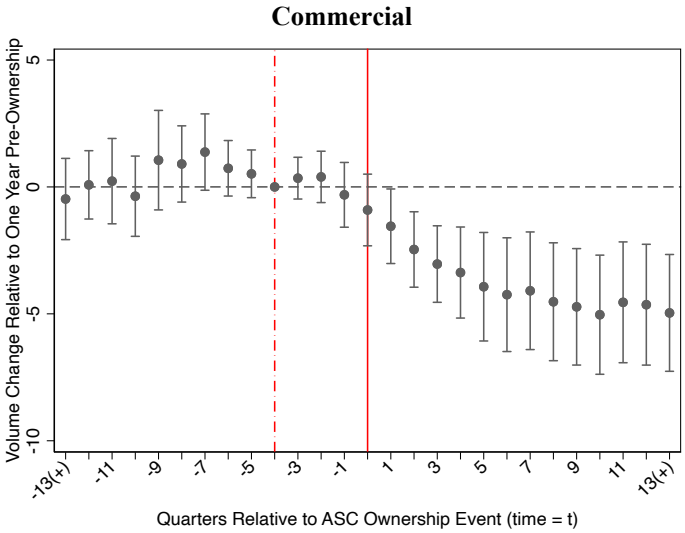
Notes: Regression is at the physician level, and the specification is from Equation 2. Restricts to physicians observed in all 32 quarters of data spanning 2010-2017. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

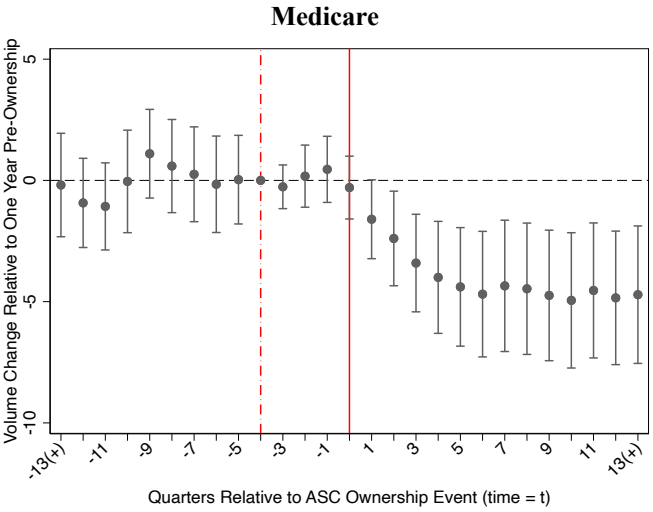
Appendix Figure A5: Event Study Results for Effects of New ASC Ownership in Procedure Allocations to ASCs

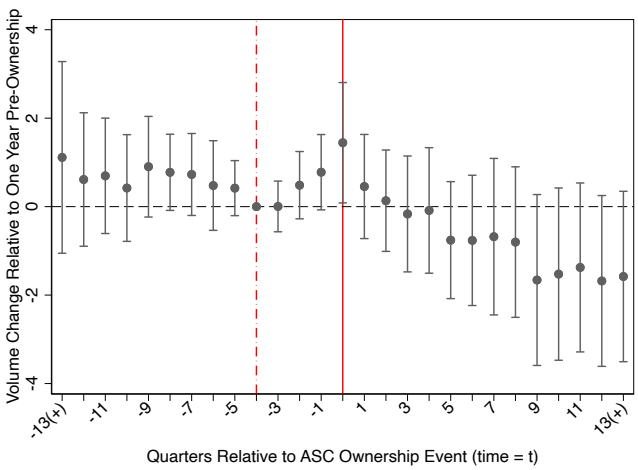


Notes: Outcome is in percentage-point (ppt) terms. Regression is at the physician level, and the specification is from Equation 2. Restricts to physicians observed in all 32 quarters of data spanning 2010-2017.

Appendix Figure A6: Event Study Results for Effects on Procedure Volumes within HOPD Settings

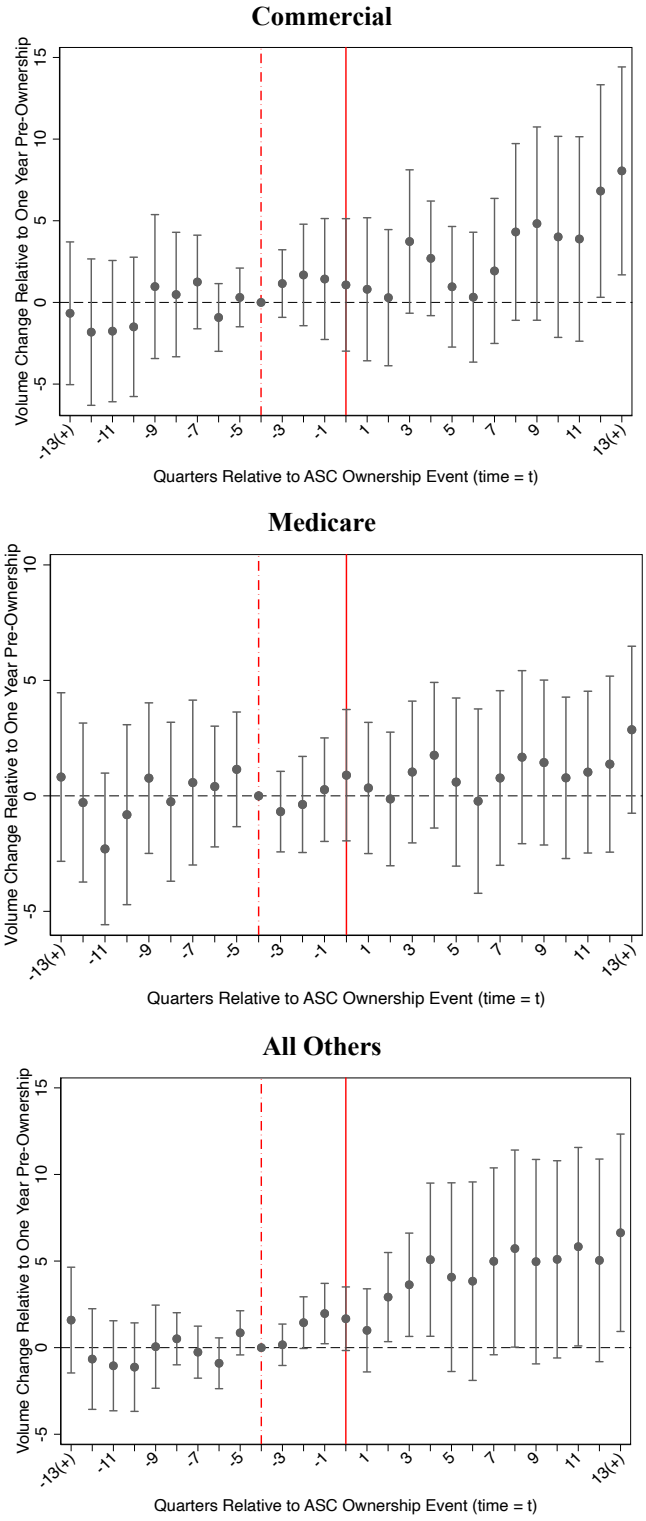






Notes: Regression is at the physician level, and the specification is from Equation 2. Restricts to physicians observed in all 32 quarters of data spanning 2010-2017.

Appendix Figure A7: Event Study Results for Effects on Total Outpatient Procedure Volume



Notes: Regression is at the physician level, and the specification is from Equation 2. Restricts to physicians observed in all 32 quarters of data spanning 2010-2017.

Appendix B

To ensure direct comparability between our two main analytic data sources, we first examine the estimates from the 100% Medicare claims data after restricting to a balanced panel of physicians practicing in Florida. Our goals are three-fold. First, we want to ascertain that we get similar sample sizes as those found in Table 1, which is using the Florida discharge database. The counts will not be exact since the available number of years differs between the Florida discharge records and the 100% Medicare claims data. Second, we want to make sure our results for share of procedures performed within ASCs, volume of procedures within HOPDs, and total procedure volume is comparable to what is found within Appendix Figures A2-A4. Third, and finally, we examine the quality of care outcomes (i.e., likelihood of utilizing emergency room care within the 30 day period following receipt of a procedure) that are not possible within the Florida discharge data.

Appendix Table B1 demonstrates strong correspondence between the Florida discharge and Medicare claims data in terms of the number of unique physicians entering into the analytic data and their average procedure volumes and shares performed within ASCs in a given quarter. As expected, with the reduced analytic window (i.e., 2013-2018) leaves us with fewer observed ownership transitions when compared to the Florida discharge data. The one departure in the summary statistics across the two databases is the average volume among 'Never Owners'. On closer examination, this appears to be driven by organizational NPIs creating a skewed right-tail in the distribution. Eliminating the top 1% of the volume distribution does not meaningfully change any of the results, however.

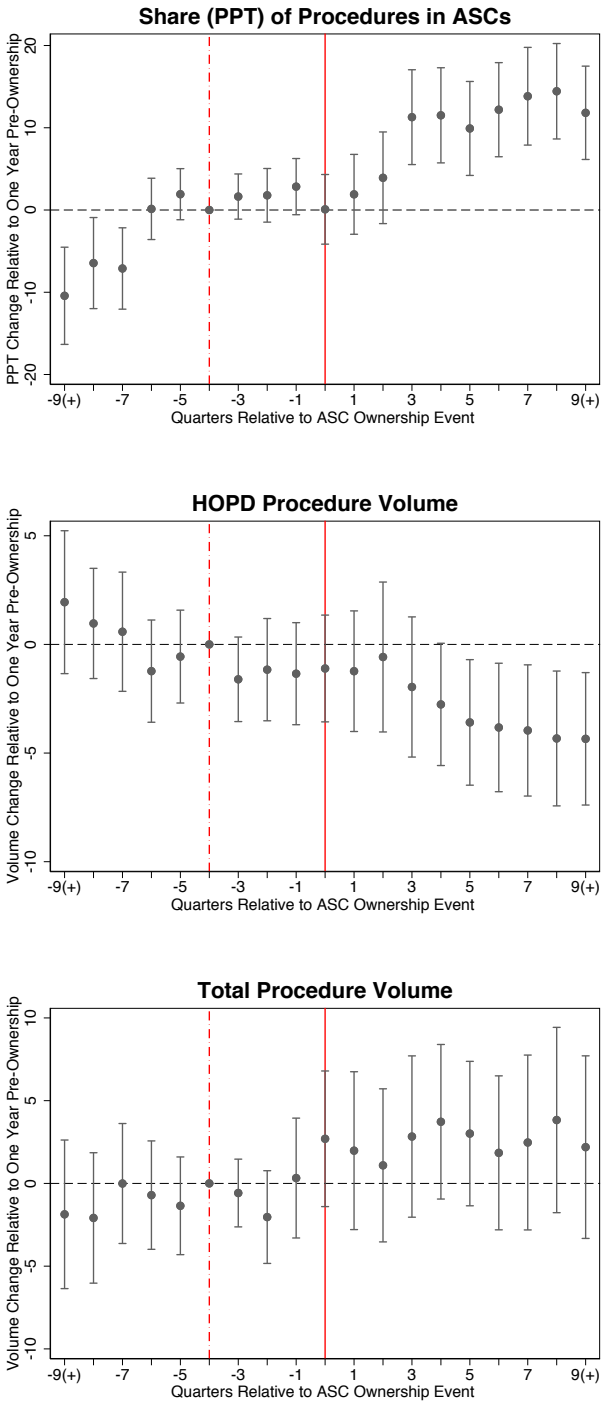
Appendix Figure B1 shows analogous outcomes from the event study model as Appendix Figures A2-A4. The qualitative patterns from the event study results as well as the magnitudes of the post-ownership estimates align reasonably well across the two analytic datasets. Finally, Appendix Figure B2 examines the propensity for emergency room (ER) use following the receipt of an outpatient procedure over the following 30 days. Again, these are outcomes we could not track in the Florida discharge data. The estimates suggest that the likelihood of an adverse event does not increase when a Florida physician newly takes an ownership stake in one or more ASCs.

Appendix Figure B3 presents analogous event study results as those found in Figure 2; however, Appendix Figure B3 is generated using the national 100% Medicare claims data from 2013-2018 for the estimation. The patterns align with those from our main results, with the exception of an increase in the total volume of outpatient procedures beginning in the six months prior to becoming an ASC owner and continuing after the ownership transition. Appendix Figure B4 offers results from a parallel analytic exercise (mirroring the top panel of Figure 2) that examines changes in the share of cases devoted as ASCs over time for the three specific outpatient procedure types. The general patterns and magnitudes of the event-time estimates for the top and middle panels of Appendix Figure B4 (arthroscopic and cataract surgeries, respectively) align reasonably well with the findings for all procedures from Florida (Figure 2); though, the change is more gradual for arthroscopic surgeries and begins during the six months prior to formal ASC ownership for cataract surgeries. The estimates are more volatile in the pre-ownership period for the physicians performing colonoscopy procedures, but they do largely stabilize starting in the second post-ownership year with elevated shares of cases allocated to ASCs. Appendix Figure B4 therefore indicates that the ASC substitution effect witnessed in Section IV is also found among our national sample of specific Medicare procedures.

Appendix Table B1: Summary Stats for Florida Subsample from 100% Medicare Claims Data

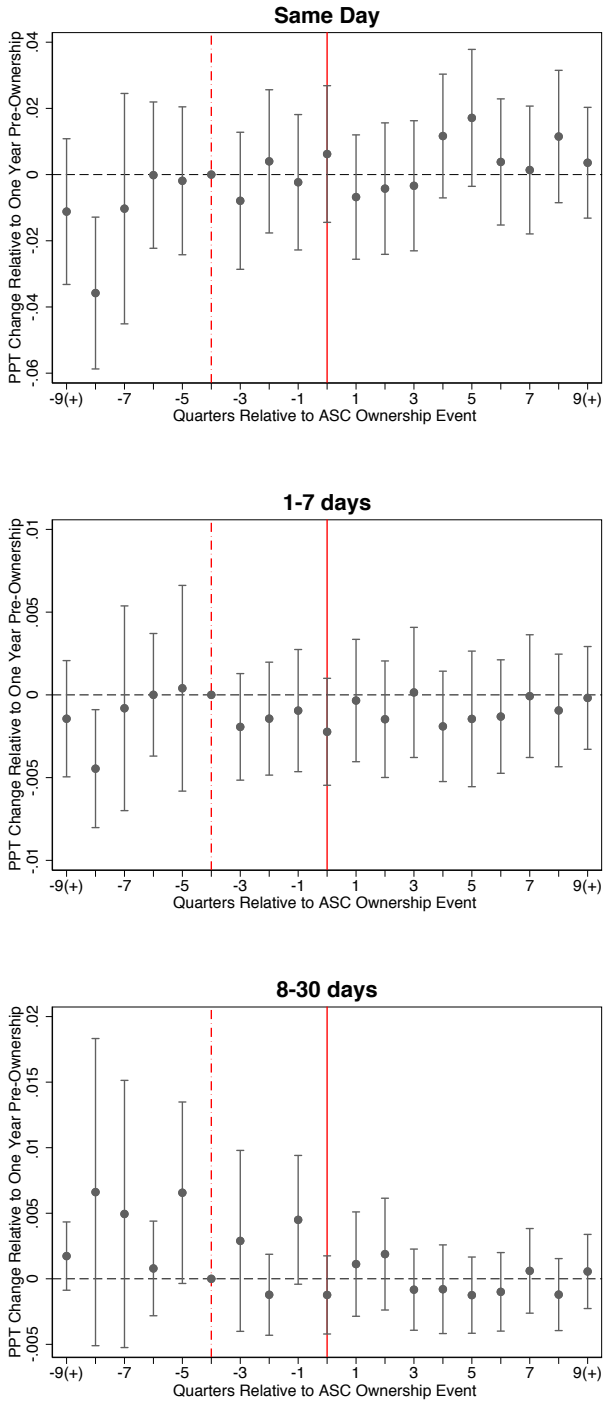
	Already Owners	**Never Owners**	**Become Owners**
	Mean (SD)	Mean (SD)	Mean (SD)
All procedures (Florida)			
Volume	67.5 (80.5)	48.6 (106.8)	41.7 (49.7)
Share of cases in ASCs	70.9 (37.2)	23.6 (39.2)	54.2 (41.2)
ER visit same day	0.102 (0.092)	0.125 (0.124)	0.106 (0.102)
ER visit 1-7 days	0.003 (0.014)	0.005 (0.022)	0.001 (0.007)
ER visit 8-30 days	0.003 (0.021)	0.006 (0.027)	0.011 (0.052)
Physicians (N)	913	5,383	180

Appendix Figure B1: Event Study Results for Effects among Florida Physicians When Using the 100% Medicare Claims Data



Notes: Regression is at the physician-quarter-year-level and restricts to a balanced panel of physicians from 2013-2018.

Appendix Figure B2: Event Study Results for ER Visit Effects among Florida Physicians When Using the 100% Medicare Claims Data



Notes: Regression is at the physician-quarter-year-level and restricts to a balanced panel of physicians from 2013-2018.

Appendix Table B2: ICD Codes and CPT Codes for Complication Identification

Panel A. ICD-9 codes for arthroscopy	
30 days	
Bleeding	998.1, 719.10, 719.16, 719.17, 39.98
Post-operative deep vein thrombosis	453.40–453.42, 453.50–453.52,453
Pulmonary embolism	415.1
90 days	
Mechanical failure	996.40, 996.4, 996.49
Wound infection	682.1–682.9, 686.9, 998.6, 998.7, 998.83, 998.3,998.5, 996.66, 996.67, 86.22, 86.28, 86.04, 81.53,81.55, 81.59, 00.70, 00.71, 00.72, 00.73, 00.80, 00.81, 00.82, 00.84,80.05, 80.06, 80.09
Postoperative nerve injury	955, 956, 957.8, 957.9
Panel B. ICD-10 codes for arthroscopy	
7 days	
Cardiovascular complications	I2109, I2119, I2111, I2129, I214, I213, I219, I21A1 , I21A9, I973, I20, I240, I248,
Pneumonia & influenza	J13, J181, J120, J121, J122, J1281, J1289, J129, J150, J151, J14, J154, J153, J1520, J15211, J15212, J1529, J158, J155, J156, A481, J159, J157, J180, J189, J1100, J09X1, J1008, J690
Shock	R571, R578, R6521, T8110A
Sepsis	A409, A412, A4101, A4102, A411, A403, A414, A415, A413, A4151, A4152, A4153, A4159, A4189, A419, R6521, R6520, R7881
30 days	
Bleeding complications	D7801, D7821, D7822, E3601, E3602, G9731, G9732, G9751, G9752, H59111, H59112, H59113, H59119, H59121, H59122, H59123, H59129, H59311, H59312, H59313, H59319, H59321, H59322, H59323, H59329 , H9521, H9522, H9541, H9542, I97410 , I97411, I97418, I9742, I97610, I97611, I97618, I9762, J9561, J9562, J95830, J95831, K9161, K9162, K91840, K91841, L7601, L7602, L7621, L7622, M96810, M96811, M96830 , M96831, N9961, N9962, N99820, N99821, D7831, G9762, H59341, H59342, H59343, H59349, H9551, H9552, I97621, L7602, L7632, M96840, M96841, N99841, G9764, I97622, L7634, M96842, M96843, N99843, T888XXA
Hemarthrosis	M2500, M25069, M25061, M25062, M25011, M25012, M25019, M25073, M25076
Control bleeding	0W3Q3ZZ, 0W3Q4ZZ, 0W3Q7ZZ, 0W3Q8ZZ, 0X320ZZ, 0X323ZZ, 0X324ZZ, 0X330ZZ, 0X333ZZ, 0X334ZZ, 0X340ZZ, 0X343ZZ, 0X344ZZ, 0X350ZZ, 0X353ZZ, 0X354ZZ, 0X360ZZ, 0X363ZZ, 0X364ZZ, 0X370ZZ, 0X373ZZ, 0X374ZZ, 0X380ZZ, 0X383ZZ, 0X384ZZ, 0X390ZZ, 0X393ZZ, 0X394ZZ, 0Y390ZZ, 0Y393ZZ, 0Y394ZZ, 0Y3B0ZZ, 0Y3B3ZZ, 0Y3B4ZZ, 0Y3C0ZZ, 0Y3C3ZZ, 0Y3C4ZZ, 0Y3D0ZZ, 0Y3D3ZZ, 0Y3D4ZZ, 0Y3F0ZZ, 0Y3F3ZZ, 0Y3F4ZZ, 0Y3G0ZZ, 0Y3G3ZZ, 0Y3G4ZZ, 0Y3H0ZZ, 0Y3H3ZZ, 0Y3H4ZZ, 0Y3J0ZZ, 0Y3J3ZZ, 0Y3J4ZZ
Post-operative DVT/PE	I742, I743, I8010, I80209, I803, I808, I809, I82220, I82290, I823, I82479, I82499, I82609, I82629, I82890, I82A19, I82B19, I82C19, I2690, I2692, I2699, T800XXA, T81718A, T8171XA , T8172XA, I82409, I82419, I82429, I82439, I824Y9, I82449, I82499, I824Z9, I82509 , I82549, I8291
ABO incompatibility	T8030XA, T80311A, T8039XA
Pulmonary embolism	I2690, I2699, T800XXA, T81718A, T8172XA, I2692
90 days	
Mechanical complications	T84498A, T84039A, T84029A, T84019A, M979XXA, M9711XA, M9712XA, T84033A, T84032A, T84059A, T84069A, T84099A, T84119A, T84129A, T84199A,
Cellulitis & infection	L03221, L03319, L03119, L03129, L03317, L03811, L03818, L0390, L0391, L089, T8183XA, T8169XA, T8189XA
Wound disruption	T8130XA, T8132XA, T8131XA, T8133XA, K6811, T8450XA, T8460XA, T847XXA

Postoperative nerve injury	S4430XA, S4410XA, S4400XA, S4420XA, S4440XA, S4450XA, S6430XA, S448X9A, S4490XA, S7400XA, S7410XA, S8400XA, S8410XA, S7420XA, S8420XA, S84809A, S84809A, S8490XA, S149XX, S149XXA

Panel C. CPT codes for cataract surgery

90 days	
Repositioning of IOL (insertion of ocular lens)	66825
Removal of IOL	65920
Exchange of IOL	66986
Repair of wound or iris	66250, 66680, 66682
Therapeutic paracentesis of anterior chamber	65805
Removal of anterior chamber blood or clot	6,581,565,930
Re-inflation of anterior chamber	66020
Repair of retinal detachment	67101–67110
Vitrectomy and related procedures	65810, 67005, 67010, 67015, 67025, 67036, 67039
Removal of IOL posterior segment	67121
Intravitreal injection	67028
Drainage of choroid	67015
Anterior orbitotomy	67400
Removal of eye, evisceration, or enucleation	65091, 65093, 65101, 65103, 65105

Panel D. ICD-9 codes for colonoscopy

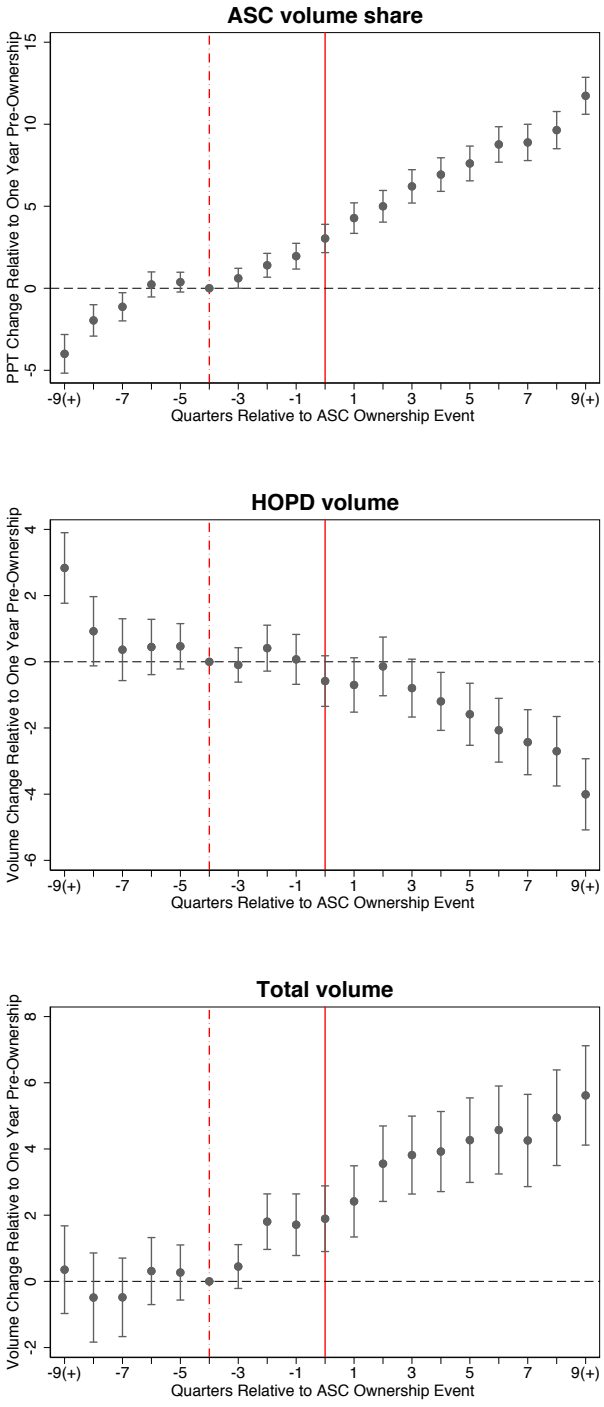
30 days	
Arrhythmia	427.0–427.4, 427.6–427.9
Congestive heart failure	428.0–428.9
Cardiac or respiratory arrest	427.5, 799.1, 997.1
Syncope, hypotension, or shock	453.29, 458.8–458.9, 639.5,780.2, 785.50–785.51, 998.0, 995.4
Perforation	569.83, 998.2
Lower gastrointestinal bleeding	558.9, 578.1, 995.2, 995.89,998.1–998.13, 286.5, 459, 562.02–562.03, 562.12, 562.13, 569.3,569.84–569.86, 578.9, 792.1
Infection	780.66,790.7, 424.9–424.99
Paralytic ileus	560.1
Nausea, vomiting, dehydration	276.5, 536.2, 787.0-02
Abdominal pain	789
Diverticulitis	562.01, 562.03, 562.11, 562.13
Enterocolitis	555–556

Panel E. ICD-10 codes for colonoscopy

30 days	
Arrhythmia	I471, I472, I479, I4891, I4892, I4901, I4902
Acute myocardial infarction	I2109, I2119, I2111, I2129, I214, I213, I219, I21A1, I21A9, I495, R001, I498, I499
Congestive heart failure	I50814, I509, I501, I5020, I5021, I5023, I5030, I5031, I5033, I5040, I5041, I5043, I50810, I50811, I50813, I5082, I5083, I5084, I5089, I509, I110, I130, I132, I255, I420, I425, I426, I427, I428, I429, I43X, I469, R092, I9788, I9789
Syncope, hypotension, or shock	45329, I9589, I959, R55, T882XXA, R579, R570, T8110XA, T81, T811, T8110, T8110XA, T8110XD, T8110XS, T8111, T8111XA, T8111XD, T8140XS, T8140, T8112XA, T8112XD, T8112XS, T8119, T8119XA, T8119XD, T8119XS
Disruption of wound, including perforation	T813, T8130, T8130XA, T8130XD, T8130XS, T8131, T8131XA, T8131XD, T8131XS, T8132, T8132XA, T8132XD, T8132XS, T8133, T8133XA, T8133XD, T8133XS, T814, T8140, T81 40XA, T8140XD, T8140XS, T815, T8150, T81504, T81504A, T81504D, T81504S, T81508, T81508A, T81508D, T81508S, T81509, T81509A, T81509D, T81509S, T8151, T81510, T81514, T81514A, T81514D, T81514S, T81518, T81518A, T81518D, T81518S, T81519, T81519A, T81519D, T81519S, T81524, T81524A, T81524D, T81524S, T81528, T81528A, T81528D, T81528S, T81529, T81529A, T81529D, T81529S, T8153, T81532, T81533, T81534, T81534, T81534D, T81534S, T81538, T81538D, T81538S, T81539, T81539A, T81539D, T81539S, T8159, T81590, T81594, T81594A,

	T81594D, T81594S, T81595, T81596, T81597, T81598, T81599, T816, T8160, T8161, T8169, T817, T8171, T81710, T81711, T81718, T81718A, T81718D, T81718S, T81719, T8172 , T8172 A, T8172 D, T8172 S, T818, T8181, T8182, T8183, T8189, T819
Perforation	K631, E3611, E3612, G9749, I9752, J9572, K9171, K9172, L7612, T888XXA
Lower gastrointestinal bleeding	K921, T50905A, T8851XA, E3601, E3602, E89810, E89811, E89820, E89821, G9732, G9752, G9762, I9742, I97620, I97621, J9562, J95831, J95861, K9161, K9162, K91840, K91841, L7602, L7622, L7632, N9962, N99821, N99841, E89822, E89823, G9764, I97622, J95863, K91872, K91873, L7634, N99843, T888XXA
Bleeding complications	R58, K625, K5521, K6381, K922, R5084, J690, J698, J158, J159, 4838, J168, J189, R7881, I38, I39
Ileus	K560, K567
Nausea, vomiting, dehydration	E869, E860, E861, R1110, R112, R110
Abdominal pain	R109
Diverticulitis	K5712, K5713, K5732, K5733
Hemorrhage	I609, I619, I621, I6200, I629
Cerebral infarction	I6330, I6340, I6350
Occlusion and stenosis	I669, I6609, I6619, I6629
Other cerebrovascular diseases	I6789
Pulmonary embolism	I260, I2601, I2602, I2609, I269, I2690, I2692, I2693, I2694, I2699

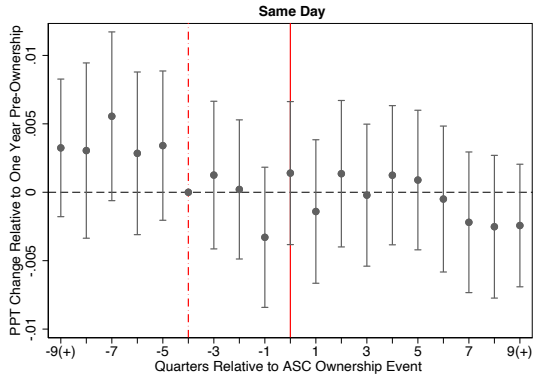
Appendix Figure B3: Event Study Results for New ASC Ownership Effects When Using the National 100% Medicare Claims Data Analytic Sample



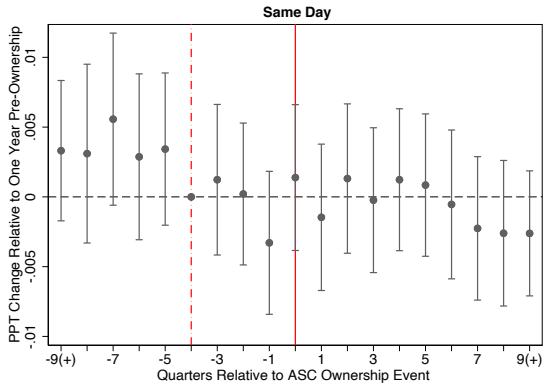
Notes: Regression is at the physician-quarter-year-level and restricts to a balanced panel of physicians from 2013-2018

Appendix Figure B4: Robustness of Event Study Results for Effects of New Ownership on ED Utilization When Using Alternative Control Groups and Analytic Samples

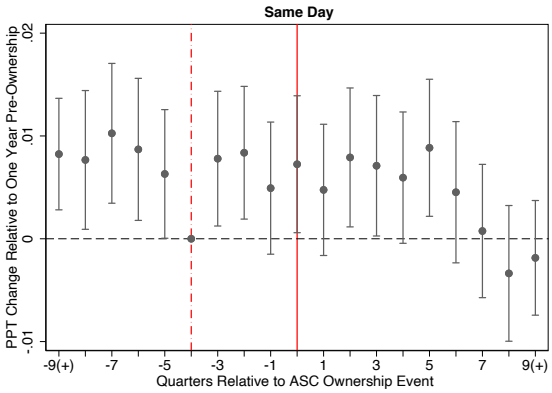
Alternative Analytic Sample 1



Alternative Analytic Sample 2



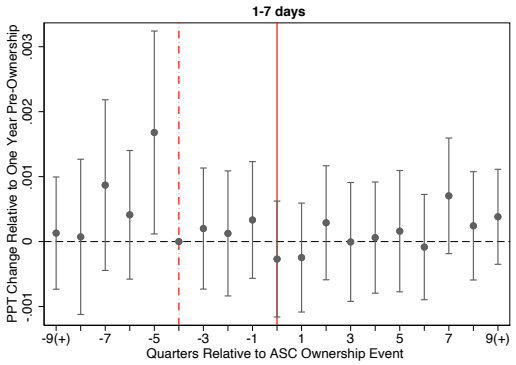
Alternative Analytic Sample 3



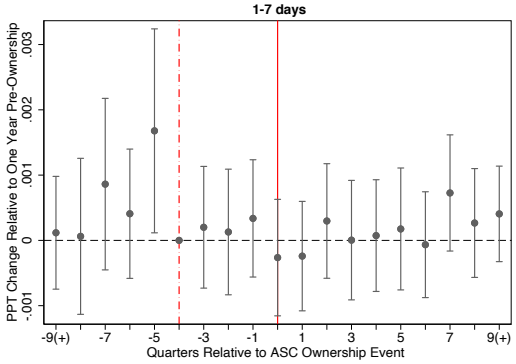
Notes: Restricts to physicians observed in all quarters of 100% Medicare claims data spanning 2013-2018. Alternative analytic sample 1 removes “already” owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses “never” owners as the control group. Alternative analytic sample 3 only uses “never” owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B5: Robustness of Event Study Results for Effects of New Ownership on ED Utilization When Using Alternative Control Groups and Analytic Samples

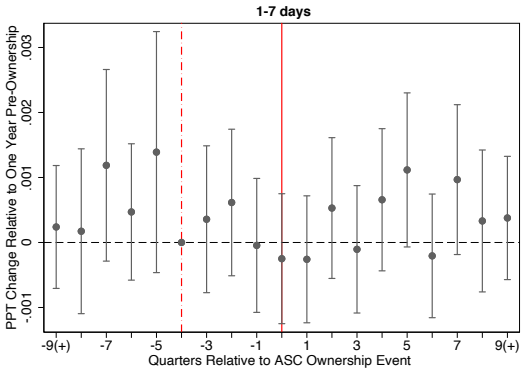
Alternative Analytic Sample 1



Alternative Analytic Sample 2



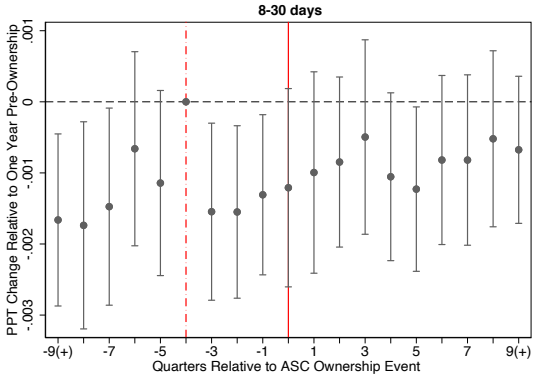
Alternative Analytic Sample 3



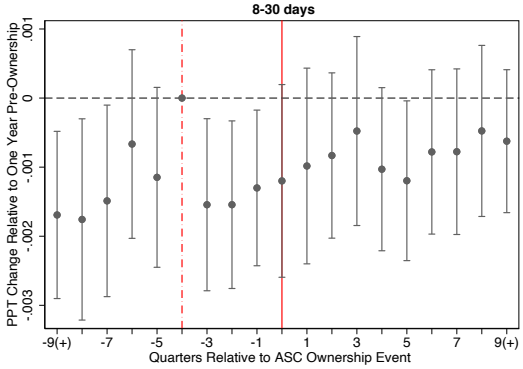
Notes: Restricts to physicians observed in all quarters of 100% Medicare claims data spanning 2013-2018. Alternative analytic sample 1 removes “already” owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses “never” owners as the control group. Alternative analytic sample 3 only uses “never” owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B6: Robustness of Event Study Results for Effects of New Ownership on ED Utilization When Using Alternative Control Groups and Analytic Samples

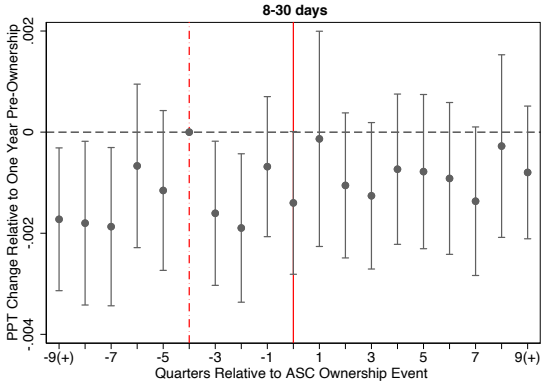
Alternative Analytic Sample 1



Alternative Analytic Sample 2

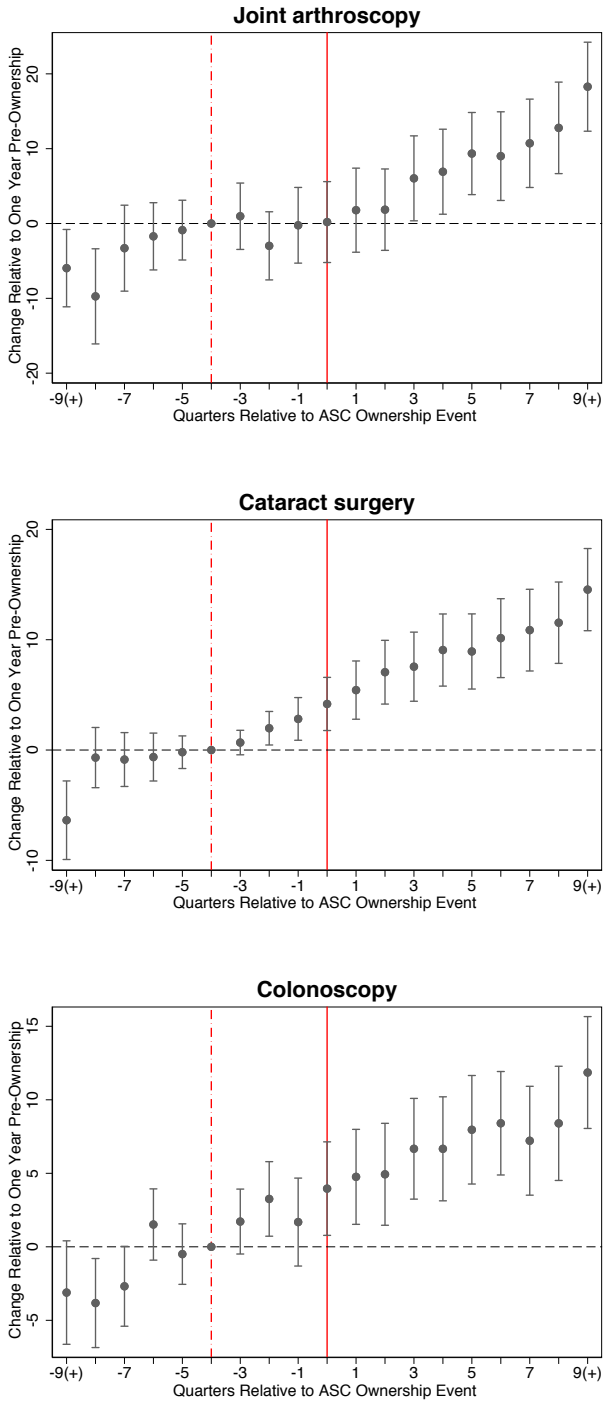


Alternative Analytic Sample 3



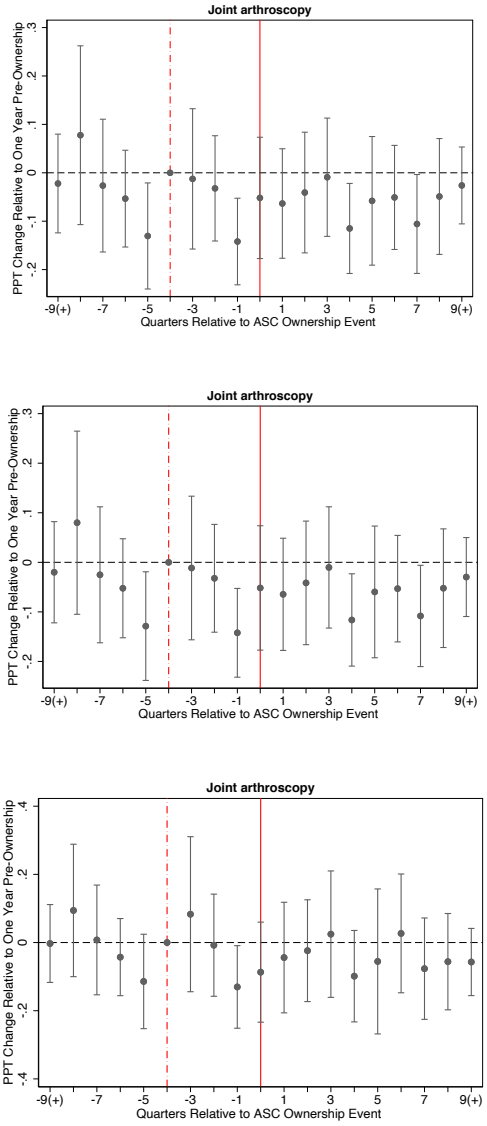
Notes: Restricts to physicians observed in all quarters of 100% Medicare claims data spanning 2013-2018. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B7: Event Study Results for New ASC Ownership Effects on Share of Cases Performed within ASCs



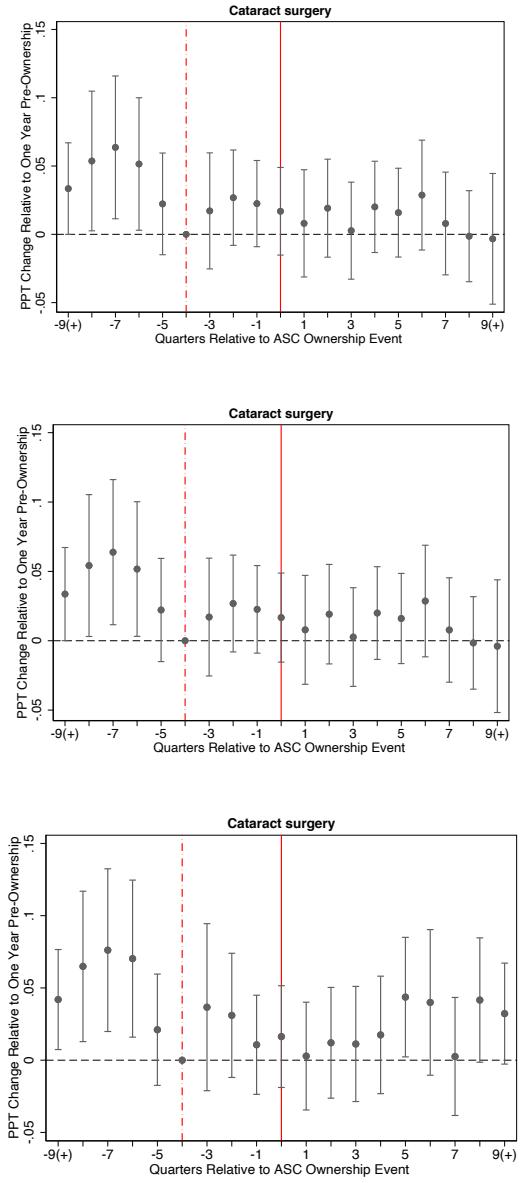
Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3.

Appendix Figure B8: Robustness of Event Study Results for Effects of New Ownership on Joint Arthroscopy Complication Rates When Using Alternative Control Groups and Analytic Samples



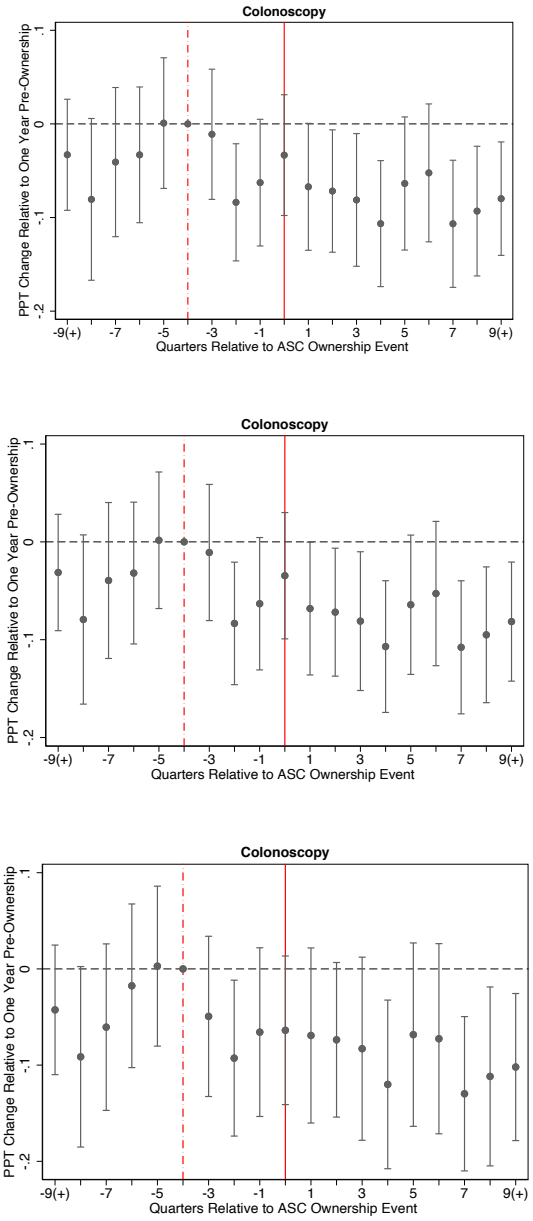
Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B9: Robustness of Event Study Results for Effects of New Ownership on Cataract Surgery Complication Rates When Using Alternative Control Groups and Analytic Samples



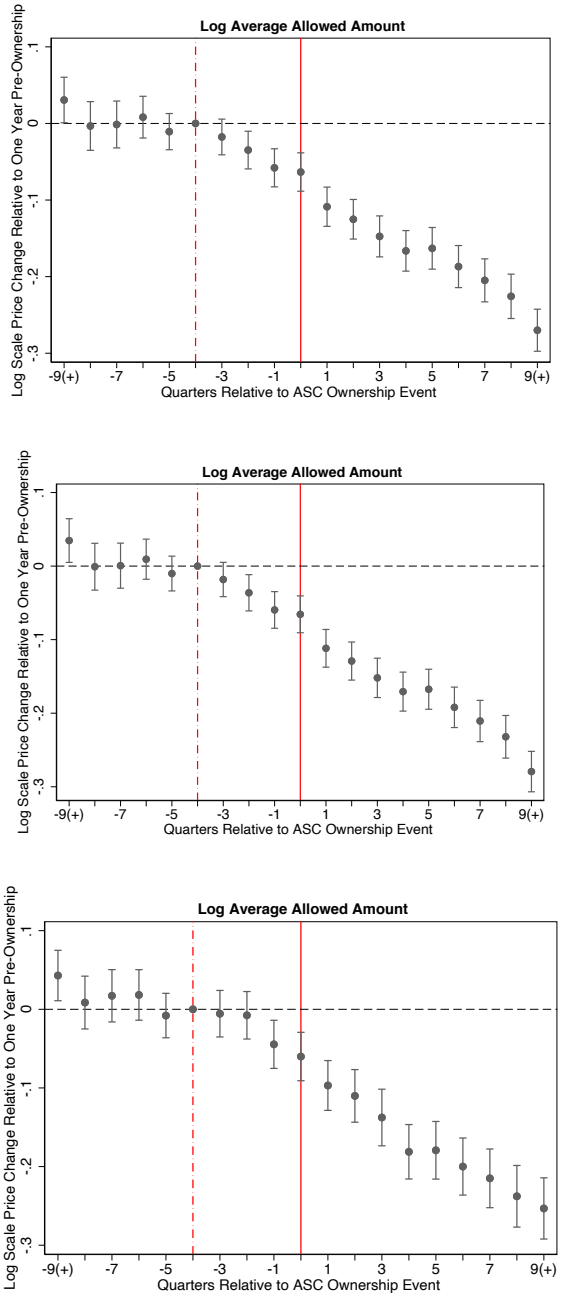
Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B10: Robustness of Event Study Results for Effects of New Ownership on Colonoscopy Complication Rates When Using Alternative Control Groups and Analytic Samples



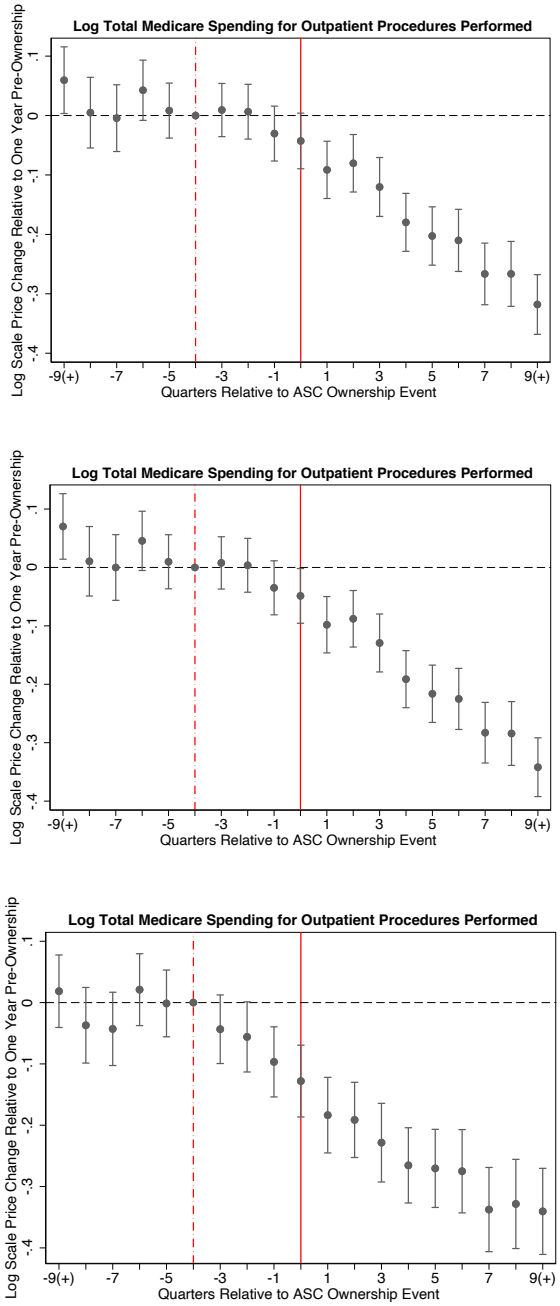
Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B11: Robustness of Event Study Results for Effects of New Ownership on Average Per Procedure Medicare Spending When Using Alternative Control Groups and Analytic Samples



Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.

Appendix Figure B12: Robustness of Event Study Results for Effects of New Ownership on Total Medicare Spending for All Outpatient Procedures When Using Alternative Control Groups and Analytic Samples



Notes: Analytic data are from the 100% Medicare claims data, 2013–2018. Regression is at the physician level, and the specification is from Equation 3. Alternative analytic sample 1 removes "already" owners that became a new owner within two years of the start of our analytic window. Alternative analytic sample 2 only uses "never" owners as the control group. Alternative analytic sample 3 only uses "never" owners as the control group and then also removes new owners during our analytic period with less than 2 years of pre-period data.