Can Private Equity Buy Referrals?

Evidence from Multispecialty Physician Practice Acquisitions

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Abstract

Multispecialty physician practices (MSP) incentivize referrals from generalists to be made to specialists within the practice. With growing acquisitions of MSP by private equity funds (PE), there is concern that high-powered for-profit incentives of PE may accelerate misalignments in patient-physician relationships to increase self-referrals, with unknown implications for patient welfare. Using novel data on PE acquisitions linked to Medicare claims data, I advance the literature on PE and vertical integration in health care markets by studying the precise ways that PE acquisitions of MSP change strategic referral behavior. I base my empirical analysis on 230 acquisitions of MSP over a 4-year period. Using a discrete choice model, I find that PE acquisitions increase self-referrals by 7 percent. I then consider the channels through which acquisitions increase self-referrals and find that neither increased market concentration nor endogenous acquisition selection explains increases in self-referrals. Rather, observed increases in self-referrals are driven by the adoption of PE's managerial strategies. Finally, I consider the welfare implications for patients and payers. Self-referrals can reduce welfare if they foreclose competing specialists from accessing patient referrals; on the other hand, self-referrals can improve welfare if they facilitate care coordination between generalists and specialists. I find both forces to be present. Taken together, this paper contributes policy-relevant evidence of the heterogeneous effects of vertical integration that depend on the managerial environment that shapes provider incentives. As the United States continues to transition towards value-based care contracts that pay for clinical performance, corporate ownership in multispecialty settings may have the potential to balance profitability and patient welfare by leveraging managerial skills to improve both clinical and financial outcomes.

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1. Introduction

A defining feature of health care markets is the outsized role played by providers (suppliers) in determining the overall demand for services.[1] [2] In particular, physician agency plays a central role in the demand for health care, as physicians hold information on patient medical history, informally coordinate care, and in some cases, formally manage access to specialists through referrals. A physician acting as a perfect agent will make treatment decisions to maximize their patients' utility. However, in the presence of information asymmetries, physicians may act as imperfect agents for their patients by incorporating their own economic interests in decision-making, rather than just patient utility.[2] Growing acquisitions of physician practices by high-powered institutional investors such as private equity funds (PE) raise concerns that PE may undermine physician agency by influencing physician tradeoffs between patient benefits and economic interests with unknown implications for patient welfare.

Physician referrals are a key dimension of physician agency. A formal referral or informal recommendation from a primary care physician (generalist) is a key factor in a patient's decision to seek specialty care.[34] For this reason, influence over referrals from generalists has motivated an extensive degree of consolidation in US health care markets. Consolidation in turn can distort physician agency by incentivizing physicians to change their referral patterns to better align with the financial interests of the acquiring entity. For example, theoretical models posit that physicians may join vertically integrated practices to make or receive hidden payments for referrals.[5] [6] Moreover, empirical research has shown increases in self-referrals following vertical integration of complementary providers across several settings.[7] [8] [9] [10] Given the potential for physicians to make referrals for economic benefit at the expense of patient welfare, federal and state statutes such as the 1972 Anti-Kickback Law and the 1995 Stark Physician Self-Referral Law (collectively the "Stark laws") restrict compensation of physicians based on their referral behavior.

Despite growing evidence on how vertical integration can distort physicians' referral choices to favor co-owned providers, less is known about another potential multiplier of distortions: the growing acquisitions of vertically integrated physician practices by PE. PE investment in health care has increased 20-fold from $5 billion in 2000 to $100 billion in 2018.[12] [13] In general, PE acquires physician practices with the aim of driving operational changes that generate high annual investor returns of 20 percent over short investment horizons of 3-7 years.[11] To realize their desired investment returns, PE funds have clear incentives to influence physician behavior where possible to improve the profitability of acquired firms. Growing PE acquisitions of multispecialty practices, characterized by vertical integration of generalists and specialists, raise particular concerns about whether the high-powered for-profit incentives of PE on top of traditional vertical integration accelerate misalignments in patient-physician relationships to direct referrals internally for financial gain.

The impact of PE acquisitions on physicians' referral behavior is not well established empirically. Although legal and contractual restrictions such as the Stark laws ban explicit compensation arrangements that account for the volume or value of physician referrals, in practice these arrangements may be difficult to detect if referral incentives are hidden within newly formed employment relationships or performance incentives.[14] Assessing the welfare consequences of PE acquisitions of multispecialty practices requires policymakers to consider the key tradeoff between physicians making self-referrals based on financial gain over patient needs, on the one hand, and any efficiency gains that may result from provider coordination facilitated by self-referrals, on the other. For this reason, understanding the effect of PE acquisitions on generalist referral behavior in multispecialty settings is an important empirical issue. Yet, despite this, no previous work has identified how PE acquisitions affect generalists' choice of specialists, or even whether PE acquisitions affect generalist choices at all.

In this paper, I seek to fill this gap by examining the referral choices of generalists in multispecialty practices that are acquired by PE during the study period. Specifically, I investigate whether PE acquisitions of multispecialty eyecare practices increase the likelihood of self-referrals from generalists to affiliated specialists. I do so by examining referrals from optometrists (generalists) to ophthalmologists (specialists) for cataract surgery. Eyecare services provide a novel opportunity to study the effects of PE acquisitions on referral behavior. First, there is generally a clear delineation between primary eye care delivered by generalists (optometrists) and surgical eye care delivered by specialists (ophthalmologists), making formal referrals for specialty care common. Second, eyecare is among the leading office-based specialties with PE acquisitions, ranking second only to dermatology in 2018.[15] [16] Acquisitions of eye care practices have tripled between 2016 and 2019 and over 10 percent of ophthalmologists are estimated to be working in PE-acquired settings as of 2019.[17] [18] [19] [20]

My analysis is based on granular individual-level claims from a 20% sample of Medicare beneficiaries from 2015-2019 linked to hand-collected data measuring changes in ownership of 230 multispecialty eye care practices from 2016-2019. I estimate conditional logit discrete choice models to examine the probability of a generalist choosing a particular specialist as a function of characteristics of the specialist (including whether he or she is integrated with the generalist in the same practice, distance from the patient, and measures of average costliness), characteristics of the generalist (including PE ownership status), and interactions between the two.

Estimated choice probabilities show that generalists in practices that are acquired by PE increase the likelihood of self-referral by 7 percent following acquisition. While these results are consistent with the hypothesis that PE acquisitions change financial or non-financial incentives to shape referral behavior, they may also be consistent with a few alternate mechanisms that I consider.

First, because acquisitions do not occur randomly, acquired multispecialty practices may differ from those not acquired in unobservable ways. To investigate this hypothesis, I re-estimate my choice model to estimate pre-acquisition "treatment effects." If increases in the likelihood of self-referrals were merely a continuation of pre-acquisition trends in self-referrals, we would expect to see an effect prior to acquisition. Results from this counterfactual simulation are small and not statistically significant, mitigating concerns about the endogeneity of the PE acquisition decision.

Second, given PE's "roll-up" acquisition strategy, where acquired firms gradually increase market share by acquiring smaller competitors, PE may increase self-referrals by hiring specialists with pre-existing referral relationships. To investigate whether self-referrals are driven by practice expansion rather than changes in generalist behavior, I estimate a counterfactual simulation where I hold constant the integration status of specialists before any acquisition (2015). If increases in self-referrals reflect practice expansion, we would expect to see small and insignificant results under this counterfactual. However, estimated counterfactual choice probabilities are comparable to my main results, ruling out this alternate mechanism.

Third, I examine whether increases in self-referrals are driven by potential increases in market concentration from add-on acquisitions of generalists. As generalists are the primary source of referrals for cataract surgery, add-on acquisitions may allow PE funds to increase market concentration and retain referrals from cataract surgery in-house.[12 18] To investigate this, I re-estimate the choice model excluding referrals that originate from generalists who join acquired practices after acquisition. If results were driven by increased generalist market concentration, this counterfactual would generate small and insignificant results. However, estimated results are comparable to my main results, suggesting that increased self-referrals are not driven by increases in market concentration but rather are driven by the adoption of PE's managerial strategies.

Finally, I examine the welfare implications of PE by assessing changes to total referral volume and to measures of quality, spending, and access. To do so, I use a matched difference-in-differences design that compares PE-acquired practices to a matched cohort of control practices, before and after acquisition. I find no changes to the total volume of cataract surgeries following PE acquisition, perhaps reflective of PE reducing unnecessary referrals to contain costs. There is a marginally significant decrease in post-surgical spending, suggesting that, in multispecialty settings, PE may generate efficiencies in care delivery that benefit both patients and payers. There are no observed changes to quality or access measures. In addition, I find no evidence of preferential patient risk selection following acquisition.

Taken together, this paper demonstrates that by changing managerial policies and incentives that shape referral behavior, PE acquisitions of multispecialty practices increase self-referrals from generalists to affiliated specialists. This has the effect of reducing health care spending by both patients and payers, without changing post-surgical quality. Increases in self-referrals without accompanying increases in total referral volume suggest that PE increases self-referrals at the expense of competitors. Policymakers assessing the welfare implications of PE in multispecialty settings must balance any potential reduction in competition against efficiency gains that result from improved care coordination.

This paper contributes to several distinct literatures. First, this paper contributes to the broad literature on mergers and acquisitions in health care markets.[21] Much of this literature has examined horizontal hospital mergers, focusing on how mergers affect prices through changes in market power. [22] [23] [24] Second, this paper contributes to the literature on vertical integration, which has found vertical integration in health care markets to be associated with higher care utilization, prices, and spending, with mixed evidence on efficiency or quality improvements. [25] [26] [27] [28] [29] [30] This literature has also emphasized that vertical integration can distort physician agency by incentivizing generalists to steer patient referrals to affiliated specialists, perhaps for treatments that would not otherwise be recommended.[5] [7] [10] [31] [32] [33] [34]

This paper builds on this large body of work in several ways. First, while the existing literature focuses primarily on hospital-physician integration, this paper examines agency problems raised by integration of physicians of complementary specialties, e.g., generalists and specialists, in multispecialty physician practices.[35] Existing research has shown that multispecialty practices have the potential to reduce health care expenditures.[36] By documenting how PE ownership of multispecialty settings alters referral decisions to drive variation in spending outcomes, this paper illustrates heterogeneous effects of vertical integration in US health care markets.

Third, this paper contributes to a recent literature that is specifically focused on the effects of corporatization in medicine. PE acquisitions have been shown to increase short-term mortality through reductions in nurse staffing in nursing homes, [37] [38] increase charge-to-cost ratios, increase net income, [39] and increase the provision of profitable services, with mixed evidence of improved quality in hospital settings.[40] In the physician practice setting, PE acquisitions have been shown to increase health care spending through higher prices, increased patient volume, and increased utilization of ancillary services such as laboratory tests and diagnostic imaging.[20] [41] [42] This paper builds on this body of work by examining whether and how PE acquisitions shape physician decision-making in multispecialty practices, focusing on generalist-to-specialist referrals as an important dimension of physician agency.[43] [44] [45]

The rest of the paper proceeds as follows. Section 2 provides relevant information for the clinical setting I examine. Section 3 introduces a model of generalist decision making in the style of Ellis and McGuire (1986), where physicians derive utility from both patient benefits and physcians' own financial incentives. Section 4 describes the various data sources I use to examine my research questions. Section 5 describes the setup of the choice model and Section 6 presents key results. Section 7 examines welfare implications, and Section 8 concludes.

2. Background

This section provides a brief overview of the clinical setting and acquisitions I study, informed by interviews with ophthalmologists in PE-acquired practices.

2.1 Clinical Setting: Eye Care

Workforce. Eye care services are delivered primarily by two types of health care providers: ophthalmologists and optometrists. Ophthalmologists (specialists) are medical doctors (MDs) or osteopathic doctors (DOs) who perform surgical eye care (e.g., cataract surgery). Optometrists (generalists) are responsible for primary care of the eye and are typically not licensed to perform surgical care, although they can be involved in pre- and post-operative care.

Organization. Eyecare practices may be comprehensive or multispecialty, defined by the presence of both generalists and specialists; optometry-only, defined by the presence of generalists only; and smaller sub-specialty practices, defined by the presence of specialists who have undergone additional training for diagnosis and treatment of diseases of the retina, cornea, or other specialized settings.[16]

Cataracts. Cataract surgery is the most common surgical procedure in the United States.[46] Over 24.4 million Americans ages forty and older are affected by cataracts, and it is estimated that half of all Americans will have cataracts by age seventy-five.[47] A cataract is a clouding of the normally clear lens of the eye, typically diagnosed with a medical eye exam performed by a generalist. Once a cataract results in blurry vision, the generalist may refer a patient to a specialist for a cataract surgery. A cataract surgery is typically performed on an outpatient basis and involves removing the clouded lens and replacing it with a clear artificial lens.

Cataract Referrals and Co-management. Specialists rely on referrals from generalists for cataract surgery. Co-management relationships are common. In these relationships, a generalist sends a patient to a specialist for cataract surgery, and following surgery, the specialist sends the surgical patient back to the generalist for post-surgical care. [48]

Cataract Risk Factors. Certain risk factors, such as diabetes and age, can increase the complexity of cataract surgery.[49] Cataract surgery in individuals with diabetes has a 30% higher likelihood of post-operative complications compared to non-diabetic individuals.[50] While certain adverse conditions may occur in the post-operative period, these are uncommon.[51][52][53] The Centers for

Medicare and Medicaid Services (CMS) uses a clinical quality measure to identify complications following cataract surgery. [54] This measure defines complications from cataract surgery that can reasonably be attributed to the surgery, by using billing codes to identify the presence of complications including endophthalmitis, retained nuclear fragments, dislocated or wrong power intraocular lens (IOL) or retinal detachment.

Medicare Coverage. Medicare is the single largest payer for cataract surgery and an estimated 80 percent of all cataract surgeries are performed on Medicare patients.[55] [56] While Medicare does not pay for routine vision care such as eye exams for glasses or contact lenses, it does cover diagnosis and treatment of chronic eye conditions, including medical eye exams for cataract surgery.

2.2 Private Equity and Physician Practices

When PE invests in physician practices, it typically combines equity from institutional investors with varying degrees of debt to acquire a majority stake in a practice (a so-called "platform practice").[57] PE acquisitions of platform practices are often followed by rapid growth, often driven by add-on acquisitions of smaller practices. Most physician practice acquisitions fall below the reporting thresholds under the Hart-Scott-Rodino Act for pre-acquisition notification to the federal antitrust agencies (which is $101 million in 2022) and are therefore typically unreported.[58]

Eye care is among the leading office-based specialties with PE acquisitions. Acquisitions of eye care practices by PE funds have been rapidly increasing, from fewer than 10 acquisitions in 2016 to over 90 acquisitions in 2019. By one estimate, approximately 135 physician practices were acquired by PE between 2016 and 2019, with multispecialty eye care practices representing over 90 percent of acquisitions.[17] PE acquisitions of eyecare practices over this period were concentrated in states in the Northeast, Southeast, and West. New York was the single state with the largest number of PE acquisitions and PE penetration.[17] [18] [19]

There are several reasons to expect differential practice patterns under PE ownership. While all private entities are motivated by profit, PE ownership offers distinct incentives to rapidly increase the value of portfolio firms. This is because PE acquisitions are financed by large amounts of leveraged debt, PE managers receive compensation through a call option-like share of the profits, and PE aims to liquidate investments within 3-5 years.[57] Leveraged debt used by PE to finance the acquisition can be greater than 60-90 percent of transaction value and is typically placed on the platform practice's balance sheet.[59] If the portfolio practice does not grow at a sufficient rate to maintain cash flow to service the debt, PE may use practice revenue to pay down more debt, restricting cash flow availability for other practice needs. Further, PE managers are unlikely to generate adequate returns if practice operations continue as-is, and thus often need to adopt aggressive growth strategies.

Physician compensation structure can also motivate differential practice patterns under PE ownership relative to other types of for-profit ownership (including physician ownership). The traditional physician-owned practice model typically requires physicians to work for several years before the practice offers them the opportunity to acquire equity shares in the practice. In this setting, when physicians leave the practice, they sell their shares back to the practice, typically with minimal to no profit. In contrast, under PE ownership, physicians are salaried employees who are often also offered equity ownership in the acquired entity at the time of acquisition. [59] [18] Physicians with equity stakes in PE-acquired practices can sell their shares for a large payout once the practice resells within 3-5 years. Thus, equity in a PE-acquired practice is distinct from equity in a physician-owned practice: the former is similar to an income stock that pays steady but modest dividends every year, whereas the latter operates as a growth stock with much greater expected returns and growth potential, given the likelihood of resale or recapitalization within 3-5 years. [59] Given these differences in equity incentives, practice profitability can play a much more salient role in physician compensation structure under PE ownership.

3. Theoretical Model

In this section, I introduce a simple model of generalist decision making to motivate my empirical analysis. Following Ellis and McGuire (1986), I model referral choice of generalists in multispecialty settings as a function of generalists' financial incentives and patient preferences. Following PE acquisition, I hypothesize that PE alters the nature of decision-making such that generalists incorporate PE profitability, in addition to their own incentives and patient preferences, in their referral choice.

The timing of my model is as follows. First, a patient k experiences a health shock (e.g., cloudy vision), and sees a generalist, i, for a medical eye exam. The generalist evaluates the patient and decides whether they need to see a specialist. I consider the choice of specialist at this point to be the starting point for the model.[1]

I model a referral to a specialist as a result of a joint decision-making process between the patient and generalist. In making the referral decision, the generalist observes patient preferences and his or her own incentives. The generalist then chooses a specialist j. I assume that the patient derives utility from expected health outcomes $E[X_k]$, expected cost outcomes $E[Y_j]$, as well as attributes of the specialist j, such as distance the patient would have to travel to see the specialist. Thus, patient utility can be represented by:

$$V_{jk} = f(E[X_k], E[Y_j], j) \tag{1}$$

Following Ellis and McGuire (1986), the generalist's choice utility for specialist j can be represented by U_{ijk}, a weighted sum of her own financial incentives and patient preferences that are weighted by, α, an altruism parameter:

$$U_{ijk} = B_{ij}I_{ij} + \alpha f\big([X_k], E\big[Y_j\big], j\big) + \varepsilon_{ijk} \tag{2}$$

In a multispecialty practice characterized by vertical integration of generalists and specialists, the generalist's financial incentives may include an incentive payment B_{ij} that represents the bonus incentive she receives when she refers a patient to a specialist she is integrated with, i.e., when I_{ij}, an indicator for when generalist i and specialist j are integrated, equals 1. Thus, the B_{ij} term encourages generalists in vertically integrated settings to steer patients towards integrated specialists. Given the Stark laws, incentives can be implicit rewards or threats but cannot be

[1] This simplification abstracts away another decision margin: whether to send a patient to a specialist at all. For patients where a generalist is on the margin of whether to refer them at all, PE acquisitions may incentivize generalists to make referrals for specialist care for patients who otherwise may not require specialist care. I revisit this hypothesis in Section 7.

explicitly tied to referral behavior. Finally, idiosyncratic decision shocks, ε_{ijk}, may drive seemingly similar patients to different specialists.

As seen in equation (2), if the generalist operates as an (imperfect) agent of the patient, the generalist's choice utility incorporates both physician and patient preferences, but not PE profitability. After PE acquisition, I hypothesize that PE's managerial strategies provide financial and nonfinancial incentives to physicians in the acquired practice to align the generalist's post-acquisition utility with PE profitability, Π_{ij}, where $\Pi_{ij} = f(j)$. These may include mechanisms such as equity ownership, revenue sharing, productivity bonuses, or investments electronic health record systems that facilitate self-referrals.

Thus, post-acquisition, the generalist's choice utility incorporates PE profitability, in addition to physician and patient preferences, where PE profitability depends, in part, on specialists chosen for referrals:

$$U_{ijk} = \Pi_{ij} + B_{ij}I_{ij} + \alpha f\left([X_k], E\left[Y_{ijk}\right], j\right) + \varepsilon_{ijk} \tag{3}$$

The above framework can be incorporated in a standard random utility model used to derive conditional logit models.[60 61] Assuming that generalists are utility maximizers, generalist *i* will choose specialist *j,* in her choice set, if

$$U_{ijk} = max(U_{i1k}, \ldots, U_{ijk}), \forall j = \{1, 2, 3, \ldots j\} \tag{4}$$

If U is additively separable and ε_{ijk} are independently and identically distributed with a type I extreme value distribution,[60] then, the probability of generalist *i* choosing $j*$ from her choice set can be written as

$$Pr(Choice_{ij*k} = 1) = P\left(U_{ij^*k} + \varepsilon_{ij^*k} > U_{ijk} + \varepsilon_{ijk}\right) = P(\varepsilon_{ijk} < U_{ij^*k} - U_{ijk} + \varepsilon_{ij^*k}), \forall j \neq j^* \tag{5}$$

the probability that *i*'s choice utility for $j*$ is higher than all other options j.

4. Data

To examine referral choice of generalists in PE-acquired multispecialty practices, I construct my analytical sample in multiple steps: first, identifying PE acquisitions of physician practices, then identifying multiple practice sites and physicians associated with each acquisition, and finally linking this information to a sample of referrals constructed using Medicare claims data.

4.1 Private Equity Acquisitions

First, to identify PE acquisitions from 2016-2019, I use proprietary data from PitchBook Inc., a financial database that tracks mergers and acquisitions across industries and has been used by other studies examining PE in health care.[39, 62] To identify individual providers affiliated with acquired practices, I use two databases from IQVIA, a health care data vendor: the 2016 SK&A Office Based Physicians database ("SK&A") and the 2019 OneKey ("OneKey") database, an updated version of the SK&A data that uses the same approaches to identify and verify affiliations.[63] Both datasets are independently verified with clinician-level information (e.g., location, specialty, National Provider Identifier (NPIs)) and practice-level information, including ownership and corporate affiliations, on 9.7 million health professionals in the U.S.[64, 65]

I use probabilistic record linkage algorithms to link exact and non-exact records of practice names, addresses, and ownership information (e.g., corporate parent identity) in the OneKey data to reported acquisitions. For any unmatched deals, I manually matched a subset of acquisitions to the OneKey data by using public information online to verify practice locations and potential name changes for acquired practices. As OneKey lists multiple office sites belonging to a particular practice, I included all practice site locations associated with an acquisition. Next, to facilitate linkages to claims data, I use provider NPIs to link my sample of providers in PE-acquired practices to office-based claims from a 20% sample of Medicare beneficiaries from 2015-2019.

4.2 Physician Vertical Integration

To construct measures related to physician organization, I rely on the Medicare claims data. First, following existing research, I use the federal tax IDs (TINs) associated with each claim to identify physician practices.[26, 66] TINs provide a measure of financial organization, with integrated physician practices typically billing under a unique TIN, although some large provider groups may organize themselves into subsidiaries, billing under separate TINs. While TINs may not be a perfect measure of firm boundaries, prior research has used this approach to examine physician organization and consolidation. [66] [67] [68]

Second, to identify vertically integrated multispecialty practices, I follow prior literature that defines a vertically integrated organization as one made up of medical providers who provide primary care and medical providers who provide specialty care. [5] [29] [66] [69] I use the information on physician specialty and tax ID-based practice definition to classify practices into three groups: (1) multispecialty practices, (2) generalist (optometrist) only practices, and (3) specialist (ophthalmologist) only practices. For this study, multispecialty practices must include at least one primary eye care provider (optometrists, physician specialty code 41) and at least one specialty eye care provider (ophthalmologists, physician specialty code 18). Conversely, a generalist-specialist pair is assumed to be integrated if they submit claims under the same multispecialty practice ID in a given year.

Table 1A and 1B summarize identified acquisitions in each year of my sample, by organization type. Between 2016-2019, PE acquired 318 eye care practices, of which 230 (72 percent) are multispecialty practices. There are no identified acquisitions in 2015. Acquisitions increase five-fold from 2016 to 2019, with 2018 having the largest number of acquisitions.

Figure 1 shows geographic distribution of cataract claims that are in PE-acquired practices over the entire study period. PE claims are concentrated in the Northeast, in Texas, Florida, Arizona, as well as Michigan and Indiana.

4.3 Referrals Sample Construction

My primary goal is to examine generalist referral behavior, where a referral is defined as a specialist visit for cataract surgery within 365 days of a generalist visit.[2]

I broadly rely on a sample construction approach used in prior studies on provider referral choice to construct my analytical sample.[5] [70] First, I define the sample of individuals with a first cataract surgery claim (CPT 66984) with a specialist at an Office setting (place of service code

[2] Results are consistent when a referral is defined using an alternate definition of a specialist visit for cataract surgery within 90 days of a generalist visit.

11).[3] I drop from this process any claims for patients younger than 65 or older than 99 years, claims with missing zip code of residence, or claims originating outside contiguous states. After these restrictions, I end up with a sample of 890,961 individuals in 2015-2019.

Next, to build the sample of referrals, I link individuals with cataract surgery claims to their generalist. To do so, I examine each individual's claims history and identify the generalist with whom the beneficiary has had the highest number of eye exam claims in the previous 365 days (CPT 99202-99204, 99212-99214).[8 71 72] I drop individuals to whom I cannot assign a generalist, i.e., individuals without eye exam claims. This leaves us with 746,083 remaining individuals in the analytical sample, which represents 83% of the sample with surgical claims (Appendix Table 1).

Appendix Table 2 displays the changes in basic patient summary statistics as I define my referrals sample compared to all cataract claims in the Medicare data. Individuals in my final sample (identified referrals) have more chronic conditions than the complete universe of individuals with cataract surgery claims but are otherwise similar. Given that Medicare benefits only offer coverage for eye exams for individuals with specific risk factors for disease, this is not surprising.

Finally, given that my objective is to examine referral behavior of generalists in multispecialty settings only, I restrict my referrals sample to referrals that originate in a multispecialty practice. Making this restriction excludes from the analytical sample any referrals that originate in optometry-only or other single specialty settings, as these organizational forms likely have different referral incentives compared to multispecialty settings. Following this, the final referrals sample comprises 395,490 individuals with referrals that originate in multispecialty practices only. (Appendix Table 1)

5. Empirical Strategy

I model the referral decision of the generalist using a conditional logit framework, with standard errors clustered at the generalist level. In this framework, a generalist will refer to a specialist if

[3] CPT 66984 is the most commonly billed code for routine noncomplex cataract extractions. The other codes, CPTs 66982-66983, reflect cataract extractions with significant complications, requiring devices or techniques not generally used in routine cataract surgery or performed on patients in the early developmental stage.

the probability that his or her choice utility from referring to that particular specialist is higher than all other specialists in his or her choice set.

Choice Set

I define the choice set using a revealed preference approach as the universe of specialists within 150 miles of the generalist that the generalist has a patient-sharing relationship with.[73] [74] To identify a patient-sharing relationship for a generalist-specialist pair, I first examine the number of cataract patients seen by a specialist who were also seen by the generalist in the 365 days prior to surgery over the period 2015-2019. I then make an additional restriction to identify and exclude low-volume relationships that are likely to emerge by chance. Specifically, following prior research that has validated patient sharing approaches to constructing physician referral networks[73] [74] [75], for each generalist, I exclude all specialists whose share of the generalist's total referral volume is less than 1 percent. The remaining universe of specialists are included in the choice set for each generalist. To mitigate endogeneity concerns in defining the choice set, I hold each generalist's referral network (i.e., choice set) to be fixed over time by including all potential specialists that meet the inclusion criteria across *all* years in the study period rather than separately by year.

Choice Probabilities

The probability of a generalist choosing a particular specialist is estimated as a function of characteristics of the specialist (including whether he or she is integrated with the generalist in the same practice ($Integrated_{ij}$)), the generalist (including whether he or she practices in a PE-acquired practice (PE_i)), and interactions between the two. A generalist may take into account patient preferences for geographic proximity or lower spending in referral decisions. Thus, I include additional attributes of specialists in the choice set: the distance a patient would need to travel to see the specialist (z-score) and average post-surgical spending associated with each specialist, in the 90 days following surgery (Medicare and OOP) (collectively, X_{jk}). The latter serves as a proxy for post-operative resource use, including specialists performing or recommending additional services, choosing more expensive services, or post-surgical complications that may drive spending.

From Equation (5) in Section 3, the probability of specialist choice can be derived as:

$$Pr(Choice_{ijk}=1) = \frac{exp\ (\alpha Integrated_{ij} + \beta\ (Integrated_{ij} * PE_i) + \gamma X_{jk} + \varepsilon_{ijk})}{\sum exp\ (\alpha Integrated_{ij} + \beta\ (Integrated_{ij} * PE_i) + \gamma X_{jk} + \varepsilon_{ijk})} \quad (6)$$

where *i* indexes generalist, j indexes specialist, and *k* indexes patient, as in Section 3. The probability of specialist choice ($Choice_{ijk}$) is modeled as a function of the attributes of specialist j, including whether she is integrated with the generalist in the same practice ($Integrated_{ij}$), and interacted with attributes of the generalist, including whether she is in a PE-affiliated practice (PE_i).

Model coefficients from the choice models are reported in terms of their average marginal effects on choice probabilities. The effect of generalist ownership by PE is not identified separately in the conditional logit model, as are none of the generalist or patient characteristics that are constant across specialist choices.

Robustness Checks

The identifying assumption in the conditional logit model is that the relative probabilities of choosing any two specialists are independent of any other available alternative specialists, i.e., the independence of irrelevant alternatives (IIA) assumption. This assumption is unlikely to hold if unobserved characteristics (e.g., prior referral history) cause certain specialists to be closer substitutes than others. To assess potential violation of the IIA assumption, following Train (2002), I re-estimate Equation (6) using an alternate definition of the choice set which generates a subset of the choice set in the main specification.[61] In this robustness check, I re-estimate the choice model using a narrow definition of the choice set as the universe of all specialists who account for at least 10 percent of the generalist's total referral volume.

In addition, a key concern in all merger effects analyses is that PE acquisition may be endogenous to practice-level characteristics that are not observed to the researcher but nevertheless shape PE's acquisition decision. In particular, PE may seek to acquire practices with generalists who are predisposed to refer to particular specialists, even in the absence of the acquisition. In this case, estimates of the effect of PE acquisition will overstate PE's impact on specialist choice. To investigate the extent to which endogeneity of the PE acquisition decision biases my results, I re-estimate my choice model to estimate pre-acquisition "treatment effects." Specifically, I estimate a counterfactual simulation that changes the timing of PE acquisition to a random month in the time preceding PE acquisition.

6. Results

6.1 Descriptive Summary

Table 2 summarizes characteristics of individuals with referrals at baseline, prior to any acquisition. On average, individuals with referrals for cataract surgery are 61% female, 88% White, and 75 years old. Individuals whose generalists become acquired by PE have a greater number of chronic conditions (5.07 compared to 4.93) although similar rates of diabetes prevalence, a risk factor for cataract surgery. The median time to referral (i.e., number of days between eye exam and cataract surgery) is 63 days, with individuals whose generalists become acquired by PE waiting slightly longer for cataract surgery (68 days compared to 62 days).

Individuals whose generalists become acquired by PE are more likely to reside in urban areas (95% compared to 91% of individuals with non-PE generalists), consistent with prior research that has found geographic concentration in PE penetration.[19] Differences in urbanicity likely translate into differences in distances traveled for generalist and specialist care. On average, individuals whose generalists become acquired by PE travel between 1-2 miles farther to see generalists and specialists as compared to individuals whose generalists are never acquired by PE.

The baseline likelihood of self-referral is approx. 61 percent in practices that become acquired by PE compared to 59 percent in never-acquired practices. Despite this difference in levels at baseline, the trends in pre-acquisition self-referrals are fairly parallel regardless of ownership. (Figure 2)

Table 3 summarizes the characteristics of generalists making referrals in 2015, prior to any acquisition. Approx. one fifth of generalists in my sample are acquired by PE during the study period. The average generalist refers 8 patients per specialist, to 2-3 unique specialists per year. To quantify the exact dispersion of referrals, I follow Agha et al. (2018) and estimate a referral Herfindahl-Hirschman Index (HHI).[71] For a given generalist, I compute each specialist's share of that generalist's referrals. The sum of squared shares is the generalist's referral HHI. If a generalist referred an equal share of patients to two specialists, then the referral HHI would be 0.5 (calculated as sum of squared market share of (0.5) ^2 + (0.5) ^2). In contrast, I calculate an average referral HHI of approximately 0.66, suggesting that generalists referrals are concentrated among specific specialists.

6.2 Referral Choice

Figure 2 shows raw trends in self-referrals at PE-acquired practices, before and after acquisition. The self-referral rate is defined at the practice-quarter level as the share of referrals made by generalists to specialists who are integrated within the same practice. Prior to any acquisition, the self-referral rate at practices that become acquired was relatively flat at 61 percent and parallel to the self-referral rate at non-acquired practices. Following PE acquisition, there is a steady increase in unadjusted self-referral rates at PE-acquired practices that persists for at least 2 years (8 quarters) following acquisition. While Figure 2 provides suggestive evidence of increases in self-referrals following acquisition, raw trends in self-referrals may be driven by underlying variation in the entry or exit of specialists in the generalist's choice set (i.e., the denominator) rather than actual changes to specialist choice (i.e., numerator). To account for this, next, I present results from my choice model that holds constant the referral network of generalists over time (i.e., the choice set), allowing the identification of changes self-referrals due to changes in generalist's choice of specialist (numerator).

Table 4 summarizes results of the choice model with coefficients represented as average marginal effects. Consistent with prior research on vertical integration in health care, generalists in all multispecialty practices are 19.40 percentage points more likely to refer to an integrated specialist rather than a non-integrated specialist (i.e., self-refer). However, following PE acquisition, the likelihood of self-referral increases by 4.44 percentage points for generalists in multispecialty practices that get acquired by PE. This represents an increase of approximately 7 percent over self-referral rates prior to any acquisition (100*4.44 divided by a base self-referral rate of 61 percent estimated in Table 2).

Table 4 also summarizes the effect of other variables on specialist choice. A one-SD increase in distance of specialist from the patient decreases the probability of choice by 12 percentage points. A one SD increase in average 90-day spending per specialist increases the probability that a generalist chooses that specialist by 2 percentage points.

6.3 Robustness Checks

Figure 3 and Column (2) in Appendix Table 3 summarize results of my robustness tests to assess potential violations of the IIA assumption. If IIA holds in our setting, then the parameter estimates obtained on the subset of alternatives will not be significantly different from those obtained on the full set of alternatives. As seen in Appendix Table 3, results obtained from estimating a robustness test that uses a subset of choice set specialists are consistent with the main specification, mitigating concerns about the violation of the IIA assumption in our setting.

Column (3) of Appendix Table 3 examines potential endogeneity in PE's acquisition decision. If increases in the likelihood of self-referrals were merely a continuation of pre-acquisition trends, we would expect to see an effect prior to acquisition. As seen in Appendix Table 3, pre-acquisition "treatment effects" estimated in this counterfactual simulation are small and not statistically significant, mitigating concerns about the endogeneity of the PE acquisition decision.

6.4 Mechanisms

Results estimated in the prior section demonstrate that PE acquisitions increase the likelihood of self-referrals following acquisition. While these results are consistent with the hypothesis that PE acquisitions change financial or non-financial incentives to shape physician referral behavior, they may also be consistent with a few alternate explanations that I consider. Through counterfactual simulations, I conclude that increases in self-referrals are driven by adoption of PE's managerial policies (e.g., changes to referral incentives) rather than practice expansion through hiring of specialists with pre-existing referral relationships or increased market concentration through add-on acquisitions of generalists.

Practice Expansion by Hiring Specialists

Given PE's "roll-up" strategy, where acquired firms gradually increase their market share by acquiring smaller competitors, one potential mechanism that may drive self-referrals is a growth in practice size through the hiring of specialists. If PE acquisitions expand by hiring specialists, then self-referrals may increase mechanically as a greater share of a generalist's choice set will be comprised of specialists integrated within the practice. Similarly, if specialists hired after PE acquisitions represent specialists that generalists already refer to, then self-referrals will increase as a result of changes to specialist ownership rather than changes to referral strategy.

To investigate this alternate mechanism, I estimate a counterfactual simulation which holds constant the integration status of specialists in 2015 (i.e., at baseline, prior to any acquisition). By doing so, I can estimate choice probabilities under the assumption that there were no changes to specialist affiliation status following acquisition. If results are driven by practice expansion following acquisition, this counterfactual would generate small and insignificant results. However, as shown in Figure 4 and Column (2) of Appendix Table 4, results from this counterfactual simulation are comparable in magnitude and significance to main results, suggesting that the referral strategy of PE, rather than the subsequent hiring of specialists with pre-existing referral relationships, drive increases to self-referrals.

Increased Generalist Market Concentration

Another potential mechanism that may increase self-referrals is the increase in market concentration resulting from add-on acquisitions of generalists. As optometrists are the primary source of referrals for cataract surgery, add-on acquisitions of these generalists may allow PE funds to capture and keep referrals from higher paying surgical procedures within the practice.[12] [18]

To investigate this, I re-estimate the choice model using only the observations from generalists who were at acquired practices prior to acquisition. By doing so, I can exclude referrals that originate from generalists who join acquired practices following acquisition. By excluding generalist entrants in this sensitivity test, I hold the market concentration of acquired practices in the market for generalist services constant. If results are driven by increased market concentration, this counterfactual would generate small and insignificant results. However, as shown in Figure 4 and Column (3) of Appendix Table 4, results from this counterfactual simulation are comparable in magnitude and significance to main results, suggesting that adoption of PE's managerial strategies, rather than generalist market concentration, drive increases to self-referrals.

7. Welfare Implications

Next, I examine the welfare implications of acquisitions. PE's welfare implications are theoretically ambiguous. On the one hand, PE may drive operational changes that facilitate care coordination, reduce duplication of services, and improve patient welfare. On the other hand, PE can reduce welfare if they restrict competition through increases in self-referrals at the expense of referrals to competitors. Ultimately, these are empirical questions that I examine below.

7.1 Methods

My primary empirical strategy to examine the welfare implications of PE relies on a difference-in-differences design. I compare outcomes of interest at PE-acquired practices with those at non-acquired practices, before and after acquisition. My outcomes of interest represent several proxy measures for welfare, including (1) total referral volume to determine whether changes to referral behavior constitute demand inducement or competitive foreclosure, (2) spending outcomes, including Medicare and OOP spending in the 90-days following surgery, (3) quality outcomes, including revisit rates for eye sensitive complications, and (4) distance traveled for specialist care, as a proxy for changes to health care access. The identifying assumption is that there are no time-variant unobserved characteristics that differ between acquired and non-acquired practices that may confound my estimation of average acquisition effects.

Identification

One challenge to using a difference-in-differences approach is that PE's acquisition decision is not exogenous. To the contrary, PE acquisitions are likely to reflect strategical selection of investment opportunities. This suggests that practices acquired by PE may be systematically different than non-PE practices. If so, the full universe of non-PE practices may not be an appropriate control group for evaluating the impact of PE acquisitions.

To examine potential concerns regarding selection into treatment, I identify a control group of non-PE multispecialty practices that are observably similar to acquired practices at baseline. This approach is shared by several recent papers in the PE literature. [76] [77] [78] [79] I construct a control group by matching each acquired practice with up to three similar control practices at baseline, prior to any acquisition. The matching algorithm requires all control practices to be in the same state as the acquired practice, as well as within one-half standard deviation for total cataract volume and share of cataract patients with diabetes. My matched sample includes 217 acquired practices and their corresponding 622 matched control practices. Of the 230 PE-acquired practices in my sample, 197 (85.6%) are paired with a full set of three matched controls. Panel B of Appendix Table 3 reports summary statistics for this matched sample.

Estimation

To estimate the average effect of PE acquisitions on outcomes of interest, I use a matched difference-in-differences estimator to compare changes in outcomes of interest at acquired practices to contemporaneous changes in outcomes of interest at control practices, using the following regression:

$$y_{\mathrm{ict}} = \beta_0 + \beta_1 \mathrm{PE}_{\mathrm{ict}} + \theta_{\mathrm{c}} + \delta_{\mathrm{t}} + \varepsilon_{\mathrm{ict}}\,, \tag{8}$$

Where *i* indexes practice, *c* indexes matched cohort, and *t* indexes time at the quarter-year level. $\mathrm{PE}_{\mathrm{ict}}$ identifies whether practice *i* in matched cohort *c* was under PE-ownership in quarter-year *t*, θ_{c} and δ_{t} are cohort- and time-fixed effects respectively, that control for time-invariant unobservable differences across practices in a cohort as well as secular time trends.

To examine PE's effect on referral decisions on the extensive margin, my outcome of interest is the total referral volume per generalist at each practice. If PE increases incentives to refer patients, generalists may induce demand for additional referrals for marginal patients, resulting in total cataract volume increasing following acquisition. Alternately, increases in self-referrals without accompanying changes to total referral volume would suggest that increased self-referrals likely come at the expense of referrals to competing specialists.

To examine patient welfare outcomes that serve as proxies for improvements in care coordination, I examine: (1) patient revisit within 7- or 30-days for any condition, (2) patient revisit within 90-days for eye-sensitive conditions that are indicative of surgical complications (Appendix Table 4), and (3) distance traveled for specialist care. I also examine spending outcomes that can be indicative of improved care coordination, including (1) 90-day post-surgical Medicare spending, and (2) 90-day post-surgical out-of-pocket spending.

Robustness Checks

To examine whether observed changes to outcomes of interest are driven by differential patient selection following PE acquisition, I examine differential change in measures indicative of patient risk profile following acquisition. These variables include: (1) total number of chronic conditions, (2) diabetes prevalence, (3) age of patient, and (4) dual-eligible status. I construct these variables at the patient-year level using the Medicare Master Beneficiary Summary File and Chronic Conditions Warehouse data.

Finally, given differential timing of acquisitions and potential for heterogeneous treatment effects, I follow advances in the difference-in-differences literature to estimate the causal effect of PE acquisitions on outcomes of interest using the Callaway & Sant'Anna (2021) estimator.[80]

7.2 Results

Observed similarity in outcomes of interest at baseline, shown in Appendix Table 3, should ease concerns regarding potential endogeneity in the estimation approach. Furthermore, given the difference-in-differences design, the ultimate validity of findings relies on parallel *trends (*not just *levels)* in pre-acquisition outcomes between PE and control practices, illustrated in Appendix Figures 1-3.

Table 5 shows the causal effect of PE acquisitions on the total volume of cataracts at PE-acquired practices relative to matched controls using a difference-in-differences framework with practice and quarter fixed effects. Referral volume increases from 41 referrals per specialist-quarter to 54 referrals per specialist-quarter among PE-acquired practices, and 35 referrals per specialist -quarter to 44 referrals per specialist -quarter among matched control practices. After accounting for heterogeneous treatment effects and staggered timing of PE acquisitions, there is no evidence of a statistically significant increase in the volume of cataract referrals, suggesting that PE acquisitions do not change incentives to alter referral decisions on the extensive margin.[4] This result may have a simple explanation. As PE acquisitions are often associated with cost reductions, no observed changes to total referral volume may reflect PE's decision to reduce unnecessary referrals to help contain costs.

The causal effect of PE acquisitions on surgical outcomes and spending are less direct. First, there is a marginally significant reduction in 90-day post-surgical Medicare and OOP spending by 5 percent following PE acquisition, suggesting that PE acquisitions may generate marginal

[4] These results are consistent across a variety of measures that serve as proxies for changes to the extensive margin decision. These include total referral volume per generalist, total referral volume per practice, total number of cataracts (including claims not identified as referrals) per specialist, and total number of cataracts per practice.

welfare improvements through better care coordination between generalists and specialists. There are no corresponding changes to quality or access outcomes.

Results are consistent after adjusting for heterogeneous treatment effects and staggered timing of PE acquisitions (Appendix Figures 4-5). Further, I rule out the possibility that results above are potentially driven by differential patient selection following acquisition. There are no changes to observed patient risk following acquisition as measured by patient age, the number of chronic conditions, the prevalence of diabetes, or dual-eligible status (Appendix Figure 6).

8. Discussion

This paper leverages novel data linkages to contribute policy-relevant evidence to enhance our understanding of the effects of growing corporatization of health care in the United States. I examine the extent to which private equity ownership of vertically integrated providers can change strategic referral behavior, finding that PE acquisitions change managerial incentives that shape referral behavior to increase self-referrals by 7 percent. While increases in self-referrals likely come at the expense of referrals to competitor practices, self-referrals may benefit patients and payers through marginal reductions in health care spending. Thus, policymakers assessing the welfare implications of PE must balance any purported reduction in competition against efficiency gains that result from provider coordination. Equally important will be a careful examination of whether self-referrals result in over-utilization or unnecessary care, especially given recent evidence of increased health care spending following PE acquisitions, driven in part by higher patient utilization.[20]

Several mechanisms may drive increases in self-referrals following PE acquisition. The hypothesis that PE acquisitions increase self-referrals by expanding market concentration through add-on acquisitions is not supported by the data in this setting. However, to understand PE's effect on market power, a complete investigation must first establish a relevant geographic and product market, and then select appropriate measures of concentration for generalist and specialist services. These topics, while beyond the scope of this paper, are key to understanding the market-wide competitive effects of PE in health care markets, including whether PE acquisitions restrict patient choice through steering of patient referrals internally, or reduce competition for specialty care by making independent rival practices more likely to exit. If PE acquisitions do increase market power, greater antitrust scrutiny of PE may be warranted. Policies such as lowering of Hart-Scott-Rodino Act reporting thresholds for physician practice acquisitions and allowing for pre-merger review of such acquisitions can be part of overall legislation to strengthen antitrust authority and enforcement, as advocated by antitrust experts and enforcement officials. [81] [82]

If self-referrals result from diffusion of PE strategy rather than changes to market concentration, antitrust tools may not be effective at mitigating unintended negative spillovers of PE acquisitions. At present, the lack of accessible information about physician practice ownership makes it difficult for policymakers, regulators, and payers to understand the effects of private equity in health care. Enhancing transparency of practice ownership will allow policymakers to better monitor the effects of PE on care delivery processes and outcomes, including patient quality and access. In addition, comprehensive corporate practice of medicine doctrines can prevent corporate ownership from exercising control over clinical judgment in ways that are harmful to patient welfare.

The growing corporatization of medicine raises important first order questions about how public policy can be used as a lever to align economic incentives in health care markets. One policy solution to align incentives between corporation's duty to maximize investor returns and a physician's duty to act in the interest of their patient would be to harness well-designed payment systems. Value-based reimbursement mechanisms can create incentives for health care organizations to control health care costs and improve patient outcomes. However, in order to realize the full potential of payment reform, organizations will also have to create incentives for physicians through compensation packages that incentivize value over volume of care. [83] As the United States continues to transition towards value-based care contracts that pay for clinical performance, corporate ownership in vertically integrated settings may have the potential to balance profitability and patient welfare by leveraging managerial skills to improve clinical in addition to financial outcomes.

Can Private Equity Buy Referrals? Evidence from Multispecialty Physician Practice Acquisitions

Tables and Figures

Table 1. PE acquisitions, 2015-2019

Table 1A. Count of practices, by type and acquisition status, 2015-2019

	Acquisition Status	
Practice Type	**Non-PE**	**PE**
Multispecialty	2,334	230
Optometrist Only	1,369	N/A*
Ophthalmologist Only	3,272	81
Total:	**6,975**	**318**

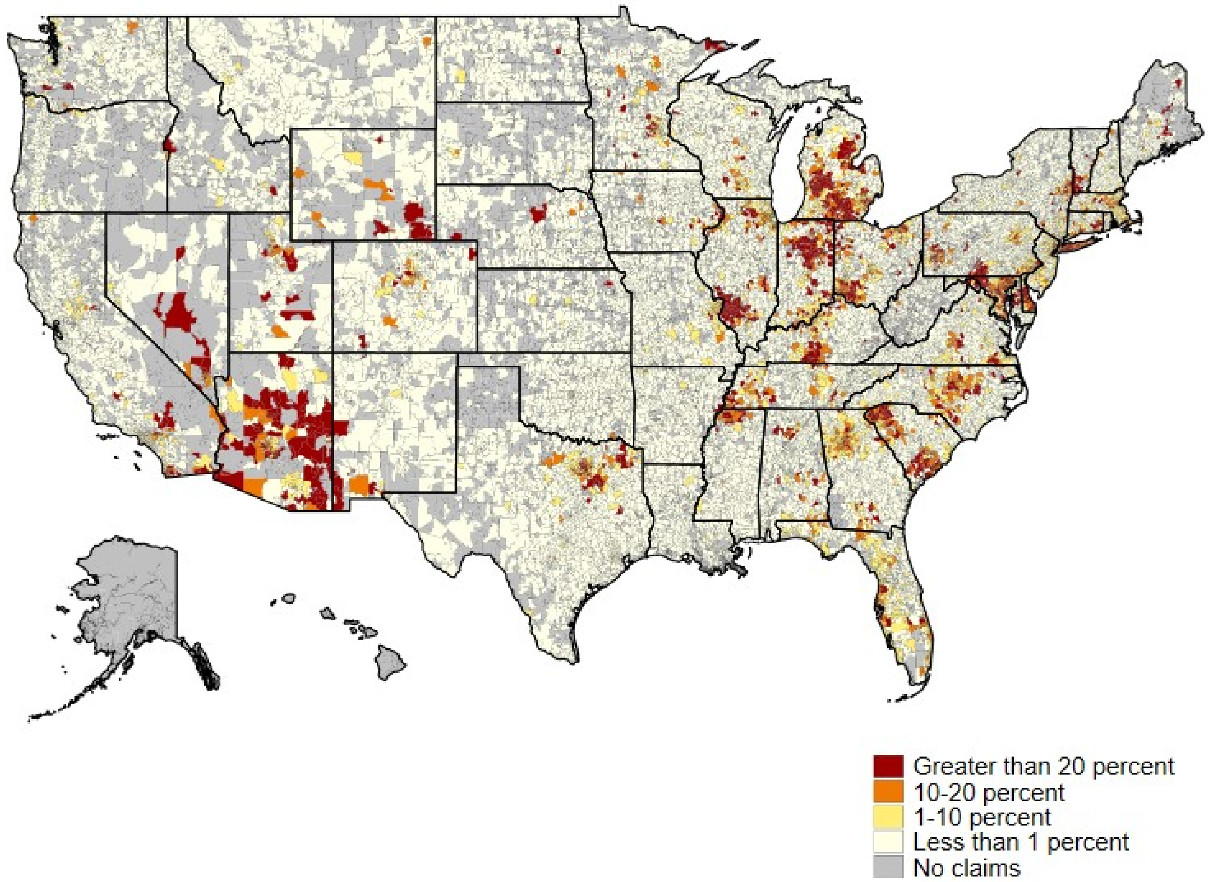
Notes/Sources: Author's analysis of Pitchbook, IQVIA SK&A and OneKey data, and Medicare claims data. This table summarizes the number of practices by type (multispecialty status) and acquisition status. Multispecialty practice is identified as a TIN with claims submitted by both optometrists (specialty 41) and ophthalmologists (specialty 18). *There are no identified acquisitions of optometry-only practices.

Table 1B. Multispecialty eye care acquisitions, by year of acquisition, 2015-2019

Year	Count of acquisitions
2015	0
2016	12
2017	55
2018	97
2019	66
Total:	**230**

Notes/Sources: Author's analysis of Pitchbook, IQVIA SK&A and OneKey data, and Medicare claims data. Multispecialty practice is identified as a TIN with claims submitted by both optometrists (specialty 41) and ophthalmologists (specialty 18).

Figure 1. Share of cataract claims in a PE-acquired practice, by 5-digit zip, 2015-2019



Notes/Sources: Author's analysis of Pitchbook, IQVIA SK&A and OneKey data, and Medicare claims data. This map shows the share of cataract surgeries that are done in a PE-acquired multispecialty practice.

Table 2. Characteristics of individuals with referrals, by generalist ownership, 2015

	Mean (SD)		
Variable	Generalist becomes acquired by PE	Generalist is never acquired by PE	Total
Female	0.61 (0.48)	0.61 (0.48)	0.61 (0.48)
White	0.86 (0.34)	0.88 (0.32)	0.88 (0.32)
Age, years	75.00 (6.34)	75.00 (6.34)	75.01 (6.33)
Diabetes	0.31 (0.46)	0.31 (0.46)	0.31 (0.46)
Hypertension	0.68 (0.46)	0.68 (0.46)	0.68 (0.46)
Chronic conditions	5.07 (2.54)	4.93 (2.55)	4.96 (2.54)
Urban	0.95 (0.21)	0.91 (0.29)	0.91 (0.29)
Distance to specialist, miles (Median, IQR)	11.79 (5.76, 23.25)	10.41 (5.00, 21.76)	10.58 (5.07, 22.12)
Distance to generalist, miles (Median, IQR)	12.38 (5.88, 25.54)	10.22 (5, 22.18)	10.52 (5.00, 22.77)
Days Between Generalist and Specialist Visit (Median, IQR)	68 (33, 196)	62 (30, 181)	63 (30, 183)
Self-referral rate	0.61 (0.48)	0.59 (0.49)	0.60 (0.49)
Number of individuals	15,837	79,850	95,687

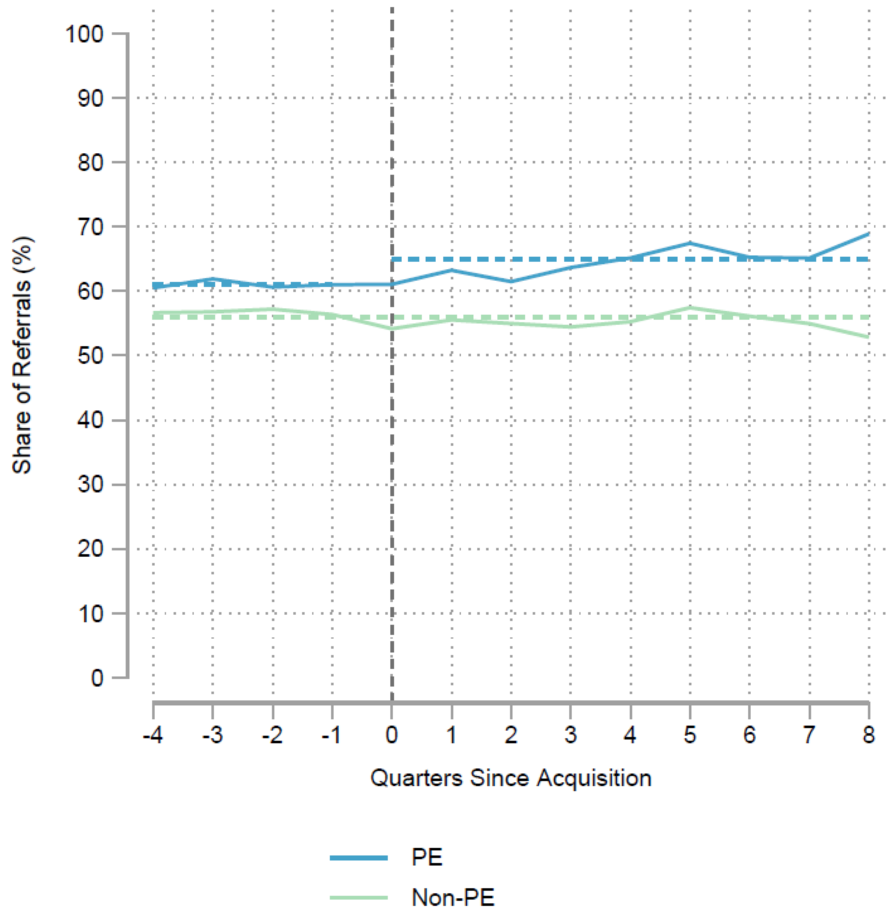
Notes/Sources: Author's analysis of Pitchbook data, IQVIA SK&A/OneKey data, and Medicare claims data. This table summarizes the characteristics of individuals with referrals for cataract surgery in 2015, the year prior to any identified acquisitions. The unit of analysis is the individual.

Table 3. Characteristics of referring generalists, by ownership, 2015

	Mean (SD)		
Variable	Generalist becomes acquired by PE	Generalist is never acquired by PE	Total
No. of generalists	2,016	8,718	10,734
Referrals per generalist	8.07 (10.46)	9.10 (10.21)	8.91 (10.27)
Specialists referred to	2.39 (1.53)	2.28 (1.33)	2.30 (1.37)
Referral HHI	0.66 (0.27)	0.67 (0.26)	0.67 (0.26)
Share in MSP (%)	100	100	100

Notes/Sources: Author's analysis of Pitchbook data, IQVIA SK&A/OneKey data, and Medicare claims data. This table summarizes the characteristics of generalists who make patient referrals for cataract surgery in 2015, the year prior to any identified acquisitions. The unit of analysis is the generalist.

Figure 2. Descriptive trends in self-referrals



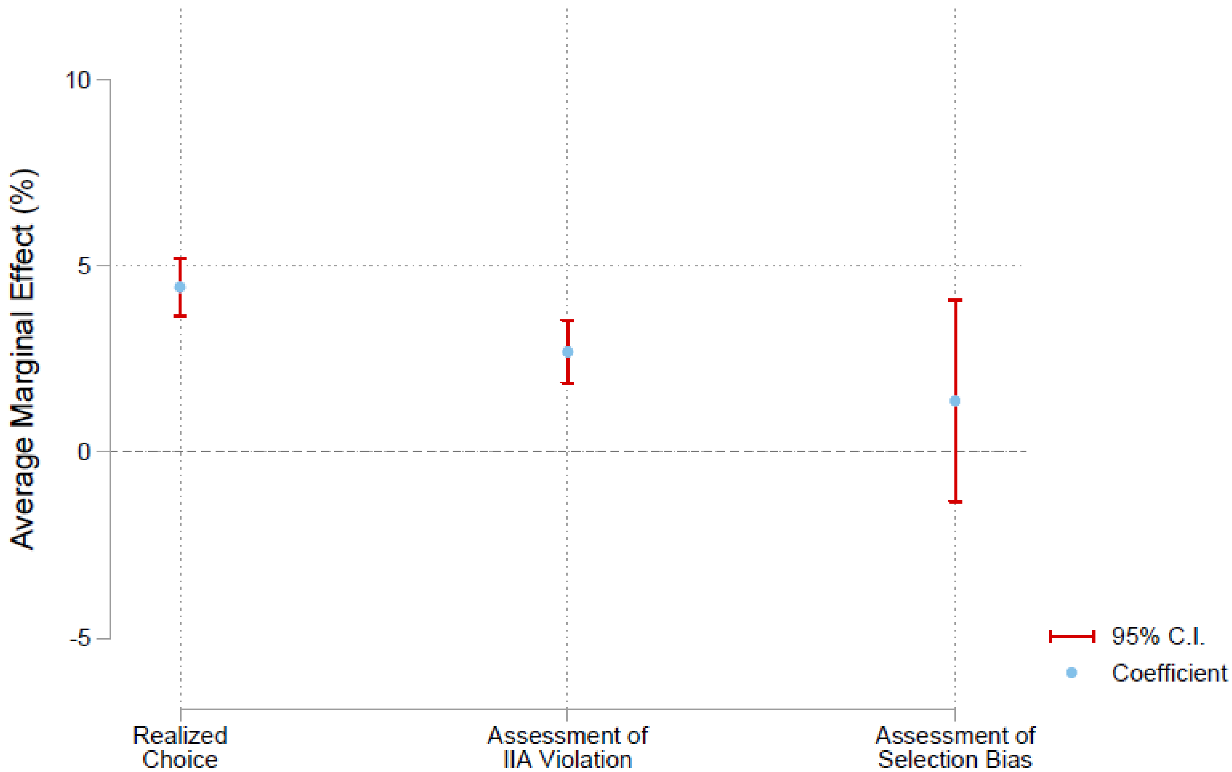
Notes/Sources: Author's analysis of Pitchbook data, IQVIA SK&A/OneKey data, and Medicare claims data. This figure summarizes the raw (unadjusted) trends in self-referral rates, defined as the share of total cataract referrals that are made from generalists to specialists within the same practice. Quarter 0 denotes the quarter of acquisition. The dotted horizontal lines represent the average self-referral rates at PE-acquired practices and matched controls, before and after acquisition.

Table 4. Effect of PE acquisition on referral choice

Variable	Average Marginal Effect	95% C.I. Lower Bound	95% C.I. Upper Bound
Specialist is integrated within the same practice * Generalist is acquired by PE	0.0444	0.0364	0.0523
Specialist is integrated within the same practice	0.1940	0.1922	0.1958
Distance (z-score)	-0.1240	-0.1259	-0.1222
90-Day Spending (z-score)	0.0264	0.0254	0.0275
Number of observations = 2,145,713			

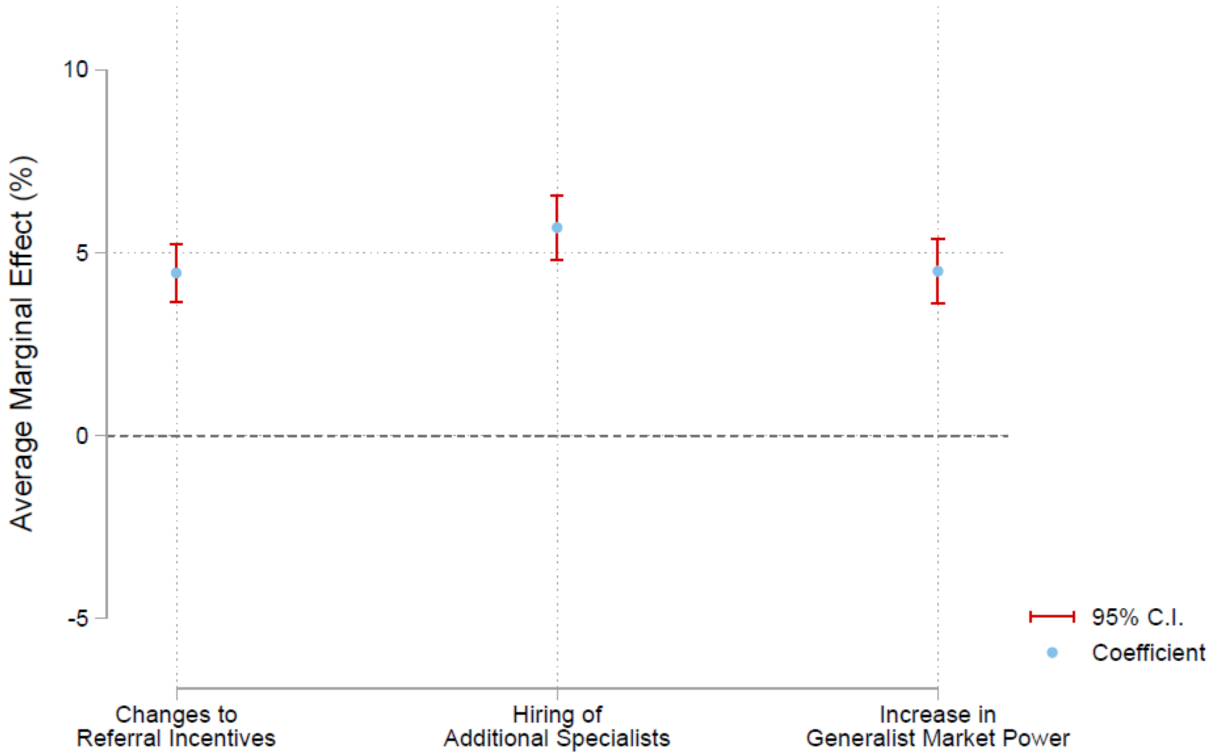
Notes/Sources: Author's analysis of Pitchbook data, IQVIA SK&A/OneKey data, and Medicare claims data. This table summarizes average marginal effects obtained from a conditional logit model that examines generalist choice of specialist for individuals requiring cataract surgery. Standard errors clustered at the level of the generalist. Number of generalists = 17,612. Number of individuals = 395,490.

Figure 3. Average marginal effect of PE acquisition on the likelihood of self-referral, Robustness Tests



Notes/Sources: Author's calculations. Table summarizes average marginal effects and 95% confidence intervals for estimates obtained from a conditional logit model and accompanying robustness tests. IIA violation is assessed by re-estimating the main specification using a subset of the choice set. Selection bias is assessed by estimating a counterfactual simulation that estimates pre-acquisition treatment effects by changing the timing of acquisition to the pre-period.

Figure 4. Average marginal effect of PE acquisition on the likelihood of self-referral, Alternate Mechanisms



Notes/Sources: Author's calculations. Table summarizes average marginal effects and 95% confidence intervals for estimates obtained from a conditional logit model and accompanying counterfactual/robustness tests to evaluate two alternate mechanisms that may drive self-referrals: 1) Practice expansion through the hiring of additional specialists is examined as an alternate mechanism by estimating a counterfactual simulation that assumes the integration status of specialists to be unchanged since 2015, prior to any acquisition. 2) Generalist market concentration is examined as a potential mechanism by re-estimating the choice model using only observations from generalists who were in the practice prior to acquisition.

Table 5. CS (2021) Difference-in-differences estimates for welfare outcomes

	PE		Controls		Raw	Adjusted (CS)		
	Pre	**Post**	**Pre**	**Post**	**Diff-in-diff**	**Diff-in-diff**	**%**	**p-value**
Cataracts per specialist	40.9	53.7	35.2	43.5	4.4	0.32	0.78	0.82
Spending								
90-day Medicare spending	2977	3195	3389	3656	-48	-157	-5.27	**0.08**
90-day OOP spending	627	663	710	756	-10	-32	-5.10	**0.06**
Quality								
7-day revisit rate (%)	40.8	41.6	42.1	45.1	-2.3	0.94	2.30	0.62
30-day revisit rate (%)	88.0	89.0	90.2	90.9	0.3	-0.87	-0.99	0.41
90-day revisit rate (eye) (%)	0.84	1.01	0.76	0.70	0.23	0.2	0.78	0.18
Patient Access								
Distance to specialist (miles)	23.5	25.3	18.4	17.8	2.5	-0.38	-1.62	0.60
Patient Selection								
Chronic conditions	5.05	5.09	4.93	4.99	-0.02	-0.11	-2.18	0.18
Diabetes prevalence (%)	31.2	29.8	30.5	29.3	-0.20	-0.12	-0.38	0.35
Age	74.6	74.2	74.5	74.2	-0.09	-0.13	-0.17	0.56
Dual eligible (%)	12.0	11.1	10.0	8.6	0.50	-0.35	-2.92	0.74

Notes/Sources: Author's analysis of Pitchbook data, IQVIA SK&A/OneKey data, and Medicare data. This table summarizes difference-in-differences coefficients estimated using the Callaway & Sant'Anna (2021) estimator to account for staggered treatment adoption and heterogeneous treatment effects. Diff-in-diff (CS) presents the Callaway & Sant'Anna (2021) average effect using a simple aggregation. Standard errors are clustered at the level of the matched cohort.

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Can Private Equity Buy Referrals? Evidence from Multispecialty Physician Practice Acquisitions

APPENDIX TABLES AND FIGURES

Appendix Table 1. Sample Construction

Year	STEP 1: Identify cataract claims	STEP 2: Link cataract claims to generalist visit in past 365 days (i.e., identify a referral)	STEP 3: Restrict sample to referrals that originate in multispecialty practices
2015	184,721	136,906	72,584
2016	178,413	154,580	78,997
2017	177,403	153,191	79,997
2018	176,640	151,930	81,620
2019	173,784	149,930	82,373
Total	**890,961**	**746,083**	**395,490**

Notes/Sources: Author's calculations. This table summarizes the sample construction process to identify referrals for cataract surgery that are made by generalists in multispecialty settings.

Appendix Table 2. Characteristics of patients with identified referrals for cataract surgery (2015-2019)

	Mean (SD)		
Variable	**Individuals without identified referrals** **N = 144,878**	**Individuals with identified referrals** **N = 746,083**	**All Individuals** **N = 890,961**
Female (%)	0.60 (0.49)	0.61 (0.48)	0.61 (0.48)
White (%)	0.84 (0.37)	0.87 (0.34)	0.86 (0.34)
Age (years)	73.83 (6.31)	74.69 (6.22)	75.55 (6.25)
Diabetes (%)	0.29 (0.45)	0.31 (0.46)	0.30 (0.46)
Hypertension (%)	0.65 (0.48)	0.69 (0.46)	0.68 (0.46)
Chronic conditions	4.68 (2.59)	5.06 (2.56)	4.99 (2.57)

Notes/Sources: Author's calculations. This table presents summarizes characteristics of individuals with identified referrals (i.e., individuals with cataract claims whose primary eye care provider was identified using claims history) compared to individuals without identified referrals (i.e., individuals with cataract claims and no accompanying claim for an eye exam with a generalist in the 365 days prior to surgery).

Appendix Table 3. Robustness Tests

		Robustness Checks	
	(1) **Main specification**	**(2)** **Assessment of IIA violation**	**(3)** **Assessment of selection**
Specialist is integrated within the same practice * Generalist is acquired by PE	0.0444 (0.0364, 0.0523)	0.0270 (0.0186, 0.0355)	0.0138 (-0.0132, 0.0410)
Specialist is integrated within the same practice	0.1940 (0.1922, 0.1958)	0.1498 (0.1477, 0.1518)	0.2081 (0.1993, 0.2169)
Distance (z-score)	-0.1240 (-0.1259, -0.1222)	-0.1667 (-0.1733, -0.1600)	-0.1208 (-0.1289, -0.1128)
90-Day Spending (z-score)	0.0264 (0.0254, 0.0275)	0.0228 (0.0216, 0.0240)	0.0314 (0.0265, 0.0364)
Number of observations	2,145,713	1,623,292	2,145,713
Choice set size, Mean (SD)	7.25 (3.63)	6.80 (3.33)	7.25 (3.63)

Notes/Sources: Author's calculations. Table summarizes average marginal effects and 95% confidence intervals for estimates obtained from a conditional logit model and accompanying robustness tests. Assessment of IIA violation is done by estimating the main specification with a subset of the choice set. Assessment of selection is done by estimating a counterfactual simulation that estimates pre-acquisition treatment effects by changing the timing of acquisition to the pre-period.

Appendix Table 4. Alternate Mechanisms

		Alternate Mechanisms	
	(1) Main specification	**(2) Practice Expansion:** Counterfactual holding constant the integration status of choice set specialists	**(3) Generalist Market Concentration:** Counterfactual without observations that originate from generalists who join practice after acquisition
Specialist is integrated within the same practice * Generalist is acquired by PE	0.0444 (0.0364, 0.0523)	0.0568 (0.0481, 0.0655)	0.0449 (0.0361, 0.0537)
Specialist is integrated within the same practice	0.1940 (0.1922, 0.1958)	0.1965 (0.1946, 0.1984)	0.1939 (0.0361, 0.0537)
Distance (z-score)	-0.1240 (-0.1259, -0.1222)	-0.1257 (-0.1277, -0.1236)	-0.1244 (-0.1263, -0.1225)
90-Day Spending (z-score)	0.0264 (0.0254, 0.0275)	0.0274 (0.0262, 0.0286)	0.0265 (0.0255, 0.0276)
Number of observations	2,145,713	2,145,713	2,123,721
Choice set size, Mean (SD)	7.25 (3.63)	7.25 (3.63)	7.24 (3.61)

Notes/Sources: Author's calculations. Table summarizes average marginal effects and 95% confidence intervals for estimates obtained from a conditional logit model and accompanying counterfactual/robustness tests to evaluate alternate mechanisms that drive self-referrals. Practice expansion is examined as a potential mechanism driving self-referrals by estimating a counterfactual simulation that assumes the integration status of specialists to be unchanged since 2015, prior to any acquisition. Generalist market concentration is examined as a potential mechanism by re-estimating the choice model using only observations from generalists who were in the practice prior to acquisition.

Appendix Table 5: Practice-level characteristics at baseline (2015), before and after matching

	A. Before Matching			B. After Matching		
	Non-PE	**PE**	**p-value**	**Non-PE**	**PE**	**p-value**
	N=3,648	N=230		N=622	N=217	
Practice Size (No.)	6.57 (9.75)	18.47 (22.66)	**<0.001**	7.15 (10.10)	17.22 (21.26)	**<0.001**
Urban (%)	0.79 (0.41)	0.85 (0.36)	**0.038**	0.81 (0.39)	0.84 (0.37)	0.27
Cataract volume per quarter (No.)	55.54 (73.89)	74.35 (94.69)	**<0.001**	54.79 (61.05)	62.64 (68.28)	0.11
Age	74.63 (2.50)	74.79 (2.41)	0.34	74.74 (2.18)	74.81 (2.46)	0.69
Chronic conditions (No.)	4.93 (1.04)	5.10 (0.95)	**0.012**	4.99 (1.00)	5.10 (0.96)	0.14
Diabetes prevalence (%)	0.32 (0.18)	0.34 (0.17)	0.15	0.33 (0.16)	0.34 (0.17)	0.36
7-Day revisit rate (any condition)	0.35 (0.22)	0.35 (0.20)	0.98	0.37 (0.22)	0.35 (0.21)	0.28
30-Day revisit rate (any condition)	0.86 (0.15)	0.85 (0.13)	0.26	0.87 (0.13)	0.86 (0.13)	0.055
90-Day revisit rate (eye condition)	0.01 (0.04)	0.02 (0.08)	**0.017**	0.01 (0.03)	0.01 (0.08)	0.056
90-Day Medicare spending	2909.22 (966.18)	2780.32 (1453.01)	**0.060**	2896.42 (844.42)	2784.70 (1479.12)	0.18
90-Day OOP spending	606.03 (191.04)	579.07 (288.30)	**0.047**	604.34 (168.11)	579.84 (293.47)	0.14

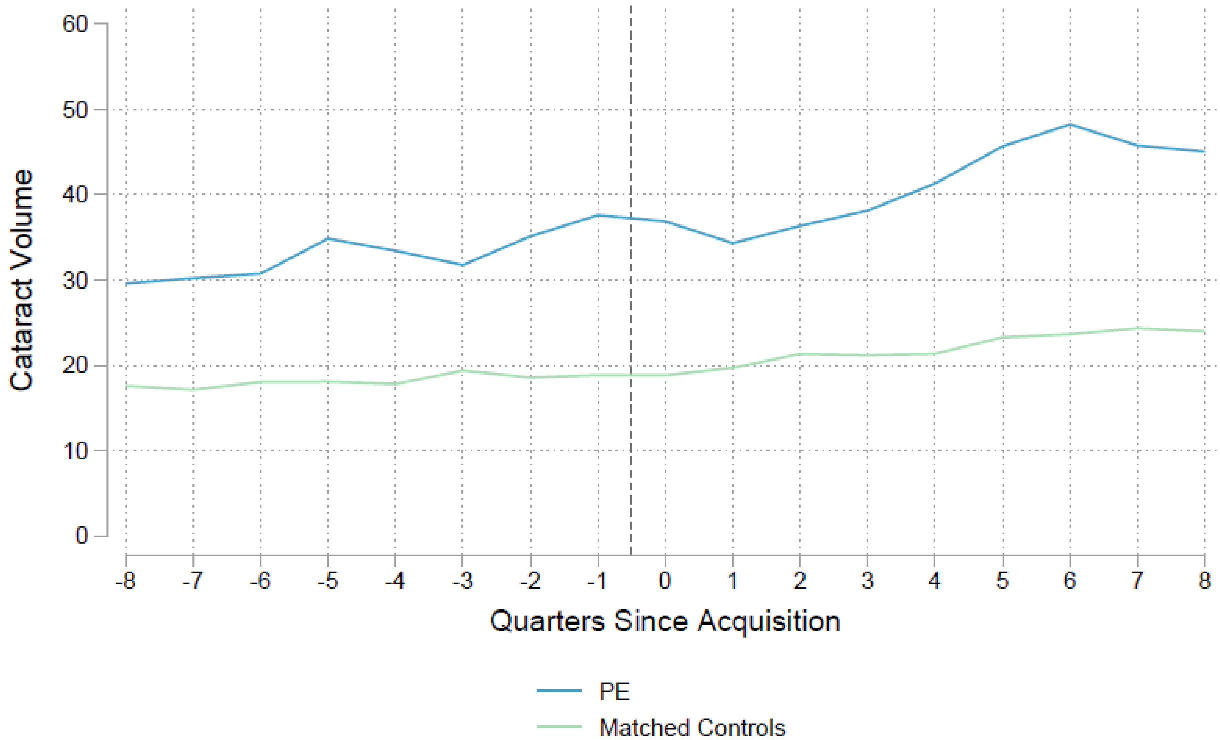
Notes/Sources: Author's calculations. Baseline characteristics for private equity acquired and non-acquired practices in 2015. Non-acquired practices represent multispecialty practices identified using 3:1 caliper matching without replacement. Matching algorithm requires matches within one-half standard deviation for continuous covariates (90-day Medicare spending, average number of chronic conditions, and share of patients with diabetes).

Appendix Table 6: List of CPTs for eye sensitive conditions

Objective	**CPT Code(s)**
To identify major complications within 90 days following cataract surgery: retained nuclear fragments, endophthalmitis, dislocated or wrong power IOL, retinal detachment, or wound dehiscence	65235, 65860, 65880, 65900, 65920, 65930, 66030, 66250, 66820, 66825, 66830, 66852, 66986, 67005, 67010, 67015, 67025, 67030, 67031, 67036, 67039, 67041, 67042, 67043, 67101, 67105, 67107, 67108, 67110, 67141, 67145, 67250, 67255

Notes/Sources: Quality ID #192 (NQF 0564): Cataracts: Complications within 30 days following cataract surgery requiring additional surgical procedures, available at https://qpp.cms.gov/docs/QPP_quality_measure_specifications/Claims-Registry-Measures/2018_Measure_192_Registry.pdf (accessed July 18, 2022).

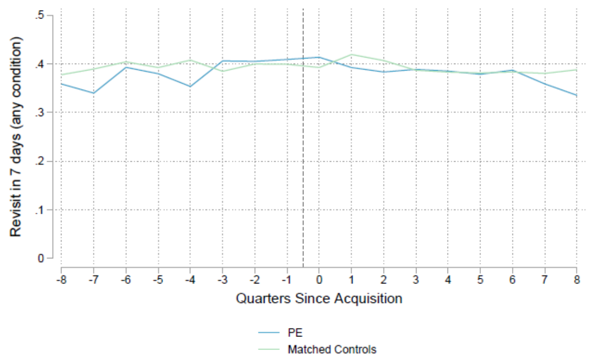
Appendix Figure 1. Descriptive trends in total referral volume, PE-acquired practices and matched controls



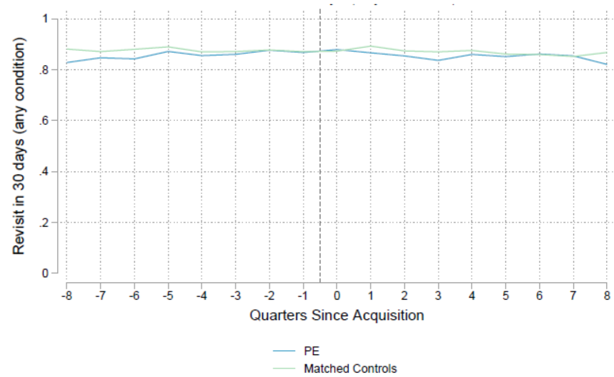
Notes/Sources: Author's calculations using Pitchbook data, IQVIA SK&A/OneKey data, and Medicare data. This figure presents raw (unadjusted) number of claims for cataract referrals per generalist, at PE practices and matched controls. For matched controls, the quarter of acquisition represents the quarter in which the PE practice in the match cohort was acquired. The vertical dash line represents the quarter of acquisition.

Appendix Figures 2. Descriptive trend in welfare outcomes, PE-acquired practices and matched controls

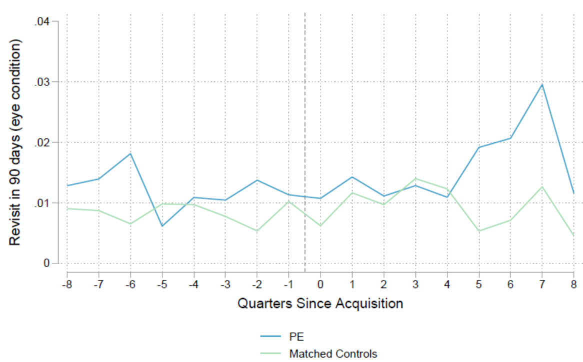
(a) Revisit in 7 days (any condition)



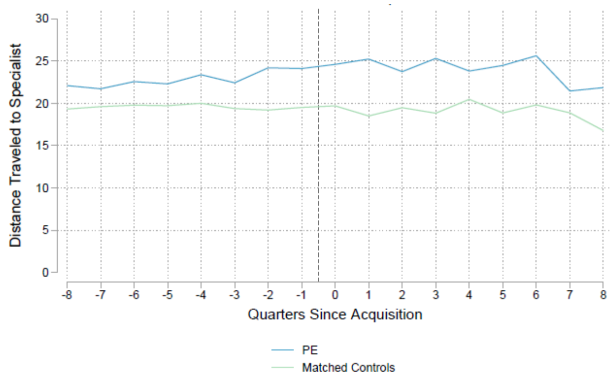
(b) Revisit in 30 days (any condition)



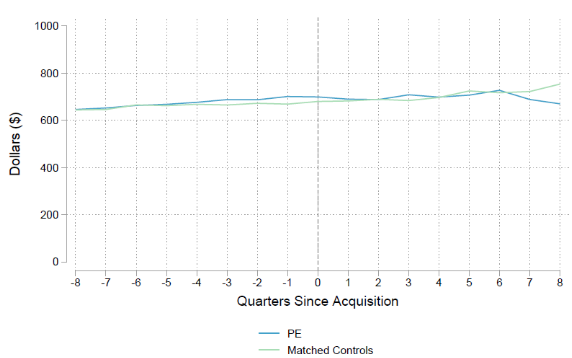
(c) Revisit in 90 days (eye condition)



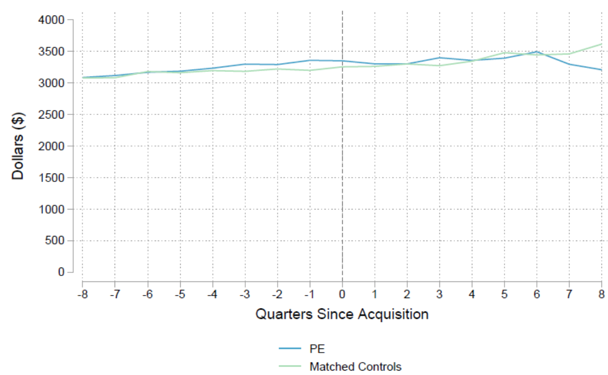
(d) Distance to specialist



(e) 90-Day OOP spending



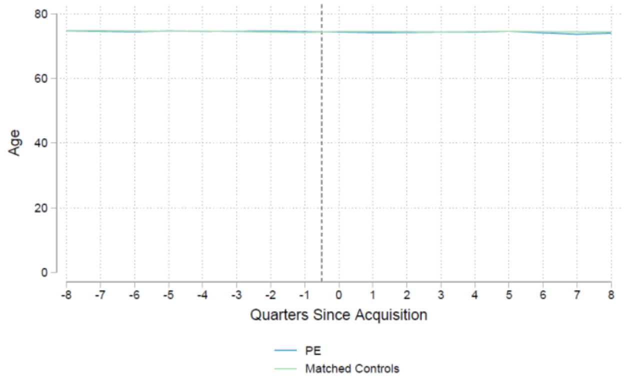
(f) 90-Day Medicare spending



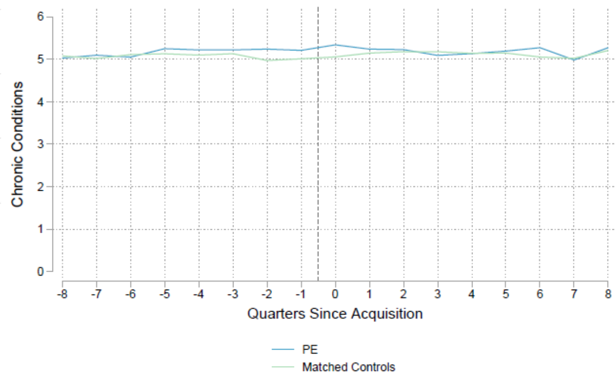
Notes/Sources: Author's calculations using Pitchbook data, IQVIA SK&A/OneKey data, and Medicare data. This figure presents raw (unadjusted) outcomes of interest for PE practices and matched controls. For matched controls, the quarter of acquisition represents the quarter in which the PE practice in the match cohort was acquired. The vertical dash line represents the quarter of acquisition.

Appendix Figures 3. Descriptive trend in patient selection, PE-acquired practices and matched controls

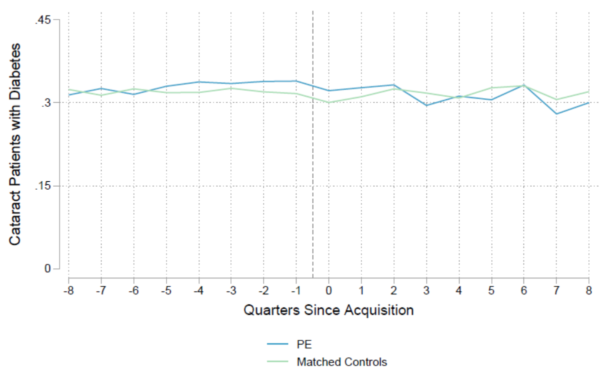
(a) Age



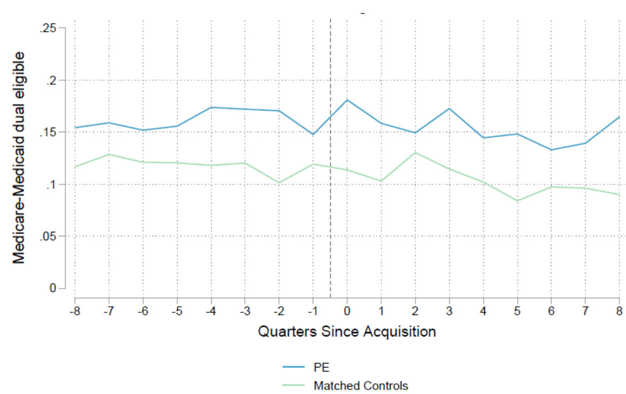
(b) Chronic Conditions



(c) Diabetes Prevalence

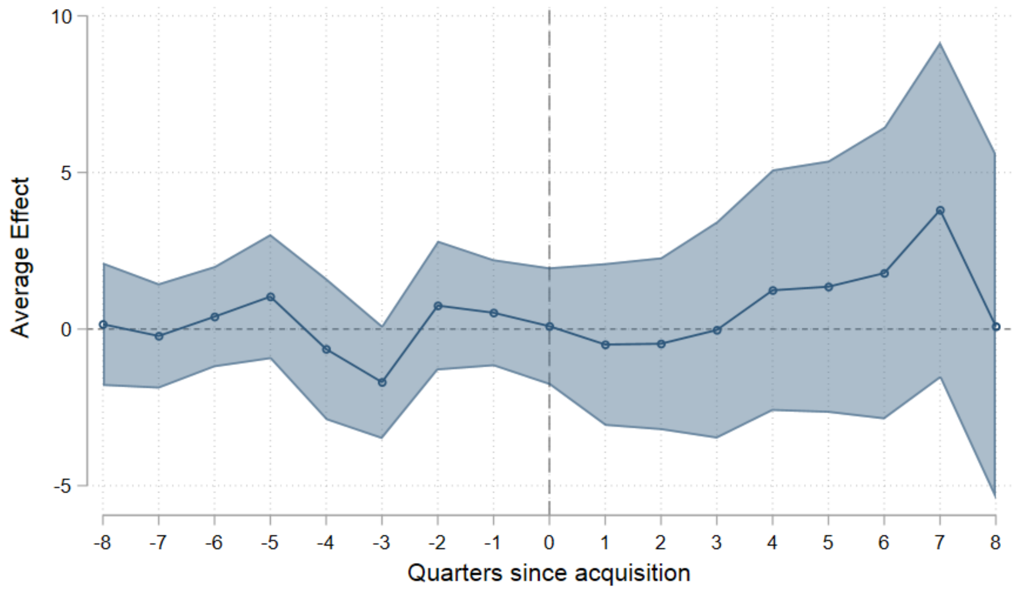


(d) Dual-Eligible Status



Notes/Sources: Author's calculations using Pitchbook data, IQVIA SK&A/OneKey data, and Medicare data. This figure presents raw (unadjusted) outcomes of interest for PE practices and matched controls. For matched controls, the quarter of acquisition represents the quarter in which the PE practice in the match cohort was acquired. The vertical dash line represents the quarter of acquisition.

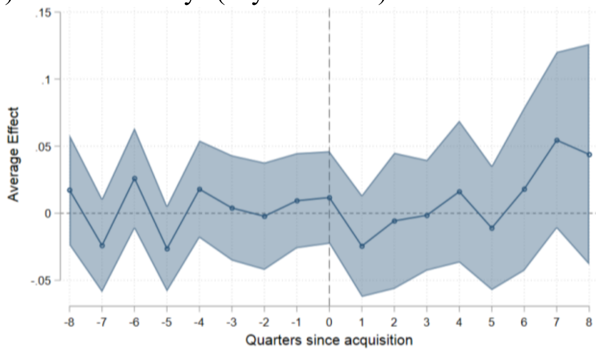
Appendix Figures 4. Effects of PE acquisition on cataract volume, Callaway & Sant'Anna (2021)



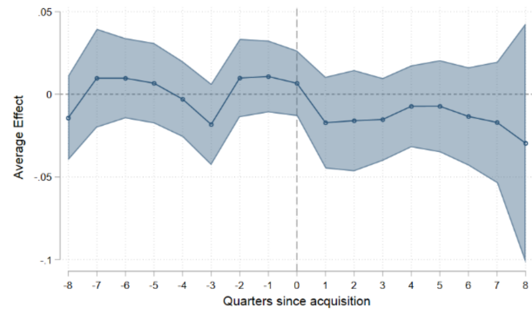
Notes/Sources: Author's calculations using Pitchbook data, IQVIA SK&A/OneKey data, and Medicare claims data. This figure presents event study coefficients from comparing the total referral volume per generalist at PE-acquired practices to those at non-PE practices, before and after acquisition, using the Callaway & Sant'Anna (2021) estimator. The vertical dash line represents the quarter of acquisition that serves as the reference period. Event time 0 denotes the quarter of acquisition. Standard errors are clustered at the level of the matched cohort.

Appendix Figures 5. Effects of PE acquisition on patient outcomes, Callaway & Sant'Anna (2021)

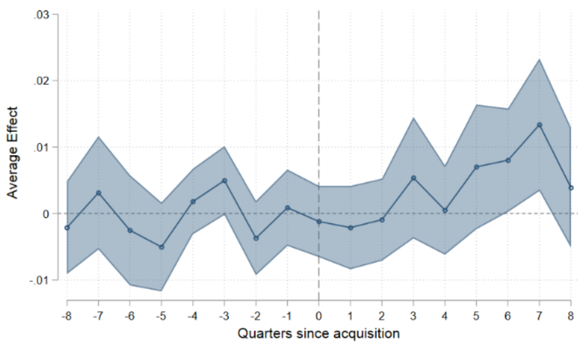
(a) Revisit in 7 days (any condition)



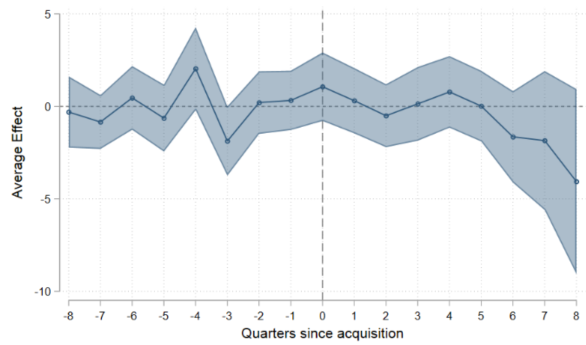
(b) Revisit in 30 days (any condition)



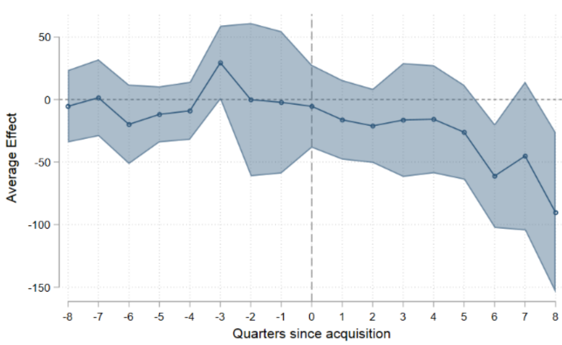
(c) Revisit in 90 days (eye condition)



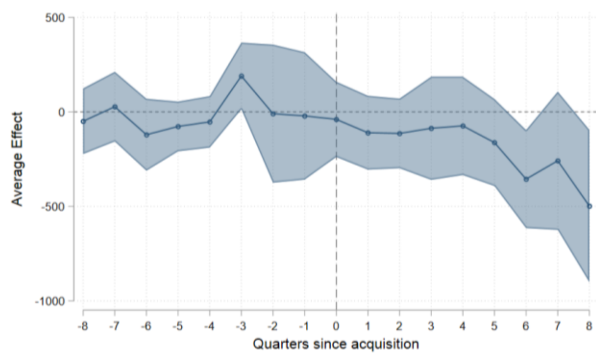
(d) Distance to specialist (miles)



(e) 90-Day OOP Spending



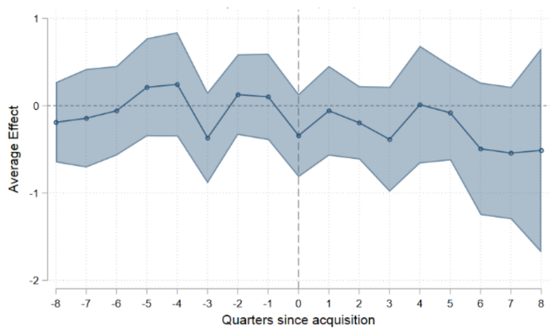
(f) 90-Day Medicare Spending



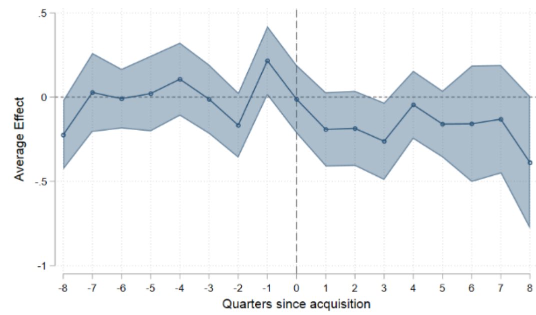
Notes/Sources: Author's calculations using Pitchbook data, IQVIA SK&A/OneKey data, and Medicare data. This figure presents event study coefficients from comparing characteristics of individuals who get a cataract surgery at PE-acquired practice to those at a non-PE practice, before and after acquisition, using the Callaway & Sant'Anna (2021) estimator. The vertical dash line represents the quarter of acquisition that serves as the reference period. Event time 0 denoted the quarter of acquisition. Standard errors are clustered at the level of the matched cohort.

Appendix Figures 6. Effects of PE acquisition on patient selection, Callaway & Sant'Anna (2021)

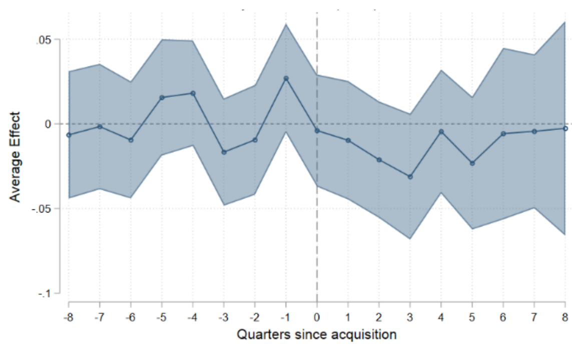
(a) Age



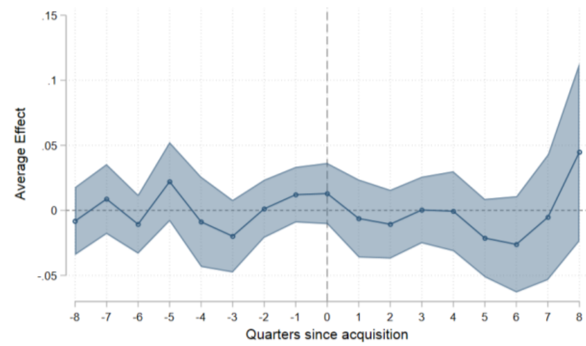
(b) Chronic Conditions



(c) Diabetes Prevalence



(d) Dual-Eligible Status



Notes/Sources: Author's calculations using Pitchbook data, IQVIA SK&A/OneKey data, and Medicare data. This figure presents event study coefficients from comparing characteristics of individuals who get a cataract surgery at PE-acquired practice to those at a non-PE practice, before and after acquisition, using the Callaway & Sant'Anna (2021) estimator. The vertical dash line represents the quarter of acquisition that serves as the reference period. Event time 0 denoted the quarter of acquisition. Standard errors are clustered at the level of the matched cohort.